CO-PRODUCTION BETWEEN PERMANENCE AND CHANGE

Federica Natalia Rosati

ULB UNIVERSITÉ LIBRE DE BRUXELLES
LIÈGE université
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Unfolding
the co-evolution
of water infrastructures
and built environments
in the incremental city

Thesis submitted in partial fulfilment of the requirement for the degree of Doctor in Architecture and Urban Planning

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Federica Natalia Rosati
April 2024

Promoters
Prof. Jacques Teller (University of Liège)
Prof. Luisa Moretto (Free University of Brussels)

Committee members
Geoffrey Grulois (Free University of Brussels)
Sigrid Reiter (University of Liège)
Prof. Marco Ranzato (Università degli Studi Roma3)
Dr. Pascale Hofmann (University College London)

University of Liège - Faculty of Applied Science - Urban and Environmental Engineering ;
Free University of Brussels, Faculty of Architecture La Cambre Horta - Landscape, Urbanism, Infrastructures and Ecologies

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Acknowledgements

I believe that acknowledgments are an extremely relevant part of a research work because, to some extent, they preserve the humanity of the researcher in the face of a possible distance mostly attributable to the coldness and impersonality given by the technicality of the scientific approach and language that a doctoral thesis risks assuming. Moreover, they reveal the recognition of how much beyond the researcher's subjectivity nourishes and enhances, ultimately shaping the thoughts.

This research work would not have reached this level of maturity and this form were it not for the presence and support of the many people who have enriched these fruitful years of my life, continuously offering me stimuli and new perspectives to observe, interpret reality, and act upon it.

I must begin this long list by thanking Jacques for his infinite patience and trust in my capacities as well as for his constant aptitude to bring order to the sometimes disorganised complexity of my thoughts. I thank Luisa for her capability and sensitivity in firmly holding the reins of the project, always ensuring the right balance between the efforts of work and the joy of research. Giuseppe, a loyal friend and adventure companion, for coloring these years of work with moments of mutual learning and conviviality. I thank Andrea and Marco and the Latitude team for the support given to the research and for the mastery with which they facilitated the work tables with the communities, making them important occasions for knowledge and exchange. A thought of affection and gratitude goes to all the teachers, fellow researchers, and students of the Universities of Hanoi, HUCE, and HUST, who welcomed me, accompanied me, facilitating my fieldwork and the meeting with both institutional subjects and communities. In particular, to Thi Huong for her incredible ability to organize my work in Hanoi and her readiness to provide feedback on the collected data; to the colleagues Phuong, Hien, Minh, Thuy, Hiep, and Thao for their friendship and constant care in making me feel at home; to the friends

Ngoc and Viet, Elise, Francesco, and Quan, thanks to whom I have woven a special relationship with this city that I love so much. Thanks to Juan, a pioneer in the field in Cochabamba for sharing his research work, his contacts, and for having nurtured a fruitful dialogue over the years; to the students and colleagues of UPB and the University of San Simon for the support provided despite the challenges of the pandemic, meticulously gathering research material; and to Marcelo and Sergio for guiding us in conducting the workshops.

Thanks also to all the colleagues from the University of Liège and Brussels and to the technical and administrative staff, always by my side with prompt solutions for each trouble.

A special thanks to the committee and jury members, Sigrid, Pascale, Geoffrey, for accompanying my work over these years, for providing stimuli and precious suggestions to improve this research work.

A thought of gratitude goes to my closest roots, my family. I thank my mother, for giving me the sensitivity and empathy that allowed me to enter into a deep relationship with the people I met in these distant places, making them feel close and for transmitting to me a marked sense of justice that guides my interest towards those who dwell the margins. I thank my father, to whom I owe an indomitable curiosity towards the human nature and the inclination to the creative association of ideas and concepts and who pushed me, since I was little, to broaden my horizons of thought. Then I thank my grandmothers, my rocks. Ivana, for strength and tenacity, and Gabriella, for fantasy and the ability to dream that hold my hand in this life. My grandfathers, Rigo, for the entrepreneurship and trust in life, and Tiziano, my guardian angel, for his love for beauty and distant lands. A thought goes also to my ancient roots and to those which I have not known but that I carry within and to my new roots that ground into the mountainous landscape of the central Apennines.

Warm thanks go to the nun sisters of La Rupe, companions of research and spiritual guides on this journey into the depths of my inner self, where I found resources, I did not know I had, and who invited me to look up to admire the beauty of the sky. To the Venetian community of Pennabilli. Especially to Mario, my craftsman friend and inspirer, who led me through the pages of his life and to whom I owe much of the

philosophical positioning of this work; and to Valter, who continues to accompany the days of melancholy with the vivid colors of his paintings and the joy of his songs. Thanks go to the friends of Chiocciola and all the inhabitants of this valley with whom I share dreams and projects, in particular Irene, Silvia, Roberto, Nicola, Tommaso, Sofia, Lia, Humberto, Enrico, Giovanna, Lu, Tete and all those who take care of and make this land flourish, reaffirming to me every day the beauty and sense of inhabiting it. To the singers Piergiorgio, Luca, Stefano, Thomas who are recovering the oral memories of an almost forgotten rural world, making our community sing and dance. To the doctor and poet on the journey, Luigi, who urges me to take care of my illnesses by walking in the woods, swimming in the rivers and picking flowers. To Alfonso, for reintroducing me to the magic of music, for welcoming my anxieties and frustrations, and for the critical reading of this work. To Laura and the uniqueness of her being by my side with fervid imagination and constantly nourishing my dreams, and for the meticulous work of editing the final version of the text. To Emma, who with aesthetic taste and extreme patience has shaped and layout this manuscript. To all the friends with whom it is worth sharing the labors and joys of this life, to Karen, Massimo, Marina, Stella, Ambra, Maddalena, Sara, Valeria, Giulia, Eva, Michael and more. To the monastic community of Pian Del Levro, for having hosted me with absolute tenderness while working on the manuscript.

A special thought goes to the community of Villa Maindi, which is now my home, especially to Sergio (the Vietcong), Antonietta, Elena, Teresa, Antonio, Laura, Livio, Alba, Franco, Marisa, Bruno, Alessandra, the best neighbors I could hope to have, who support me in every project, including those that border on madness.

Last, the greatest thanks go to the communities and all those people met along the way in Hanoi and Cochabamba, who offered me hospitality, the necessary trust to invite me into their homes and open up to sincere dialogue, granting me the time for an interview. Hospitality that I sometimes found in a friendly smile, in a cup of tea, in a fruit picked from the tree and shared, and that accompanied me in this pilgrimage in the world, restoring my faith in a humanity still capable of welcoming and being welcomed.

To them, I owe the heart of this work.

"These pages could have taken
the form of a diary.
They are part of my life.
Every reflection is speculative.
It questions, first of all,
what has been invented.
And who knows if this invention
is not, itself, the truth?
The only means to reach the truth?
Nothing is given.
Everything is to be taken,
to be learned."

Edmond Jabes, The Book of Hospitality, 1991 (translated by the author)

Research is the construction of boundaries. The very etymology of the Italian word “cercare” is linked to the Latin word “circum”, meaning around, from which the verb “circare”, meaning to go around. The word “ricercare” -“to research”- leads back to the same etymology, but the addition of the reinforcing prefix ri- suggests that the action of discovering the object of the search is accompanied by an intensity and perseverance that can only exist within a delimited, circumscribed space, within which the effort of the action can converge. Research therefore means delimiting, circumscribing a space. Defining the boundaries of this research has been the greatest difficulty I have encountered in these four years. Not only because the construction of the research question and the drafting of the manuscript has been, and still is, evidence of an open process which dialogues with the multiple stimuli given by the environment of investigation and the experiences of life in progress, but also because the boundaries of the spaces that I observed as the object of my investigation were changing rapidly making me appear ephemeral, invented, simplistic any attempt to circumscribe them. Dealing with spaces whose limits changed over time was quite a challenge. For me, accepting the challenge meant accepting that the “ephemeral” became the object of my research.

At the beginning of the research project, I had set myself the objective of measuring the “sustainability” of co-production: that is, to classify and analyse various forms of collaboration between state and community actors for the provision of water services and to assess them according to the broadest sense of sustainability, which encompasses the economic, social and environmental dimensions. Not only did this goal seem unattainable with my cognitive abilities and the analysis tools at my disposal, but the practices and phenomena I was observing were constantly changing. This made it difficult to devise a methodology and investigative tools capable of assessing the sustainability of socio-technical and spatial practices (I would say, first and foremost, human practices) that were changing extremely rapidly, sometimes to the point of disappearing, often just a few months between one fieldwork and another.

A second challenge I found myself facing during these years of research was the construction of a personal perspective of investigation, in the broader context of the project in which this thesis is inscribed: a project involving two departments (The LEMA Department in Faculty of Applied Science at the ULg and Habiter Centre in the Faculty of Architecture of the ULB) and two researchers working on four different cities

(Addis Ababa, Cochabamba, Dar es Salaam and Hanoi). It has been quite a challenge to keep together the need of coordination required by the project, including the definition of a theoretical frame of reference and shared methodological tools, with the desire to develop an autonomous reflection, by narrowing the investigation subject within the broader scope of the project.

Finally, the third difficulty I encountered was related to the interplay between research and life, the subject conducting research and the objective. I believe that there is no research that lies outside the research of the self, the experience and life path of the researcher. Being able to keep the determination and concentration to bring this work to an end burning and constant; learning to get back up after falls; to design, adjust and eventually disrupt and redesign methods and perspective of observation; reconciling the time of productive work (*chronos*) with the suspended time of thoughts reworking (*kairos*) were some of the main challenges encountered during this very rich chapter of my life.

It sometimes made it necessary to take time to stand by, to distance and to listen, to be open to grasp changes and to adapt, to let thoughts settle and with it, life.

According to the incremental theories of learning, cognitive abilities would be the result of environmental stimulations and learning experiences that, starting from the heritage of individual resources, allow an enlargement, not so much of knowledge, but of the instruments of analysis and comprehension of reality that allow an enrichment of the means towards knowledge. I was confronted with the same limitations of rationality highlighted by incrementalism theorists: a small brain, limited capacity to carry out a complete analysis, the presence of external variables that influenced and transformed the processes I was observing, the limitations of movement due to the global pandemic, the impossibility of using the same tools of investigation and language in two countries that are so different.

This research was constructed through a process of “muddling through” in which I put on the role of the bricoleur, obliged to confront a repertoire of heterogeneous materials in the production of a manuscript whose design was not given a priori but was composed through constant interaction with the material available and the local contexts object of the investigation. This is not to say that a method or a plan was denied, but that this was continuously revised in the light of circumstances, encounters and events that altered its characteristics. The process

of bricolage did not involve the creation of a puzzle of notions, information related to my object of study but rather of experiences and human stories, of voices that I hope will emerge in the next chapters and guide the reader in reading the phenomena observed and their processes of transformation over time.

ON THE SHIFTING BOUNDARIES OF CO-PRODUCTION

"Drawing a border then becomes
the way to obtain something
from others: a space of one’s own
where one can establish one’s own
rules, an autonomy visible
even from the outside,
the recognition of a diversity.
Since its first appearance,
the border shows what seems
to be its fundamental character:
to signal the place of a difference,
real or presumed that it is."

Piero Zanini, 1997

Myths always tell about boundaries with different and varied images. We can dig in the sands of memory and find the biblical creation myth, when God divided, limiting, heaven and earth; when he vetoed to take the Apple, limiting the human possibility and so generating free-

dom and free will. If we think of historical facts, we can easily think of the famous story of Caesar and the Rubicon, a limit that he could not cross; or all the invasions are nothing but the crossing of a limit that splits two realities often marking their boundaries with walls or ditches, like in the Middle Age. Similarly, the myths of the foundation of Rome, tell the creation of the city limit as a furrow traced by Romulus on the ground with a wooden branch.

The boundary is an element of tension: on the one hand, the border presents itself as an element of cohesion with respect to what lies within it, on the other, it acts as a device of fragmentation with respect to what lies beyond it. It defines the spatial limits of a community and of the system of rules on which it is based, it internally marks its rhythm and regulates its change. The incremental processes shaping the evolution of co-production practices that I observed in the cities of Hanoi and Cochabamba were dictated by a constant overcoming of the boundaries of urban space and infrastructure networks. The negotiation of the system of rules on which the communities were articulated, the constant work of making, un-making and re-making of water networks made the communities and the territories in which they lived fluid spaces, in constant mutation. During my studies in architecture first and in cooperation, I have developed a growing interest in those incremental learning processes generated by practices of appropriation and reconfiguration of territories and built fabrics by dwellers and communities. Over the years I have investigated different experiential geographies of urban accretion and shifting control over territorial boundaries, from the processes of grass-roots transformation of social housing estates in Brazil to the forms of occupation and dispossession of Palestinian territories inhabited by nomadic populations, in East Jerusalem. This research is situated in continuity with my past experience. From the organised-at-the-same-time-disorganised complexity of the incremental city, where self-construction and self-organisation coexist with more top-down planning approaches to urban and infrastructure development, one can grasp modes of co-habitation that tell of systemic capacities for innovation and experimentation, for collaboration and self-help. This adaptive capacity seems to develop consistently in those places where resources are scarce and uncertainty prevails.

This thesis arises from the need to unveil this complexity by addressing the spatial trajectories of stories of co-production of “ordinary” built environments and related water infrastructures.

It is the result of both a direct field experience and a slow and detached spatial research on the way planned and pragmatic actions co-produce and reconfigure the urban and infrastructure landscape of incremental cities.

The thesis explores how in incremental cities, built environment and related water and sanitation infrastructures are extensively co-produced and constantly re-configured by successive grafts on the system of pre-existing structures that compose them. This process of transformation is characterized by the interplay of permanence and change, by cycles of coming and going, growth and decay, in which its components are transformed into something different. In this process two forces, engines of transformation emerge. On the one hand, a comprehensive and top-down planning and design approach, which advocates for an urban and infrastructural planning, increasingly dictated by the paradigms of order and control. On the other one, an incremental and bottom-up process in which individuals and communities approach the city pragmatically and contribute to its change with small acts of design. The two forces operate simultaneously on the processes of re-configuration of the built environment and water infrastructures at different scales, allowing for processes of hybridisation, accumulation and mutual adjustments. The purpose of this thesis is to surface the dialectics of these processes: to show how incremental transformations generate systemic changes in the long term, and finally to show how this process is mediated by the continuous adjustment of existing socio-spatial boundaries that shape practices of co-production.

CHAPTER 1 INTRODUCTION

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The incrememtnal nature of wss co-production

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Survey analysis

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Cartographic analysis

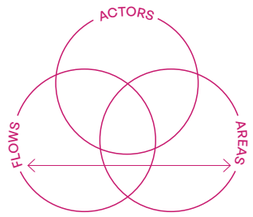
Partecipatory mapping workshops

Focus group discussion

RESEARCH QUESTIONS

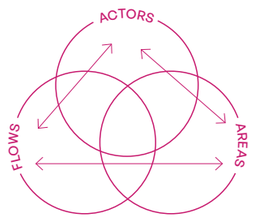
RQ1

How is water and sanitation service co-production incrementally developing over time and space in terms of built environments and technical infrastructures?



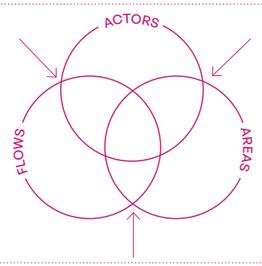
RQ2

What are the relations between incremental developement of governance structures (actors), techinal infrastructures (flows) and urban fabrics (area)?



RQ3

What are the condition/factors which impact the incrememtnal evolution of wss co-porduction practices?



CHAPTER 2 CO-PRODUCTION

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C3. Networks in-the-making: co-production and maginalisation

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Figure 1.
Thesis structure

THESIS STRUCTURE

This thesis is produced in the framework of a research project funded by the French-speaking Belgian Research Agency (FNRS) and titled “Typologies of Institutionalised Coproduction of Water and Sanitation Services in the Global South – TYCO-WSS”. The project 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 arrangements and long-term sustainability. Within the broader research project involving two universities (ULB and ULg) and two additional African case studies (Dar Es Salaam in Tanzania and Addis Ababa in Ethiopia), this research work represents a personal contribution on a particular aspect of the co-production of water services, as emerged in the previous paragraph.

The thesis is structured in nine chapters.

Chapter 1 presents the main approach to the research and the methodology. The research gaps are defined as the need ❶ to understand the incremental evolution of water and sanitation service co-production over time and space, in terms of built environments and technical infrastructures (Practices); ❷ to highlight the relations between incremental development of governance structures, technical infrastructures and urban fabrics (Processes); ❸ to identify the factors which impact the incremental evolution of WSS co-production practices (Conditions). The methods and techniques developed in the survey are described, highlighting the need for triangulation, i.e. complementary use of the various methods to answer the research questions.

Chapters 2 and 3 provide an overview of the conceptual debates that situate this work, namely the theories of co-production of water and sanitation services and incrementalism in the planning and urban discourses.

In particular, chapter 2 conceptualises water and sanitation services (wss) co-production, before exploring the different dimensions of this phenomenon. While theoretical conceptualizations of service co-production mainly refer to the public management and governance dimension, this chapter highlights the relevance of including a techno-environmental and spatial dimensions in the observation of wss co-production. It builds a comprehensive framework for addressing water and sanitation co-production based on literature from public service

management/governance to urban, socio-ecological and socio-technical fields. The proposed framework highlights the categories and factors to be considered when analysing the background conditions and outcomes of unorthodox service delivery and suggests a reference to observe the interdependencies between the various dimensions that contribute to the evolution of co-production practices.

Chapter 3 explores the concepts of comprehensive and incremental planning by piecing together theories from policy-making; infrastructures and urban planning. It highlights the incremental nature of the contemporary city, where instances of both comprehensive and incremental planning models and processes co-exist at different scales. Co-production is therefore introduced as an appropriate framework not only for addressing the delivery of water and sanitation services but also the multi-faceted nature of the urban production and infrastructure development in the fast-growing cities of the global South.

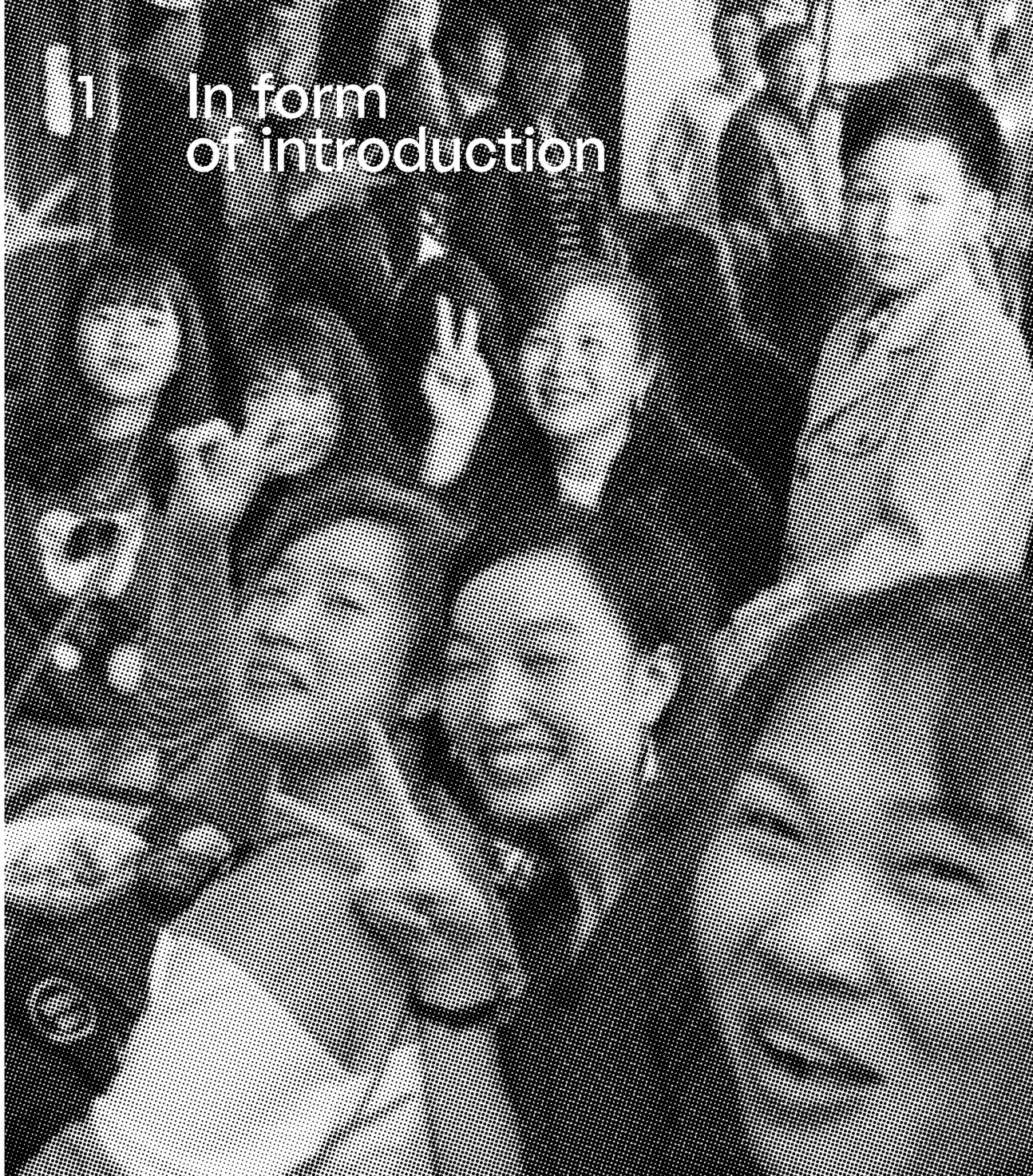
Chapter 4 explores a multitude of wss co-production practices in Hanoi and Cochabamba. Through the analysis of data collected through 600 surveys in 30 neighbourhoods (300 in Cochabamba and 300 in Hanoi), this section provides a comparative reading of the wss coproduction landscape in the two case studies. It aims to explore overall dynamics as well as recurrent and divergent features of co-pro-duction in a number of selected urban typologies, addressing both social and technical dimensions.

In Chapter 5 the observation of the case studies moves from the macro scale (the urban, socio-political, economic context under which co-production develops) to the micro scale (co-production in context). Through the reading of 6 case studies (3 in each city), this section surfaces the invisible work of production, re-configuration and maintenance of water infrastructure systems (Graham and Thrift 2007), showing how in co-production of water and sanitation services the relationship between service users and service providers co-evolve with the constant adjustments of the urban fabric and infrastructure networks as part of the urbanization process.

An interpretation and discussion departing from the case studies is presented in the following Chapters 6-7-8, by outlining some theoretical remarks generated from considering the reconfiguration of the built environment and embedded water and sanitation infrastructures an incremental process, stressing the place-based nature of co-production and, at the same time, its path-dependency with dynamics of urban

transformations. This chapter reflects in particular on three aspects that characterise wss co-production: ❶ practices, i.e. the whole series of actions enable those processes of reconfiguration of networks and built spaces at a local scale (Chapter 6); ❷ processes, i.e. those transformative tendencies that can be understood by observing practices at a wider scale (Chapter 7); ❸ conditions/outcomes, i.e. the intertwining between some contextual conditions and intended or unintended consequences of transformation processes (Chapter 8).

In the conclusive session, chapter 9, some challenges are presented from the observation and interpretation of case studies that research could address in the future where one wants to question the role of service co-production in generating urban commons and processes of commoning.



1 In form of introduction

1.1.1 THE CHALLENGES OF THE INCREMENTAL CITY

" We live in a moment of history where change is so speeded up that we begin to see the present only when it is already disappearing."

John Laing, 1967

Access to land, particularly serviced land, is critical for sustainable urban development. The availability of land, and with it, a resource as fundamental to life as water, will determine how our cities and neighbourhoods will grow and expand, whether they will be able to absorb the yearly population growth currently estimated at 1.1% with 82 million new inhabitants in 2019 on this planet (UN DESA 2019), and how they will respond to the consumption pressures posed by global markets and the growing demand for services.

At a time when inequalities have become more acute, also in light of the recent global pandemic and the environmental and ecological crises exacerbated by climate change (OECD 2020), a transition toward sustainable approaches to land use management and distribution of planetary resources demands urgent attention and collective efforts. The destruction of the natural basis of human life in contemporary society is the consequent result of a society that swallows ever larger quantities of energy and raw materials, to spit out goods and services that pollute the environment in its vital resources (water, earth and air) in their production, distribution, consumption and disposal. The contingent social ecological crisis, of which we have already seen the first significant signs for several years, falls above all on the poorest part of the world's population, i.e. those living in the countries of the global South, where the process of uncontrolled urban growth goes along with an alarming disparity in access to land, housing and basic services. In these urban contexts, the 24% per cent of the global urban population lives in slums and spontaneous settlements, which, outside of existing regulatory and planning instruments, often develop in the absence of basic services (UN HABITAT 2020). While not going into the theories of urban informality, the spontaneous housing contexts which often dominate the urban landscape of the urban South, are considered living images of one of the greatest challenges of this era of unprecedented urbanisation, in which rapid development, population growth and migration call for urgent political and pragmatic responses to the increasing demand for adequate housing and basic services. The "incremental" development, typical of the consolidation of human settlements throughout history, has been explored and integrated until the 1990s in the development policies carried out by international bodies such as the United Nations and the World Bank. New ways of producing housing and services were experimented, by recognising the economic and technical capacities of urban dwellers to build and improve their neighbourhoods through punctual and small-scale interventions distributed over time. Endorsing this perspective, housing policies have experimented with various land access schemes (i.e. the sites-and-services schemes), typological and architectural models (i.e. core housing schemes) and assisted financial systems (i.e. housing micro-finance programs), providing urban dwellers with regulatory, planning and financial tools capable of integrating the logics and actions of self-help practices in urban development schemes (Cities Alliance 2011). These "co-production experiments" were generally abandoned in the 1990s, when neoliberal policies reshaped the real estate and land sectors globally, leading to a return of centralised planning and mass housing production, with new forms of private funding schemes, driven by global financial capital. Global south cities, as fast developing contexts, represent a good opportunity for land speculation. While the urban core and central districts of these cities today boast high standards of living and are provided with innovative transport systems and infrastructure networks, peripheral districts repeatedly struggle with urban sprawl, environmental decay and a lacking or inadequate

access to services (Graham and Marvin ,2001). Today's energy-intensive metropolis planned by centralised public or private planning agencies proposes a different kind of rationality, one that aims to be comprehensive and to have full control over space dyna-mics. In terms of scale and quality of the spaces it produces, it seems to reduce the territory to a nude surface lacking its own legacy from which to obtain the widest possible profit margin (Bookchin 1974). In contrast to this model of technocratic urbanism expressed in the gigantism of the architectures it produces, the incremental city, of which one image remains frozen in the centuries of our European historic centres, and a living image is visible in the dynamic processes shaping cities of the Global South, seems to bring the practice of "living" back to its ontological condition of production of life and sociality. Self-help practices shape the urban landscape and determine pat-terns of urban growth. Through densification, built environments and infrastructure networks are made, unmade and remade by residents in a step-by-step process over an extended period of time, in accordance with changing economic and social situation (Baitsch 2018). Throughout history and across different geographies, people have always built their own dwellings, organising their settlements on the basis of need, following a contingent and pragmatic rationality on a small scale, unbounded by an a-priori design. A kind of rationality that Caniggia and Maffei (1979) define *spontaneous conscience*. As continuous urban growth sustained by the recent planning models has so far resulted to deepen and the divide between social groups according to resource accessibility, research is called to address alternative approaches, policies, and ideas that could possibly increase and improve access to urban services. The participation of dwellers in the design and maintenance of their settlements, by repositioning the built form and related infrastructures in the hands of self-determined communities, is often seen as solution that would allow to restore a new balance between nature and society, contributing to the preservation of that precious yet decreasing water resources that sustain livelihood (Habraken and Teicher 1998, Volontà 1982). However, these processes call for being observed over a long time-frame, in order to assess whether they succeeded in responding to the injustices that dominate contemporary cities and in building urban commons. Despite the marked divergences between Hanoi and Cochabamba, protagonists of this research, the urbanisation processes that shape their urban landscape reveal the controversies of conflicting visions that see on the one hand, the institutions in charge of

planning tending towards modern, centralized and global models of urban and infrastructural development by developing design from the top, and, on the other, urban dwellers that, with daily work and investment of resources, and collective action shape and adapt the urban space from below. At the boundary point between these two apparently opposite visions, incrementalism characterises the reconfiguration of both formal and informal built environments.

1.1.2 THE STRUGGLE FOR WATER AND SANITATION SERVICES

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. Respectively more than 500 million and 1.5 billion people in urban areas of the Global South lack access to safely managed drinking water and adequate sanitation services (UNICEF 2015). Rapid and often uncontrolled urbanization hampers the institutional capacity of public authorities and water utilities to extend water and sanitation infrastructures, especially since water demand increases very rapidly. 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). At the same time, proper sanitation services and wastewater treatment remain largely absent or inefficient and contribute to water quality decline, especially in peri-urban areas. The inability, or unwillingness, of local and national governments to provide adequate and equal facilities, including water services 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).

From the late 19th century, the global urban landscape started to be dominated by the presence of large infrastructure networks, associated with ideas of progress and modernity and health. The main discourse circulating in this period was that pathogens, largely found in wastewater, would justify the construction of large scale, underground networks, flushing wastewater out of the city (Schramm, 2016). According to this model of infrastructure development, the construction and operation of

water and sanitation infrastructure 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. Not only because of the consistent investments necessary to build and maintain large infrastructure networks, but also because of the idea that access to water and sanitation services should be ubiquitous and uniformly at disposal of dwellers at fixed tariffs. Moreover, the reasons also rest 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). Infrastructural theories that tend to normalize the ubiquitously networked urbanism have been largely applied to the cities in the South, often as a colonial pursuit of a dry and sanitary city (Graham and Marvin, 2001). However, these theories have for a long time denied the possibility that large infrastructure networks are not equitably available to urban dwellers. While research on urban infrastructures is increasingly questioning the efficiency and equitability of centralized delivery of public services in these contexts, some criticisms have emerged (Mitlin 2008, Ostrom 1996).

First, the modern ideal of standardized universal provision of WSS services through a centralized infrastructure network has not been successfully applied in all Global South cities (Coutard 2008, Coutard and Rutherford 2015; Fernandez-Maldonado 2008, Furlong 2014, Graham and Marvin 2001, Kooy and Bakker 2008, Moretto and Ranzato 2017, Jaglin 2012, Zérah 2008). The development of ubiquitous networks, meant to sustain and accelerate processes of urbanization, struggle to keep pace with increasing urban demand for water. Due to poor economic and planning capacities, and chronic dependence on external capital, service providers are often unable to cope with increasing population.

Second, their implementation has often legitimated a policy of spatial segregation and urban socio-economic and political fragmentation, which contributed to further exclude a large part of the urban population from the access to basic services (Coutard and Rutherford, 2015). Indeed, when available, these infrastructure systems hardly cover the entire urban territory, often leaving low income and peripheral areas (generally with less value) disconnected. In particular, the rapid growth of peri-urban areas, generally characterized by lower population densities and higher distance to centralized service networks, makes centralized solutions unaffordable for the poor (Allen et al. 2017, UCL 2011). For this

reason, alternative, often decentralised systems responding to a lack of network are developed in these territories.

Third, these large-scale centralized systems, even where they are present, present gaps (obsolescence, irregularities, etc.) so that other systems are developed in parallel in order to improve the quality of the services they deliver.

Faced with the lack or limitation of conventional systems of services, centralised networks and infrastructures, a number of scholars have begun to observe and study the multiplicity of individual and collective practices of self-governance and self-management taking place in built environments and infrastructure systems and those socio-technical solutions that still enable the majority of urban dwellers in the Global South to access water and sanitation services.

1.1.3 CO-PRODUCTION: A THIRD WAY?

For much of the past hundred years, governments have been experimenting with various models, policies and strategies to deliver public services to an increasing number of urban dwellers. The limitation of traditional service delivery models, both public and market based, that emerged in the context of the Global North as early as the 1980s after a period dominated by centralization, liberalization and privatization, led to the emergence of a new theoretical concept, that of co-production, a participatory governance model that considers user engagement in the service delivery process.

Accordingly, attention to different user-provider arrangements and the role of users in producing services has increased in international and scientific communities and co-production has entered the debates on service provision as a third way to deliver urban services (Joshi and Moore 2004, McGranahan 2013, McMillan, Spronk and Caswell 2014, Mitlin 2008, Moretto and Ranzato 2017, United Nations [UN] 2016a).

A broad literature, mostly on public administration, has conceptualized and delimited the boundaries of citizen-state engagement in service co-production (Brudney and England 1983, Joshi and Moore 2004,; Moretto and Ranzato 2017, Nabatchi et al. 2017). Most research addres-

ses the motivations behind service co-production (why do service users co-produce), its institutional setting and the characteristics of stakeholders' engagement (how do users and providers interact). Nevertheless, it is usually because of its benefits that it is increasingly addressed by scholars and promoted as a more horizontal form of governance. The interest in co-production of public services is indeed underpinned by the view that the engagement of users in some or all the phases of the service cycle may bring double benefits. Co-production constitutes a service delivery model that may improve service efficiency and accountability by making better use of the available resources while increasing trust among the actors involved. Indeed, state and citizens have different but complementary forms of knowledge, which together can contribute to improving service outcomes (Ostrom 1996, Watson 2014). At the same time, the move toward co-production as public governance and policy framing tool is a way of addressing institutional deficits by favouring the reconfiguration of state-society relationships through the rise of new democratic institutions (Mitlin 2008). By contrast some authors raise concerns about co-production initiatives as forms of co-optation and as vehicles for the institutionalization of inequalities (Cornwall 2004, Jaglin 2002) and, at the same time, as drivers of socio-spatial fragmentation (Moretto et al. 2018, Cabrera 2015, Cabrera and Teller 2021).

Within studies on planetary urbanisation, service co-production is often seen as a way to overcome the dichotomy between formal and informal approaches to urban planning and service delivery (Faldi et al. 2019, Misra 2014). Literature has shown that urban dwellers in fast growing cities connect with water and sanitation services in a range of ways. While a number of residents formally connect with networked systems, a wider number access urban infrastructure informally. Many others augment their "formal" access to resources and services, and therefore access urban services in both formal- and informal ways (Misra 2014). When referring to networked infrastructure, the concept has been increasingly mobilised in the literature on socio-technical systems to address the fragmented landscape of hybrid service modalities which engage small scale operators (formal or informal), local communities and dwellers in the service delivery process. In this perspective, service co-production is often presented as a decentralized, hybrid form of service delivery developed to bridge the gaps left by poor or absent centralized networks.

In the limited capacity of conventional networked services, many dwellers in the urban South are forced to co-produce their own services, often relying on localized and grass-roots technologies and arrangements for accessing water and sanitation (Coutard and Rutherford 2015, Bakker 2003, Furlong 2014, Jaglin 2012, McGranahan 2013, Moretto and Ranzato 2017). These emerging forms of provision of water and sanitation services -mainly decentralized, city-driven, often "invisible" to the public sector (UCL, 2011)- are adopted on a daily basis by dwellers and communities, with or without support from governments and water utilities (Allen et al. 2017). Their existence contributes to making the incremental cities of many countries in the Global South "fluid, diverse and unstable" landscapes of service provision in which urban life continuously results in efforts of design and redesign, contingent planning actions and material improvisation, upgrade and repair of existing infrastructure systems (Graham and Thrift, 2007). This ordinary and continuous process of transformation emerging beyond centrally planned networked infrastructures questions the value of a universal and equitable service provision. Compared with large-technical infrastructure, co-produced systems show a high degree of adaptability which is related to the local learning capacity for dealing with changes in resource systems and mediated by simple, grass-roots technologies which are close to users. Moreover, co-production reveals an alternative logic of production of water infrastructures which is characterised by incremental changes, small scale adjustments and constant repairs (Coutard and Routerford, 2015). However, there are major challenges in guaranteeing sustainable management of the system, maintaining service equity and efficiency and ensuring water and environmental standards (Faldi et al. 2019).

1.1.4. COPRODUCTION AS ANALYTICAL LENSE

While it is important to recognize that any theoretical approach inherently carries a degree of normativity, based on the underlying values and assumptions of its creators, this research primarily employs coproduction as an analytical lens. By intentionally avoiding a normative stance, coproduction serves as a foundational theory to explore and scrutinize the diverse, unconventional configurations of water and sanitation service delivery in rapidly urbanizing contexts. Specifically, this study aims to analyze and comprehend the dynamics, challenges, and

evolving nature of cooperative efforts between regular service providers (such as government bodies, NGOs, and private entities) and users (including communities, groups of households, and individuals). The objective is to reveal how these collaborative interactions manifest in reality, identify the types of spaces and conditions that influence their transformation over time, and understand their impact on service delivery and community livelihood across various settings.

The research work was grounded on the assumption that as water is "co-produced" by nature, it becomes relevant to recognize the complex interactions and collaborations between various stakeholders in the creation, management, and delivery of water services. Accordingly, the research assumed that some degree of co-production in the two cities would be found across different spaces and scales, and that co-production, as a situated practice, would assume multiple configurations in the selected contexts.

For this reason, the 30 cases in the two cities were selected before gaining knowledge of what kinds of co-production arrangements could be found in place. Moreover, because of its incremental nature, in rapidly urbanizing environments, co-production would imply the emergence, evolution, and eventual disappearance of different kinds of socio-technical practices over time. The fieldwork activities endorsed a grounded theory approach to test some assumptions regarding the role of the different actors involved in co-production, and the use of mapping activities was oriented towards an understanding of the various configurations and dynamics of change.

To sum up, co-production was used here as an analytical framework to organize a vocabulary of knowledge around the possible configurations it may assume and around its step-by-step development. In this research I approach water and sanitation service co-production from a descriptive rather than a normative perspective. In other words, I do not focus on the collaborative dimension of co-production practices; nor do I evaluate their benefits in terms of quality of services. The focus is rather on understanding how different practices co-production of water and sanitation services develop over time in incremental environments. Service co-production is here understood as an incremental practice, namely a process in which hybrid modalities of service provision, involving state actors, service users and a wide range of intermediaries, are interacting in an evolving socio-political, technical and territorial context (Ahlers et al. 2014, Faldi et al. 2019, Joshi and Moore 2004). Grounded in

the idea that the co-production of water and sanitation services has a path-dependent nature, this research draws attention to the relation ship between the evolution of co-produced practices and the processes of consolidation and transformation of human settlements and infrastructure networks. It does so by looking at the incremental nature of the built environment and the role of incrementalism in sustaining urban livelihoods through processes of maintenance, upgrade and transformation of water and sanitation infrastructures (Button 2017, Graham and Thrift 2007, Offner 1993, Silver 2014). Reading service co-production as an incremental spatial practice, as opposed to a policy or a static service delivery model, helps us to understand its origin, evolution and role in the transformation of Global South cities.

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1.1.5 THE INCREMENTAL NATURE OF WSS CO-PRODUCTION

By exploring a variety of situated socio-technical configurations that characterize service co-production and their adaptability towards change, the research aims to inform urban infrastructures theory and design with empirical evidence on the co-evolution of water infrastructures

and the built environment and contribute to a renewed understanding of water and sanitation services co-production. At the core stand the processes of physical construction of dwellings and water infrastructures with an eye on the decisions and actions of the different actors involved in the service cycle. Through the observation of processes of reconfiguration of the built fabric and water infrastructure that support urban life in Hanoi and Cochabamba, this thesis tells stories of resilience and innovation in co-production. Over time, these socio-spatial-technical practices show capacity to adapt to changing environmental, urban and institutional conditions, providing efficient and adaptive solutions to the pressures posed by urbanization. The socio-technical choices in co-production do not appear to be outputs of a comprehensive planning model, made on a means-ends, but pragmatic actions, often in response to local or broader changes.

Thus, scope of this investigation is to develop a practical understanding of the evolution of the ordinary practices that fall under the umbrella of WSS co-production, as to show the rationality of the ordinary, that is, the capacity for adaptation and learning inherent in decision-making and operational processes (planning and practice) that shape the incremental evolution of WSS wss co-production.

Drawing on the concept of interactive planning and that of interactive knowledge proposed by Lindblom (1990) and Crosta (1986), co-production practices are here considered as both contingent forms of planning and pragmatic actions, where planning is not understood as a method that identifies goals and determines the means or programs to achieve them. It is rather intended in an “interactive” way: as a negotiation space built around problems posed and, especially, those generated by the unplanned consequences of actions (Crosta, 1986). This vision gives depth to time, understood as a time of transformations and cumulative processes while leaving a space for the unexpected and incremental consequence of the planning activity, at the core of this research.

Addressing the evolutionary character of the spatial side of water and sanitation services co-production requires to identify the rationality behind the various re-configuration processes over time. The legacy of urban morphology has defined a method to address the continuous transformation of human settlements which implies a disassembly and reassembly of the built environment in order to generate an understanding of the rationality of the ordinary that can also be instrumental to

the design activity. However, this approach does not generally address infrastructure networks, which are on the contrary observed within socio-technical and urban studies with little reference to their relationship with the built fabric (Rosati et al. 2022). Adopting an incremental approach to the built environments and infrastructure networks implies giving centrality to the time factor, that is, recogniszing that the city has the qualities of a living organism, continuously adapting to the conditions of its surroundings (Habraken and Teicher, 1998). Understanding the rationality of this “logos of change”, through the observation of case studies, is helpful to assess previous policies in housing and service provision and eventually to adjust the planning tools for operating in the incremental city to the unintended consequences of planning. Moreover, the emphasis on the interactive dimension of the planning action suggest a pathway for recognizing and integrating those “non-professional” knowledge that drive individual or collective choices in water and sanitation services co-production. This is beneficial, especially when self-help solutions are to be accommodated into institutionalised schemes, as for co-production, increasingly promoted as alternative governance arrangement for the delivery of urban services.

1.1.6 RESEARCH QUESTIONS

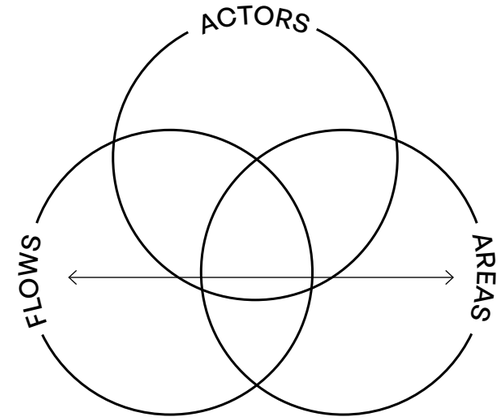
This research is an attempt to better understand the incremental nature of co-production of water and sanitation services under present-day urban conditions in the Global South. The scale of the phenomena, i.e. the large percentage of global population that have no access (or limited) to centralized water and sanitation networks and the difficulties for city planners and institutionsi to come up with appropriate solutions to this challenge, is putting emphasis on the potential role played by co-production for an equitable delivery of urban services. As such, co-production is approached as a new collaborative policy model increasingly integrated into planning and design processes nourishing the contemporary city. My point of departure is that, whereas literature often mobilizes co-production as a policy tool to be integrated in urban planning or public services delivery, co-production in the context of the Global South can be better understood as the product of incremental

practices (Rosati et al. 2020). In most cases observed, water and sanitation services co-production has not been planned by policy, or designed as such, but it has developed over the time in co-evolutionary relationship with the context (political, social, environmental) at different scales. The dominance of the public administration perspective in service co-production literature, has generally disregarded spatial and environmental considerations (Moretto et al. 2019), which are fully integrated in this work. Moreover, the misconceptions at multiple levels about the processes and dynamics at play in the development of co-production initiatives, its blurred definition, the dominance of the normative approach (assessing co-production outcomes), has generally led researchers to neglect co-production evolutionary dimension in the context of fast growing urban environments. In this research, I contribute to the growing literature on co-production of water and sanitation services, by proposing a new perspective to inquiry it, that of incrementalism, which provides a centrality to the time dimension and the urban fabric.

The empirical account of water and sanitation co-production practices presented in this thesis will show how large parts of the cities of Hanoi and Cochabamba are actually incrementally co-produced, in terms of infrastructures and urban space involved. Hence, the primary assumption upon which this thesis is built is that wss co-production is incremental, by nature. The research focuses on the analysis of incremental change in co-production practices. In particular, I look at three specific articulation of this concepts. Namely the ways in which such forms of infrastructures, the built-environment and governing organization are constituted, consolidated and transformed over time.

The primary question that this thesis addresses reads as follows:

Q.1 How is water and sanitation service co-production incrementally developing over time and space in terms of built environments and technical infrastructures?



To inhabit depends on the incremental practices through which people build and consolidate their environments, livelihood and social networks (Simone 2013, Hamdi 2014). To inhabit also means to connect and to engage with the multiple supply systems that are part of the contemporary city fabric. From the 19th century, ubiquitous and invisible, supply services, such as water and sewage, have generally been buried within walls, ceilings and streets. However, it is mainly through breakages and transformations that they become visible protagonists of urban life (Habraken 1998, Graham and Thrift 2007). In this fertile and dynamic terrain of transformation of the urban fabric and infrastructural networks, co-production is expressed in a physical way.

The theme of co-production is dealt with here by resorting to the analysis of those processes, inherent in the life cycle of the urban fabric

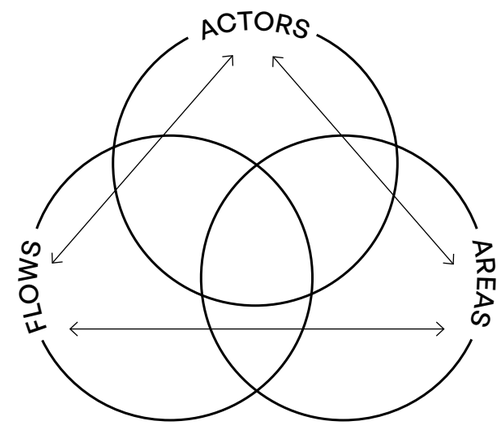
and embedded technical infrastructures, which represent the physical dimensions of the co-production practices of water and sanitation services. The incremental nature of infrastructural networks (Silver, 2014) and of the built environment (Habraken, 1998), refers to the development of the built fabric and of water and sanitation networks by successive grafts on the system of pre-existing structures that compose them. It is the intrinsically incremental process that involves the urban and infrastructural organism each time it faces a phase of transformation that this thesis wants to inquiry with this question. The case-study approach, as we will see in chapter 6, paragraph "practices", allows the definition of a "phenomenology of incremental practices" through the reading and cataloguing of the locally based dynamics of transformation of networks and the urban fabric involved in wss co-production.

Q.2 What are the relations between incremental development of governance structures (Actors), technical infrastructures (Flows) and urban fabrics (Area)?

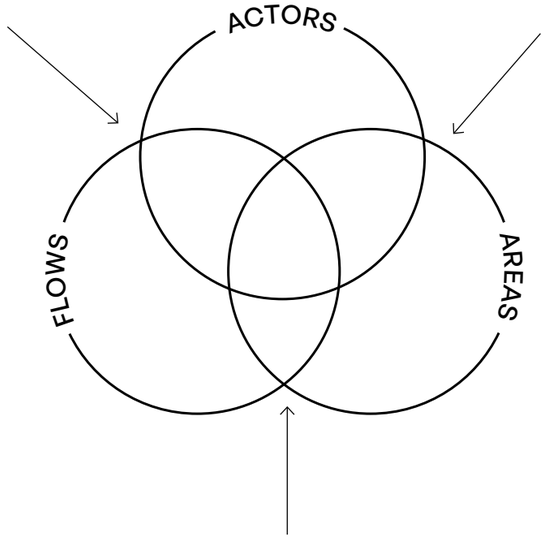
The second part of the research builds up on the need for improved understanding of the interplay between governance systems, technical infrastructures and the built environment in order to address the incremental evolution of wss co-production practices. On a continuous basis, changes in co-production environments bring about new sets or combination of circumstances that must be confronted through ma-

nagement decisions (feed-backs) if co-production organizations are to survive and grow. Hence, the thesis focuses on the processes underlying WSS co-production, to better understand the outcomes it generates. This research question emphasises the inter-relationships between the various dimensions and variables that characterise WSS co-production in order to develop a phenomenology of transformation processes.

In chapter 76 “processes”, I will reflect over the incremental nature of co-production, that is to say, that paradoxical "change in continuity", where the persistence of certain constitutive invariants of co-production is combined with a permanent evolution through successive re-configuration of its boundaries. This is a central theme in this investigation, which aims to bring out from empirical cases, the multiple declinations of these incremental processes, starting from the observation of interdependencies between processes of reconfiguration of the built environment and technical infrastructures embedded in water and sanitations service co-production, and their governing organizations. Drawing on the concept of cyclicality of infrastructural networks (Offner, 1998), of the built environment (Muratori, 1967), of organising (Weick, 1995), the research aims to understand how WSS co-production is constituted, consolidated and transformed over time.



Q.3 What are the conditions/ factors which impact the incremental evolution of WSS co-production practices?



The third aspect the thesis wishes to highlight relates to the conditioning of the incremental development of co-production. The propositions indicated in chapter 8 "conditions", specify possible types of problems for which the usefulness of incrementalism and mutual adjustment, as techniques for dealing with complexity, must be weighed against the usefulness of more synoptic and centrally coordinated strategies. These categories have been identified through deductive analyses found in the scientific literature and are re-articulated and discussed through the inductive and comparative analysis of the case studies analysed in this research work. By answering to this last question, pur-

pose of this thesis is to develop an analytical capacity to identify how co-production may be adapted to different contexts. The analysis of the conditions allowing for incremental development of co-production initiatives, if integrated and deepened in subsequent studies by scholars from other disciplines, could indeed represent a reference to assist public administrators in their efforts to match more efficiently decision strategies to problem types. In particular, this could be helpful in the design of co-production arrangements (increasingly supported by governments), to anticipate the unintended consequences of the planning action as well as to explain "rational" evolution or types of complex problem areas that might arise in the implementation of wss co-production.

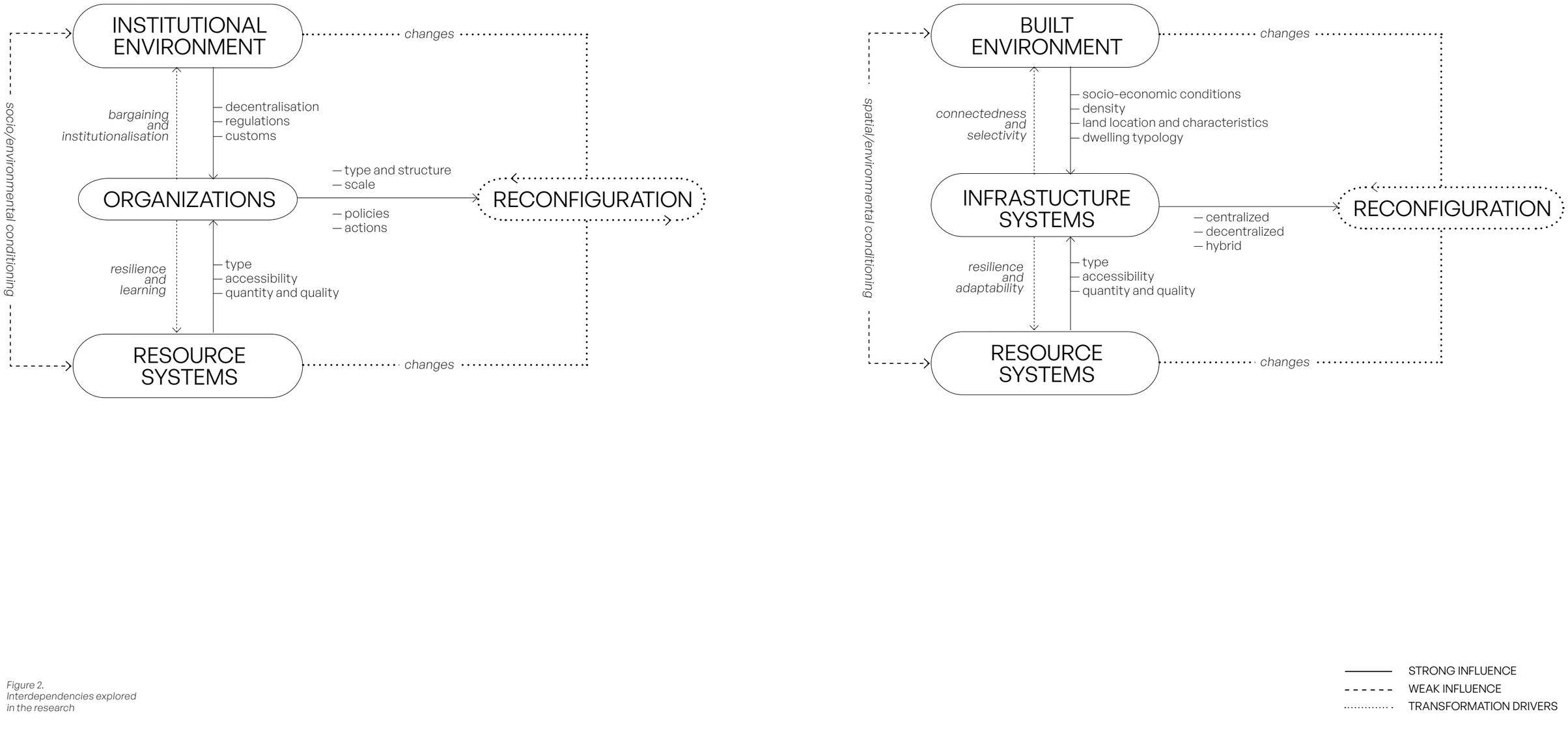


Figure 2.
Interdependencies explored in the research

1.1.6 INNOVATIVENESS OF THE RESEARCH: A MULTI-SCALAR; EVOLUTIONARY AND COMPARATIVE APPROACH FOR ADDRESSING WSS CO-PRODUCTION

The present work deals with some issues concerning the relationship between water and sanitation management systems and land and infrastructure transformation processes, taking these latter aspects as a reference to explore the dynamics that affect some significant disciplinary issues. In particular, the focus of this research is on the evolution of wss co-production practices over time. Based on the knowledge acquired in the analysis of the state of the art and in the historical spatial reconstruction of the different contexts of reference in the cities of Hanoi and Cochabamba, the research demonstrates an innovative character as it deals with certain aspects:

❶ the focus on the spatial side of co-production and, more generally, on its role in shaping processes, forms and architectures of living;

❷ the incremental perspective, which is applied to the three main dimensions of co-production research (actors, flows and areas) and inquired within the relationship between permanence and change;

❸ the focus on transformative dynamics of co-production: the observation is shifted from the effects that co-production produces (outcomes) to the dynamics of re-configuration it generates over time (processes);

❹ the comparative analysis (2 cities and 30 case studies are addressed by the research to build a grounded theory): this approach sustains the construction of a complex vision of the concept of co-production by outlining the different configurations that co-production takes on, in relation to a series of variables (environmental, actor and spatial) and their transformations over time;

❺ the multi-scalar approach: from co-production as a dynamic describing trends on a broad, city-wide scale to co-production as a practice embedded in local practices at a small-scale.

3.
Fieldwork Research in Hanoi, October 2017

1.2 Methodology

1.2.1 FIELD WORK AND THESIS REDACTION

The research builds on several periods of fieldwork carried out between the year 2017 and 2020 in the cities of Hanoi and Cochabamba. Field research activities were alternated with periods spent in Belgium devoted to the analysis of the collected data, writing, geared mainly toward the publication of scientific articles, and participation in a number of international conferences and seminars.

Regarding the fieldwork carried out in Hanoi, a first phase began in October 2017 and ended in March 2018. These first six months in Vietnam were crucial for the construction of the survey methodology and a first redefinition of the research object. The first issue faced in Hanoi was the identification of the case studies, following difficulties in making the local context understand the object of the research. A series of interviews with institutional actors and university colleagues, on the one hand, and with ordinary citizens encountered on the field, on the other, revealed an initial mismatch between the object of the research and the perception of the phenomenon, in other words a mismatch between theories of co-production and its practical terms. It took me some time to realize that in the Vietnamese context, this misunderstanding had to do with the translation of the term and the difficulty of operationalizing the concept of co-production and understanding its application in the local context. When I asked to describe what shape would co-production of drinking water or sewage networks endorse in Hanoi, in order to identify the case studies that would become the subject of the research, my interlocutors were puzzled. Despite several attempts to explain the concept of co-production, using scientific literature and specific case studies, replacing the word co-production with other terminology, I could not get help in identifying appropriate practices in the city of Hanoi. When I asked 'experts' If they could point me any form of collaboration between state actors and community actors in the delivery of services, the answer I got was that in Vietnam the state is in charge of services. When 'non-expert actors', citizens, were asked the same question, the 'to dan pho' (residents' organization) was always indicated as the entity responsible for community services.

There seemed to be no way out of this impasse which stemmed from the difficulty of establishing a boundary to the operation of the state and non-state actors. In other words, the difficulty stemmed from what Koh (2006) and other scholars have described as a characteristic of the Vietnamese political system, where the state and civil society are not two distinct entities, but are extremely permeable and interdependent. The state permeates society and through its hierarchical structure, it comes to exert its control right down to the small streets, right down to the houses, becoming itself 'community'. After a series of interviews with institutional actors, unable to understand what was the face of co-production in the city of Hanoi, the selection of case studies took place through the construction of a method of analysis that was at first exploratory, which allowed me to have an overview of the processes of urban and infrastructural transformation on an urban scale and to identify, in a second moment, the case studies subject to an in-depth analysis.

Riding a Honda Cub, I travelled the length and breadth of the Asian metropolis, sometimes simply accompanied by a notebook and a camera, but more often, especially during the phase of interviews and questionnaires, by students and interpreters. I spent a lot of time in the selected communities sitting in the improvised cafés on the streets, trying to familiarize myself with the places and the people who lived there, hinting at what few words in Vietnamese I had learned and supported by google translator and sheets of paper on which to draw. I have to say that my presence alone in the neighbourhoods at an early stage of the research was viewed positively by the inhabitants, who felt safe from possible state inference in the dialogue, especially given that environmental issues are considered 'sensitive' in Vietnam. This allowed me to enter and photograph in the homes of plenty of Vietnamese and Bolivian families, to weave with daily constancy relationships that extended in time and space, to establish a mechanism of mutual trust without which this research work would not have been possible.

In the city of Hanoi, I carried out research in five stages spread over two years, living in a different part of the city each time, in order to increase my knowledge of the context. During the last three months of my stay, I lived with a Vietnamese family, which allowed me to confront the local culture on a daily basis through the observation of rituals, gestures

and habits, that characterise the acts of dwelling in the Vietnamese city.

However, the research work in Hanoi encountered various difficulties linked to the lack of understanding of the language and the sensitivity of the subject matter. The incomprehension of the language obliged me to be accompanied by translators and interpreters in the investigation phases whose translations were often omissive. Although I did not understand the dialogues, my perception was that when rising some political issues around environmental and water matters the interlocutors blurred, giving abrupt answers that were almost never translated by the interpreters. Any attempt to let situations of conflict emerge, either at the community level or in relations with institutions, was rejected, and almost always, despite direct observation revealing the contrary, the account of reality was sweetened by a form of deep respect or underlying fear of the work of state institutions. For this reason, there were few voices of dissent, and those that emerged as such were due to the ability to establish a relationship of friendship and trust with the interviewees. This testifies to the sensitivity of the theme addressed, and the widespread concern of discussing the government planning and its implemented policies. The theme of sensitivity was found not only at the community level, but also in institutional contexts. For example, with the exception of a few official documents that I obtained through a connection with a representative of the urban planning department, I was always denied maps of water networks and information related to their management at a city scale. All the situations and experiences, including difficulties, encountered along this research journey influenced the definition of the thesis, both from the point of view of the object of the research and from a methodological point of view.

Another issue encountered in Hanoi between the different fieldworks (often a few months apart) was the city's growth, which was so rapid that it was difficult to track its evolution both at the city level and, more specifically, in the local case studies selected.

March 9, 2019

notes from the diary

Lying on the bed in my room on Tran Hung Dao str. No. 68 in the Hoan Kiem district, I can't take my attention away from the smell of the bedsheets, the scent of laundry mixed with the smog of the sky. The city I love and the city that angers me most of all at the same time. Hanoi is the perfect love story. Dramatic, shrewd, complicit, rebellious, and contentious. A beauty that sucks in your gaze and takes your breath away. The thing that disarms me most is its perpetual and somehow balanced mess. Streams of people, scooters, things fill the streets at all hours of the day and only at night do they calm down, when the smell of broth (the pho the Vietnamese eat for breakfast) takes over. Today I got lost in one of the neighbourhoods I know best, looking for the small shack run by a friendly Buddhist family where I often used to go for lunch. Of that place I was especially fond of Pollo (this is how I called her), a small chicken who wandered among the restaurant tables looking for food. Pollo loved peanuts and would intone a note of La, to ask for more. Returning as usual along the street where I used to park my scooter, with disbelief that immediately turns into an irrepressible sadness I notice that the shacks that housed the little restaurants have given way to the barriers of a new settlement under construction. Cranes, screaming workers and moving vehicles amid dusty clouds roam that vast new urban void. Affection for that place I used to visit gives way to a sense of betrayal, and the more I become convinced that Hanoi is an eternal snapshot of its becoming. I will not be able to stop and neither to follow that becoming, which gradually carries with it the erasure of the affective landscapes that I have imprinted in my heart and that give me sense of safety and peace of mind. With a knot in my throat, I take the scooter and drive home.

4.
New bypass in Hanoi.
December 2018.

Courtesy of Jacques Teller.

I had already experienced a similar sense of loss a year earlier, returning in the city about a year after the first fieldwork. I remember one of the first evenings riding my moped, the main means of transport in the hectic Asian metropolis, and the sense of displacement due to the presence of a new overpass, built within a few months on a portion of the neighbourhood that had disappeared at the time, making the face of the city unrecognizable to my eyes. This sense of bewilderment due to the impossibility of constantly following and monitoring the rapid processes of transformation accompanied me throughout my investigation. Each time I visited the case studies, differences, sometimes very marked, appeared with respect to the situation previously photographed, both in urban terms and in terms of infrastructure and management: the emergence of new water networks, the fragmentation of existing networks, the disappearance of certain practices, the demolition and reconstruction of the built environment, the extension of the centralized network and the disappearance of old community systems, the introduction of new technical devices, their dismantling. The constant change in the practices I was observing prompted me to change the lens of observation of these phenomena and to revise objectives and tools of investigation.

I could not simply observe how these communities were confronting with water, in its multiple forms and evaluate these practices in the moment I was in the field, pretending that those rapid transformations did not exist or had no relevance to the subject of my research. I thus realized that all the questions I was developing with respect to their sustainability completely lost their meaning, by adopting a wider time frame of analysis. For how can one assess the sustainability of initiatives that exist today but in a year time no longer exist or, if they still exist, one almost struggles to recognize them so much they have undergone a transformation? Nagged for a long time by this question, I realized that there was nothing left for me to do but to investigate more deeply what looming reality of death, constantly rejected in the deep meanderings of my unconscious. To some extent, the commitment to inquire the cycles of life and death of water practices represented a largely unconscious attempt to grasp the flight of time, hoping to control it, making it orderly, visible and measurable in those processes of transformation that are at the heart of the inquiry.

5.
A man carrying bricks on his motorbike. Hanoi, November 2017

While the difficulties encountered in Vietnam were primarily of an interpretative nature, in Bolivia they were of an operational nature.

In the city of Cochabamba, the fieldwork was spread over three stages. A first research period in September 2018, a second in October 2019 and a third phase in winter 2020. The research in Cochabamba was affected by various misfortunes that forced me to revise the method of investigation. The second stay was prematurely interrupted due to the civil war that erupted in the country following the troubled presidential elections of 20 October 2019. The coup d'état (Velador and Ibarra 2019), which took place in Bolivia in the weeks following the elections, was an articulated and complex process, culminating in the resignation of former president Evo Morales on 10 November following a chain of mutinies by the National Police Corps, which occurred in several cities across the country starting in Cochabamba. The impossibility of pursuing field research was not so much due to the manifestations of violence that were taking place in the city, as to the real 'paralysis' of the city due to 'los bloqueos', hyper-organised and capillary actions of traffic blockades that did not allow mobility. I was unable to move around the city except with a bicycle that I had borrowed, the communities were ablaze in protest and not available for interviews. It was impossible to continue with field research activities. So, during these two weeks of stay in Bolivia, in such a turbulent and particular moment, I spent time to interview the people who were leading and participating in the protest in the northern part of the city and in particular to observe the ways in which they controlled and reorganized the territory, through patrols and barricades. This experience also profoundly influenced the object of investigation.

October 21, 2019 notes from the diary

On the 21 October 2019, the city of Cochabamba begins its siege. Evo Morales has been announced the winner, for the fourth consecutive term in Bolivia's presidential elections, not without strong dissent throughout the country. The northern part of the city begins to mobilise

in protest against this victory, which is deemed illegitimate. The streets begin to fill with objects, while rows of students proudly dressed in the Bolivian flag parade through the sunny streets intoning protest chants.
The corners of the city are marked by the presence and almost artistic assemblage of disparate objects found in the cellars of houses or simply picked up by the side of the road: bottles, rubble, a few larger stones are placed in the streets here and there, to discourage the passage of cars. Sometimes scraps of knotted fabric hang from one tree to another. Stretched threads and assemblages of disparate objects impede movement.
The usual carts selling moconchincis and fruit juices line the pavements, gathering passers-by around them. Slowly small human gatherings form around these urban nodes and neighbours improvise chats and friendly discussions. Hour after hour, the ephemeral barriers multiply and consolidate, becoming a capillary network, around which families begin to take turns guarding.
These dividing fractures slowly become cohesive. They fragment traffic.
They prevent free use of the street and public space. They create divisions and spaces that do not talk to each other. Yet it is precisely around these fractures that spaces of cohesion and confrontation begin to form. And so, the neighbours, who will not even return to work the next day to continue the protest, make an appointment for the following day. They also pledge to bring some other objects, perhaps larger ones, to consolidate the roadblocks.
After a few days, they have formed a WhatsApp group, named after the road junction where they usually meet. They begin to organize shifts to consolidate their presence in the street, with times and groups established from day to day. The urban landscape of Cochabamba, which I had always known as chaotic and hyperactive, is now a grid of disconnected and deserted streets. Traffic is paralyzed almost everywhere in the north. The thousands of trufis, microns and taxis that transport people around the city on a daily basis have disappeared. Vanished. They are probably concentrated in the south, or perhaps parked outside their drivers' homes. As the days go by, the obstacles to traffic are consolidated until they become veritable barricades controlled by groups of organized neighborsneighbours, deciding who and how can cross the boundaries.

The city is totally paralyzed.

This experience had a twofold effect on this research. On the one hand, it prevented me from completing the fieldwork, forcing me, due to the subsequent pandemic which impeded also the third fieldwork activities, to reorganize the work from remote by delegating a broad part of the data collection to the team of Bolivian colleagues. On the other hand, it gave me a lead to reorient the research. I realised that I was terribly fascinated by the process of construction of borders, by their constant mutation and consolidation, by the ambivalent role they played, on the one hand as elements of separation and fragmentation and on the other as elements around which new sociality and spatiality were created. The daily observation of this phenomenon had developed in me an interest in incremental processes of spatial transformation, which then became my lens for observing the water communities I was inquiring.


6.


7.


8.


9.

6. 7. 8. 9.
Barricades along the Avenida America, Cochabamba, October 2019


10.

11.


12.


13.

10. 11. 12. 13.
Barricades along the Avenida America, Cochabamba, October 2019

Then the pandemic came. And I found myself forced to return from Bolivia prematurely in view of the national borders' closure. A somewhat troubled way back, since at the time of the impromptu return I became ill with typhoid, an illness that had several repercussions, not only physical but especially psychological, which caused me to deeply rethink my life outside the city.

Self-bordered from the pandemic, I decided to move out of the city and to inhabit a small medieval village in the Italian Apennines, Pennabilli, a border territory, historically crossed by wayfarers, shepherds and pilgrims at the same time a rich in small experiences of political autonomy inherited from the medieval time, of hermits and monastic communities, handcraft and rural communities that have inhabited the territory and conferred its peculiar landscape of movement and stasis over the centuries.

This phase, dictated by a time of reworking and writing (about 8 months) and a long silence that lasted almost a year (I admit that I suffered a kind of rejection from the thesis that I have with great effort resumed), was a less productive phase perhaps but equally central to the maturation of my thinking and research. I could realize how much my professional research was in some way driven by a personal quest, well expressed in Bauman's book *Community: Seeking Safety in an Insecure World*.

I thus came into contact, from different positions and with different degrees of interaction with multiple communities that inhabit the territory of Pennabilli and that provided me with important stimuli, as well as strength and support, to continue in my research.

First of all, the meeting with Mario and the anarchist community of Ca' dei Chiodi. The transmission of ancient knowledge over time through the artisan work, the readings we used to do together on Saturday mornings about ecology, autonomy and common goods. The encounter with the anarchist thought through some of the authors whose thoughts Mario shared with me was central to defining a new window of observation of the communities of practice being researched. Then, the friendship relationship with a community of Augustinian cloistered nuns influenced the narrowing and redefinition of the object of the thesis and provided an important stimulus to address the research. Crossing the threshold of the Augustinian community, observing the rhythm of time marked by prayer, the intertwine between life and rule, the renouncement of individual property in favour of a collective life, I became interested in inquiring the role of the border and of self-determined rules for guaranteeing the endurance of organizations. Finally, my life as a new settled inhabitant in the small community of Villa Maindi, the communal projects and management of the shared open spaces called "comunelle", the stories told by the older inhabitants at nights in front of the fire of a peasant culture almost disappearing, the "opras" collective works for managing the fields, and the community construction of water networks now managed by the water company. Daily encounters and narratives that, especially in this last year when we are witnessing a water crisis (in summer we have to ration water, to close the public fountains and at, times, we are forced to order water by tanker while all our waters are all directed to the touristic coastal cities 30 km downstream) are prompting us to ask questions on our role, as community, with respect to the management of the commons.

This space of unstated research, nor quantifiable in terms of working hours or accountable outputs, which is the space of life after all, has been equally central to reorienting this research in the wake of these new inputs.

It required a period of silence and a final phase of writing and reworking the work done of about a month in the summer of 2022, spent in a small monastery in the Alps of Trentino Alto Adige to see the work at this stage, more or less completed.

1.2.2 A MULTIPLE CASE STUDIES APPROACH

The research methodology represents the strategy through which the design and acquisition of knowledge relating to the phenomenon under examination is developed and through which the construction of the objectives is defined. In fact, it develops the articulation of the research and oversees its development according to the guidelines identified by a more general "epistemological vision" adopted. The research method is strongly influenced by the nature of the phenomenon being analysed, which significantly determines the choice of how to acquire data and knowledge in order to address the main topic. The case study approach is generally selected in research to "investigate contemporary phenomena within its real-life context" (Yin 2009, pp.4) and used to ge-

nerate an in-depth, multi-faceted understanding of a complex issue in its real-life context (Crowe et al. 2011).

As mentioned in the opening of this work, to research implies circumscribing a space of inquiry, defining main objectives and, proceeding in systematic way, from data collection to analysis and interpretation. I could not apply such a linear approach in my research given the difficulty to identify ex ante adequate co-production practices to analyse and, even more significantly, the progressive re-framing of my research object according to field experience. I hence followed a constructivist approach in this research and decided to proceed in a comparative way that would examine, in a more exploratory first stage of research, a wide range of communities of practices in the two cities, narrowing progressively that space of inquiry. Gibson's ecological approach to perceptual learning and development describes how perception – extracting meaningful information from the environment to guide actions adaptively – improves with experience, the acquisition of new means of exploration, and the development of new perception–action systems.

Thus, the selection and analysis of the 6 case studies described in chapter 5, was a slow and gradual process. This way of proceeding, made from trial and errors, allowed me to constantly readjust the methodology and object of inquiry to the circumstances encountered (including all the difficulties already narrated above) along the way.

The multiple case study approach was adopted to explore multi-faceted and evolutionary nature of water communities, by addressing a wide umbrella of individual and collective practices, physically organized in a variety of technical infrastructures and devices, spatially arranged in very different built environments and co-produced by a multitude of actors.

The objective of the research is to describe the incremental nature of water communities, that is to say, the paradoxical “change in continuity”, where the persistence of certain constitutive invariants of the practices observed is combined with a permanent evolution through successive re-configuration of their boundaries. This is a central theme in this investigation, which aims to bring out, starting from empirical cases, the multiple declinations of these incremental processes, starting from the observation of interdependencies between processes of reconfiguration of the built environment and technical infrastructures, which represent the “physical” features of water communities observed. I resorted on a grounded theory, through therefore a continuous

interaction between the observation of reality and its theoretical elaboration. Having to investigate multiple dimensions (both physical and spatial as well as social), I applied the triangulation of different methodological approaches:

ⓐ empirical: since the research is based on direct experience and evidence of facts (direct monitoring of water communities and related practices through a multiple case-study approach);

ⓑ perceptive: since much of the knowledge acquired during direct experience on the field was extracted from the environment through perception and improved with experience during the theorisation phase (ecological approach);

ⓒ mixed (quantitative-qualitative-cartographic): since the monitoring phase is followed by an interpretative analysis of the data acquired (in respect of which the researcher takes an active position);

ⓓ comparative-inductive: since from the observation of the particular cases (i.e. phenomena) an attempt is made to arrive at reconceptualization of wss co-production (in scientific terms, the drafting of a "theory", which could be in the future translated into a "meta-project").

1.2.3 NAVIGATING THROUGH THE DIVERSITY OF THE POLITICAL-INSTITUTIONAL CONTEXTS OF THE CASE STUDIES

When I took part in the TYCO-WSS research in 2016, the explicit objectives of the project were to understand and evaluate WSS (water and sanitation services) co-production. Specifically, the project aimed to analyze it in the many forms it takes and to critically evaluate its effectiveness in terms of economic, social, and environmental sustainability. The case study cities had been defined a priori, based on pre-existing contacts by the promoters and other ongoing researches in the contexts.

The theoretical background of the research, as framed by the project promoters, was rooted in Joshi and Moore's conceptualization of institutionalized co-production. This concept refers to a structured partnership between the state, civil society, and the private sector, supporting more efficient service delivery in environments characterized by

weak state capacities (Joshi and Moore 2004).

Often associated with contexts where resources or capabilities are limited, WSS co-production implies the formal or informal involvement of non-state actors in the service cycle. From a normative perspective, co-production is considered to support more efficient service delivery and is often intended as a means to strengthen community capacities and enhance citizenship (Mitlin 2008)

However, after the first few months of research, it became clear that the various arrangements for accessing water and sanitation observed during fieldwork activities in Hanoi and Cochabamba did not align with the classical interpretation of institutionalized co-production endorsed by the project. Indeed, several challenges emerged.

First, the difficulties encountered related to applying the concept of institutionalized co-production to a strong state such as Vietnam, known for its relatively centralized governance and top-down approach to planning, which refuses to acknowledge gaps or shortcomings in the systems it plans and manages (urban and infrastructure systems).

Second, in many of the neighborhoods surveyed, co-production is neither claimed by residents nor sought by utilities; it does not appear to be part of a social movement seeking to change the way institutions govern. Instead, it reflects a default set of actions, based on a pragmatic use of local resources, mediated by small-scale technologies, and by unrecognized forms of individual or group responsibility.

These invisible, unrecognised forms of co-production represent a broad spectrum of socio-technical arrangements found in the infrastructural landscapes of the two cities, mainly in Hanoi.

This mismatch between theory and practice presented me with a dilemma: either to refrain from defining a number of grassroots and unrecognized service delivery practices as co-production (e.g., individual storage and wastewater on-site treatment facilities) or to use co-production as a lens, broadening the conceptualization of co-production as a "heterogeneous umbrella context", considering co-production processes to be intrinsically context-specific, while deliberately deciding to dilute the concept of its more normative essence.

In response to these challenges in operationalizing the concept of co-production, the research required a nuanced understanding of how co-production can both complement and compensate for state capacities, recognizing the added value of the engagement of non-state actors in service delivery. This is not only a response to state weakness through stop gap solutions or as a strategy to leverage additional resources and enhance public trust: coproduction can be mobilized as a lens to address they variety of responses to complex challenges in rapidly evolving urban environments performed by service users.

A premise of this thesis is that the distinct institutional and political contexts of Vietnam and Bolivia influence the implementation and outcomes of co-production initiatives, whose evolutionary dynamics are at the core of this research. Both countries have unique political histories, governance structures, and societal dynamics that shape their approach to public service delivery, including water and sanitation services.

Vietnam, a socialist republic with a one-party system governed by the Communist Party of Vietnam (CPV), has a centralized decision-making structure that influences all aspects of public administration, including service delivery. In contrast, Bolivia's multi-ethnic society, with a history of social movements and political activism, facilitated a fight against the privatization of water resources.

In recent decades, both countries have experienced political reforms impacting water service delivery, opening different kinds of spaces for co-production. Vietnam has pursued Đổi Mới (Renovation), leading to significant economic reforms and social changes, including efforts to improve public services through decentralization, community participation, and, to a larger extent, privatization and transferring responsibility to the private sector. Bolivia has undergone significant political transformations, with administrative landscapes experiencing significant changes through the implementation of decentralization and community participation laws as part of broader reforms initiated in the 1990s and 2000s. These reforms aimed to enhance local governance, empower indigenous and rural communities, and improve public service delivery, with a reemphasis on participatory democracy and community involvement in public service provision.

In the Vietnamese context, community participation in service co-production is often structured and guided by government policies and frameworks. The focus of the Vietnamese government on economic reform and modernization shapes its approach to service co-production, viewing it as a means to enhance efficiency and leverage local resources, primarily through state-led initiatives where the government encourages private sector engagement or, more limitedly, community

participation within a strictly defined framework. This includes community-based management of water and sanitation facilities, especially in rural villages, where local communities are involved in the operation and maintenance of these services under the guidance of local authorities. These community organizations are considered an extended arm of the government. The emphasis is on harnessing local knowledge and resources to complement government efforts, within a relatively top-down approach that aligns with the centralized governance structure (hierarchical approach). Bottom-up, individual grassroots practices for water supply that compensate for state failures are not recognized by the state.

Conversely, in Bolivia, the co-production of water and sanitation services is deeply influenced by the country's emphasis on participatory democracy and the rights of indigenous communities which positions co-production as a mechanism for empowering communities and ensuring their direct involvement in the management of resources and services. This has led to a more bottom-up approach to co-production, where communities often initiate and lead projects, with the government providing support and resources. Community-led water committees, associations, and cooperatives are widespread, reflecting a strong tradition of communal organization and activism rooted in the management of the commons of the Andean traditions. The approach is more decentralized and grassroots-driven compared to Vietnam, with a strong emphasis on empowering local communities and recognizing their rights to control and manage natural resources (heterarchical approach). Furthermore, co-production actors in Bolivia have the capacity to build coalitions that influence state policies.

Vietnam's centralized, one-party system stands in contrast to Bolivia's decentralized, multi-ethnic, and politically pluralistic context. This fundamental difference significantly influences how co-production is conceptualized and implemented in each country, with Vietnam adopting a more top-down approach, while Bolivia favors bottom-up, community-led initiatives.

Applying the concept of co-production and examining its materiality and application in these two contexts comparatively was a challenging task. However, it enabled a detailed examination of the specificities of each context and a critical confrontation with the concept of co-production, informed by multiple situated experiences and a discussion of related discrepancies.

Understanding these specificities and navigating the tensions and contradictions has been instrumental in appreciating the nuances of applying the concept of service co-production across different settings.

1.2.4 SELECTION OF THE CASE STUDIES

The process of case study selection took place gradually in four different stages, illustrated in the figure above which allowed for a progressive definition of the topic of investigation in parallel with the multi-scalar approach of the research: from the macro-scale at the urban region to the neighborhood scale and finally to the micro-scale, namely the housing scale.

The first area of selection involved the choice to work in different geographical contexts, Vietnam and Bolivia. This was a choice that was not made by me but had been defined a priori by my supervisors with the construction of the research project.

The two cities addressed in this research (Hanoi and Cochabamba) were chosen mainly because of the existing and long-established contacts and exchange relationships between our Belgian universities and local ones. Relationships that have contributed greatly to facilitating research activities in the field. Leaving aside the more pragmatic reasons, one should admit that these two cases, with their enormous differences in socio-economic, political, environmental and urban conditions, proved particularly interesting for investigating the object of examination: namely, the relationship of communities with waters. Bolivia, particularly with the city of Cochabamba, is globally known for its battle against privatization of water, perhaps one of the very few cases where neo-liberal drives have met such strong and successful resistance from an organized civil society that still manages water as a common good. Vietnam, with its capital Hanoi (meaning city among the waters) is a country par excellence dominated by water, a resource as abundant as it is now contaminated, which for millennia has marked the evolution of the country, of the settlements, feeding a whole series of founding imaginaries and mythologies that, precisely in water, found their ground.

The problem of case study selection in each of these cities then arose; here I decided to resort to the choice of collective or multiple

case studies approach, and so to select a number of neighbourhoods in each city. This approach offered indeed the advantage of allowing comparisons to be made across several cases and/or replication (Crowe at al. 2011). Choosing a typical case may enable the findings to be generalised to theory (i.e. analytical generalisation) or to test theory by replicating the findings in a second or even a third case (i.e. replication logic). Yin suggests two or three literal replications (i.e. predicting similar results) if the theory is straightforward and five or more if the theory is more subtle.

The cases were thus first analysed separately, then cross-sectionally to explore patterns of similarity and difference. A pool of 30 neighbourhoods have been chosen, 15 in Hanoi and 15 in Cochabamba. This approach is consistent with the concept of open sampling, in which the selection of specific interviewees or observational sites within a target group can be indiscriminate since the purpose is to collect as much data as possible to guide the early phases of theory development (Strauss and Corbin 1998). A number of criteria were established for choosing these multiple case-studies:

› because of their potential interest for the research (i.e. informants of different typologies of wss co-production) combined with opportunity reasons (i.e. past and ongoing projects or researches conducted by colleagues at local universities).

› because of the representativeness of the different manufacturing processes that shaped the urban fabric over time. In particular, accounting diverse typologies in terms of access to land (formal/informal), level of consolidation and transformation (from older to more recent construction), housing types (i.e. individual housing, collective housing such as condominiums and towers), location from central urban areas to peri-urban villages classified as rural and environmental features and risk (i.e. downstream or upstream settlement location)

› because of the representativeness of the different socio-technical processes that shape the evolution of water networks over time. In particular, observing case studies which differ in terms of connectedness to the networked infrastructures (centralised/decentralised), level of infrastructural complexity (from more rudimental to more complex technologies), resource systems (i.e. individual housing, collective housing such as condominiums and towers)

These differences provided the opportunity for both the literal and the theoretical replication process. These 30 case studies (15 in Hanoi

and 15 in Cochabamba) were explored through the delivery of questionnaires (20 in each neighbourhood) set to open and multiple-choice questions (see below description of the method).

This phase of exploration was followed by a second one in which from among the 15 case studies for each city, five cases were subsequently selected and analysed through a methodological triangulation that, through interviews -in varying numbers of both residents and representatives of community organizations and institutions- and spatial and cartographic analysis, increased the level of knowledge of the cases by supplementing with new information those collected through the questionnaires.

A final sample group of 6 was selected among the 30 case studies with three neighbourhoods in Hanoi and three in Cochabamba which were further explored.

These six case studies (three in each city) were selected from the 30 cases in which questionnaires and semi-structured interviews were carried out. The choice of neighbourhoods was made in an attempt to cover the entire metropolitan area in order to explore the relationship between the various phases of urbanization and wss co-production. In both cities, the case study neighbourhoods have been selected trying to balance the different qualities of the territories presented: the diversity that characterises them at the level of organisations, infrastructures and urban space makes it possible to highlight the multi-faceted nature of wss co-production. The material in the description of the cases was collected and analysed through a methodological triangulation: existing literature, interviews and participatory workshops have enabled to gather the following stories.

Access to the sample group of neighbourhoods was gained through personal contacts with the support of local partner universities. All the local authorities contacted expressed an initial willingness to participate in the study, beside one in Hanoi who later withdrew because of the sensitivity of the topic. This case was replaced with another one.

It should be stressed that not all observed cases contain co-production practices that totally adhere with theory (see section 2). However, the reveal how access to water and sanitation services is splintered at the city level, far from the uniformity and ubiquity pursuit by authorities and regular providers and they help highlight under what conditions and with which shape co-production emerges as a phenomenon. In the following paragraphs, I will explain how the different methods of investi-

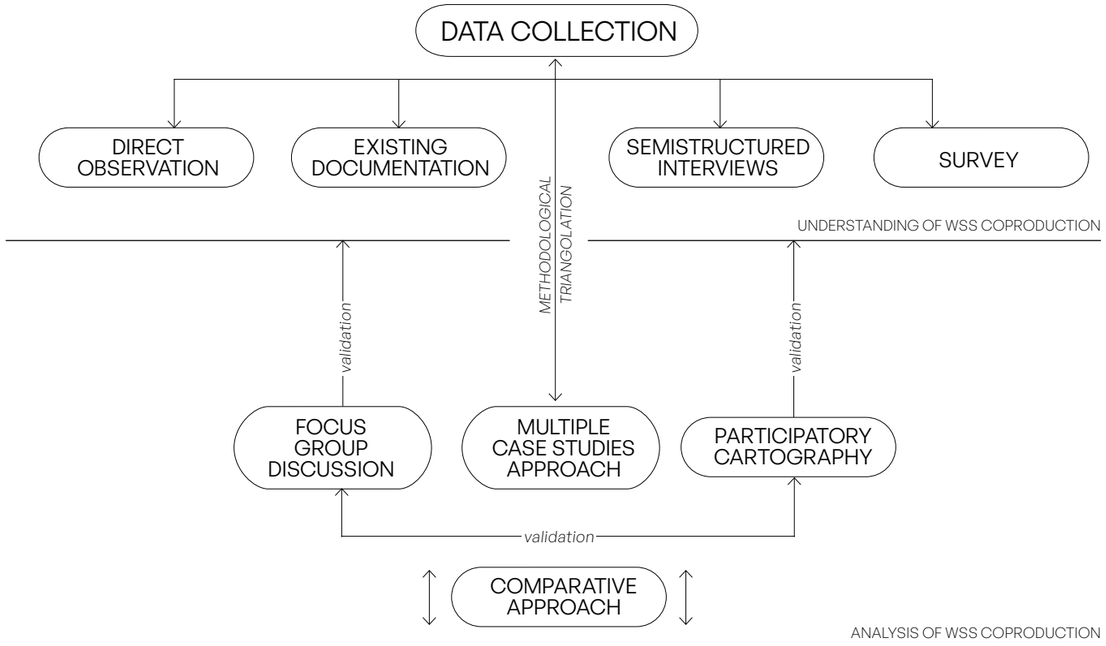


Figure 14.
Methodological triangulation for the multiple case study analysis

1.2.5 EXPLORING THE VARIETY OF PRACTICES THROUGH SURVEY ANALYSIS

The first phase of the survey involved the use of a questionnaire (see annex 1), designed to address the urban, socio-spatial, techno-environmental and economic features of the water communities addressed in this research. The scope of the survey was to better contextualize service co-production at the city level, by obtaining an overall perspective on the underlying features of the 30 different neighbourhoods selected in the two cities.

The study, whose results are described in the following chapter, is based on a statistical analysis of a total of 600 questionnaires in the two cities. 20 persons randomly selected were interviewed in each of the 15 selected study areas of the two cities. The study areas were selected in collaboration with local experts so as to identify a wide range of urban typologies, technical solutions and service provision modalities, from the most formal to the more informal ones. The survey was conducted in collaboration with local partner universities. Especially, local researchers helped me in the correct formulation of the survey questions according to their relevance to the context, and some students accompanied me in the survey administration phase by supporting the work of translation and intermediation with the respondents.

The choice of the informants was made by trying to maintain a balance of age and gender and also between landlords and tenants. At the same time, those interviewed present a uniform distribution in the selected areas, which was sought in order to identify possible discrepancies in access to services within the same neighbourhoods.

The questionnaire was structured partly with open questions and partly with single or multiple-choice questions, organized around four main topics, each targeting a different aspect and, more specifically:

❶ **Household attribution.** Questions were here formulated to acquire data on the socio-economic conditions of the households interviewed, housing type, characteristics and degree of consolidation, including transformations occurred over time to both space and technical infrastructures, presence of shared spaces. Moreover, a series of questions related to the presence and involvement in community organisa-

tions or groups dedicated to the management of water, sanitation and public space.

❷ **Water service.** In this part, information was acquired regarding the water resources used and the type of use, the treatment of these before use, the monthly cost related to water (water tariff, maintenance costs); the connectedness to centralised or decentralised networks; the presence of small-scale water infrastructure and technical devices present in the house; the perceived quality of water service, in terms of regularity, accessibility and availability of the resource.

❸ **Sanitation service.** This part acquired information related to the characteristics and management of sanitation networks and infrastructures employed, including toilet type and uses; frequency of desludging; treatment of wastewater at the household level before being discharge, the monthly cost associated with the operation of these infrastructures to their maintenance including costs, and satisfaction level of inhabitants as regard with the sanitation service, its quality and cost.

❹ **Urban and environmental transformations.** This part of the questionnaire investigated the transformative dynamics perceived over time by inhabitants in terms of built fabric, land management and environmental characteristics at the scale of their neighbourhood. The objective was to explore perceptions with respect to urbanization dynamics and environmental issues and the impact of climate change on the water practices.

The responses were encoded locally and data have then been merged and crossed between each city through the use of R software.

Through the analysis of these data (see section 4), it was possible to identify in each city a multitude of situated co-production typologies that involve a complex architecture of actors, spaces and infrastructures and different modalities of access to water and sanitation services. This clearly show how, when dealing with wss co-production, we observe a multifaceted umbrella of conditions, practices and processes which are further addressed in this research. However, one should acknowledge limitations of this survey tool. As case studies were selected with local experts as regard with their potential value for in-depth studies, the results may not be representative of all city situations. Moreover, information related to sanitation service can be subject to more biases, compared to water service. That is because in the case of water we can find some practices of co-production, may these be individual or group

co-production, in all the areas we selected, while this is not always the case for sanitation.

However, the purpose of this preliminary survey is to explore the variety of co-production practice communities and, as a result, to show the complexity of the phenomenon being discussed and then select case studies for further investigation.

The city profiles resulting from this analysis take the shape of a complex system of interaction with water networks and the variety of practices that involve citizens at the individual, group or collective level, in the provision of basic services has allowed to choose the most interesting case studies with respect to the object of the research. I then proceeded with the selection in each city of five case studies in which I conducted a more in-depth investigation of co-produced services, through a series of semi-structured interviews, collaborative mapping workshops with residents and their representatives and focus group discussions with institutional stakeholders.

1.2.6 INTERVIEWS

The interview phase would sometimes precede the survey phase, for example, when it was necessary to acquire preliminary information with respect to some potentially interesting case studies. Other times, it would follow it, in order to verify some information that emerged during the questionnaires and to further explore critical issues emerged during the fieldwork activities. A number of semi-structured, exploratory interviews were conducted in each city by engaging a number of stakeholders directly or indirectly involved in the subject inquired. Interviews were therefore addressed to both experts in the water and sanitation service delivery and urban planning sectors operating at the urban scale, and local informants belonging to public, private and community sectors, who had good knowledge of some specific issues within the study areas.

At the city level, interviews were administered to officials of institutions charged with urban and infrastructure development. A number of 10 semi-structured interviews has been reached in the two cities. These included water companies, institutions in charge of spatial planning,

both operating at the metropolitan, municipal and local levels, NGOs, international organizations, and private companies that play a key role in the management of water services in the two cities. While in Hanoi a number of 9 semi-structured interviews were addressed to institutional actors between 2018 and 2019, in Cochabamba, due to the impediments described in the prologue, the only institutional actor with whom it was possible to have an interview was an employee of the water company. The other institutional actors were interviewed through a focus group, organised virtually, in December 2020. These interviews allowed to understand the characteristics of the existing infrastructure systems both from an administrative management point of view and from a technical point of view, and to understand what role co-production plays within the existing tools of urban and infrastructure planning and in the development visions of the cities.

At the case study level, interviews were administered to community representatives and other intermediary stakeholders. Some of the informants were more directly concerned with wss co-production than others (e.g. representatives of the local communities). The interviewees were accessed through different means, with a pragmatic mix of direct contacts, step-by-step method and different relays (Blanchet and Gotman, 2015). 20 interviews have been collected at the neighbourhood scale in the two cities.

In particular, in the city of Hanoi, two kind of stakeholders were interviewed as intermediaries between the state (public sector) and the local communities: 5 representatives of the residents' group and 2 representatives of the management boards present in the newly planned neighbourhoods. In the city of Cochabamba 5 representatives of grassroots territorial organizations (OTBs) were interviewed as key players in the urban development of the neighbourhoods, as well as 4 representatives of the small- scale organisations entitled to manage basic services in their various forms of committees, water associations and cooperatives.

Interviewees were asked questions related to the urban development of the neighbourhoods and to the ways in which infrastructure networks are managed and their mediating role with upper and lower-level organizations, namely state institutions and local communities.

The interview process was semi-structured as the primary purpose of the open questions – which were not all raised if not necessary – was to facilitate the discussion. The interviews were conducted in English and Vietnamese (with translation) in Hanoi and in Spanish in Cochabamba. While in Hanoi government officials were speaking English or sometimes French, interviewees from local communities could generally speak their mother tongue. For this reason, I was always accompanied by students or interpreters during the data collection. While in Cochabamba I was allowed to record most of the interviews conducted in both city and neighbourhood, in Hanoi It did not occur, besides during the participatory mapping workshops and focus groups. For this reason, in most cases I simply listened to the conversation and transcribed the translations provided by the students in a notebook. Although I did not understand the Vietnamese language, it was quite clear that the majority of the translations were partial and often omissive, especially when the topics I was trying to confront with, appeared sensitive. It should be stated that this situation created a language bias, whose awareness was kept during the analysis of the research material, and a sceptical distance was always taken from word choices. Given the significant number of interviews and their informative purpose, the differences in accuracy of transcriptions between the two cities, not the whole content of the interviews was transcribed.

1.2.7 THINKING THROUGH WATER (OR LIVING WITH WATERS): DIRECT OBSERVATION

During these years, literally spent on the hunt for water, or following the shit flows as my friends think of me after seeing me in pictures on a moped in Hanoi overloaded of plastic bottles filled with sludge and blackwater, I have made experience of very different waters.

notes from the diary

Hanoi, November 2017

I have been in this country for three weeks and continue to suffer

from some odd insomnia. While I initially thought it was difficulty adapting to the jet-lag and the humid climate of the city, deciding to seek the advice of an acupuncture doctor, Mr. Nghia, I discovered (thanks to a series of questions he asked me at our second meeting) that the cause of my insomnia was attributable to the quantities of green tea that I was offered daily in any convivial situation I found myself and which, it seemed to my eyes very rude to refuse.
In any case, my perpetual state of theine insomnia was compounded by strange night time noises that, roughly every two-three days, would show up in my room, located on the top floor of a classic tube house in an alley in Hanoi's French Quarter. Again, it took some time to realize that what produced these insistent night sounds was the water. Indeed, once the city network was distributing water, after the filling the ground floor tank, water was pumped inside pipes that ended right on my head: on the rooftop where two water tanks were placed.

Hanoi, January 2018

Good morning, world. I open wide the curtains and windows of my apartment overlooking Truc Bach Lake and what paradoxical scene do I witness? My neighbour in flip-flops comes out of the doorway with a garbage bag and, after greeting the husband sitting on his seat on the lake's embankment, well intent on fishing, she throws it into the water. I would laugh imagining her husband cooking her delicious fish for lunch.

Hanoi, December 2018

I am only staying in Hanoi for two weeks this time to attend a seminar. I rented a room in the northern part of

Hanoi, an area that is highly popular among expats and is filling up with hotels and homestays. A cursed stay! Not only because the rooms are rented out by the hour for secret hookups, but also because the increase in density in the area has made it necessary to completely rework the water and sanitation pipes along the street. Works begin each morning with the crowing of the roost.

Hanoi, April 2019

For days a hellish stench has been exhaling from the bathroom on the ground floor of my home, which I share with a Vietnamese family. When returning home from the university one evening, I reach the busy road from which the small alley where I live departs and find the purging truck parked. The septic tank was full and Trang paid 2000 VND to empty it.

Cochabamba, November 2019

In the general chaos of a city that appears to be under siege, amid gangs with machetes and molotov cocktails made of "sopa de trigo" and rampaging motorbike riders roaming the paralyzed streets like madmen, a new collective paranoia is spreading in town: rebels have taken control of SEMAPA, occupying the Cala Cala water station in the north of the city. Apparently, water distribution is no longer guaranteed in the coming weeks. The radio advises people to fill cisterns, containers and whatever is available to prevent any shortages. I do not finish my breakfast.
I gather what is available in the house to count water (ridiculous basins and kitchen pots), fill them and take a shower. The water continues to be there the following days, but the fear remains.

Cochabamba, March 2020

Bowel pains are unbearable and nonstop terrifying fluids force me to spend hours in the bathroom and often lead me to the terrible choice between sitting to evacuate on one side or bending over, to evacuate on the other. I later discover that I have typhoid. But how will I have caught it. From ice cubs in the tea? From the vegetables? From what evil waters?

The ethnographic approach was at the core of the research, the lens that better allowed me to explore the complexity and variety of the water practices addressed. These little stories that I have decided to share, not merely to break the reading with some tragicomic episode of everyday life, but rather to introduce a more personal and experiential approach to the subject that has to some extent guided the methodological choices adopted for the research, recall various meanings, imaginaries, and experiences of water. In different forms and qualities, that of water is perhaps the most vital (as well as invisible) experience that shapes our lives: pure and vital waters, domesticated waters, fetid and diseased waters, waters that are frightening in the idea of their sudden absence or when they evade all forms of control. In the desire to enter the relationship with these different types of waters shaping not only the physical but also cultural and emotional landscapes of the communities I was observing (Illich, 1988), I made enriching encounters during my research journey. A journey in which I alternated between moments in which people led me to water and moments in which it was water leading me to people.

Direct observation and experience in close contact with people thus played an important role in knowing and understanding the phenomena observed. I spent time in the neighbourhoods under study, sitting in street cafes, entering houses, chatting with those I met during my field visits. The assiduous attendance of some of the inhabitants in the communities under study allowed me to establish a series of relationships with the social tissue and to acquire the trust and esteem thanks to which the inhabitants opened up to my presence and to the storytelling. By crossing the threshold between public and private space, visiting their

homes, having tea or lunch with them and using their bathroom, I was able to photograph and document, often through sketches in a notebook, the technical infrastructure, the devices used to access water and their distribution within the domestic space. I followed the inhabitants in their daily practices, observed them moving around the domestic space and performing a variety of water-related activities: repairing pipes, replacing filters, cleaning septic tanks, clearing drainage when clogged. Most of these practices were noted down in a notebook, in the form of diagrams, sketches. Sometimes drawings were made by people themselves. Entering homes and photographing their living environments has allowed me to map and understand all those invisible flows that are hidden behind the facades of homes and would not be observable otherwise. Direct observation was the activity that best allowed to identify the multitude of water practices that take place at an individual level, very often at a family level, in the domestic environment and to bring to surface that endless process of maintenance and repair of networks described by Graham and Thrift (2007). These invisible flows that sustain urban life, are articulated thanks to a multitude of infrastructural fragments and technical devices that require constant intervention, maintenance and upgrades that hardly emerge in the scientific literature that deals with the analysis of these phenomena and above all, are generally disregarded in the observation of wss co-production. Moreover, these observation activities have to some extent helped to show how different communities conceptualize, sustain, use, control, and attribute meaning to water.

1.2.8 CARTOGRAPHIC ANALYSIS

One of the central aspects of this research is the relationship between the co-evolution of water infrastructures and urban space over time and the way it affects co-production in the city and the neighbourhoods under investigation. Not only is the cartographic tool relevant for surfacing and tracing these dynamics, but as a method of interpreting reality it also offers important insights into the cultural aspects of a community and how these shape territories.

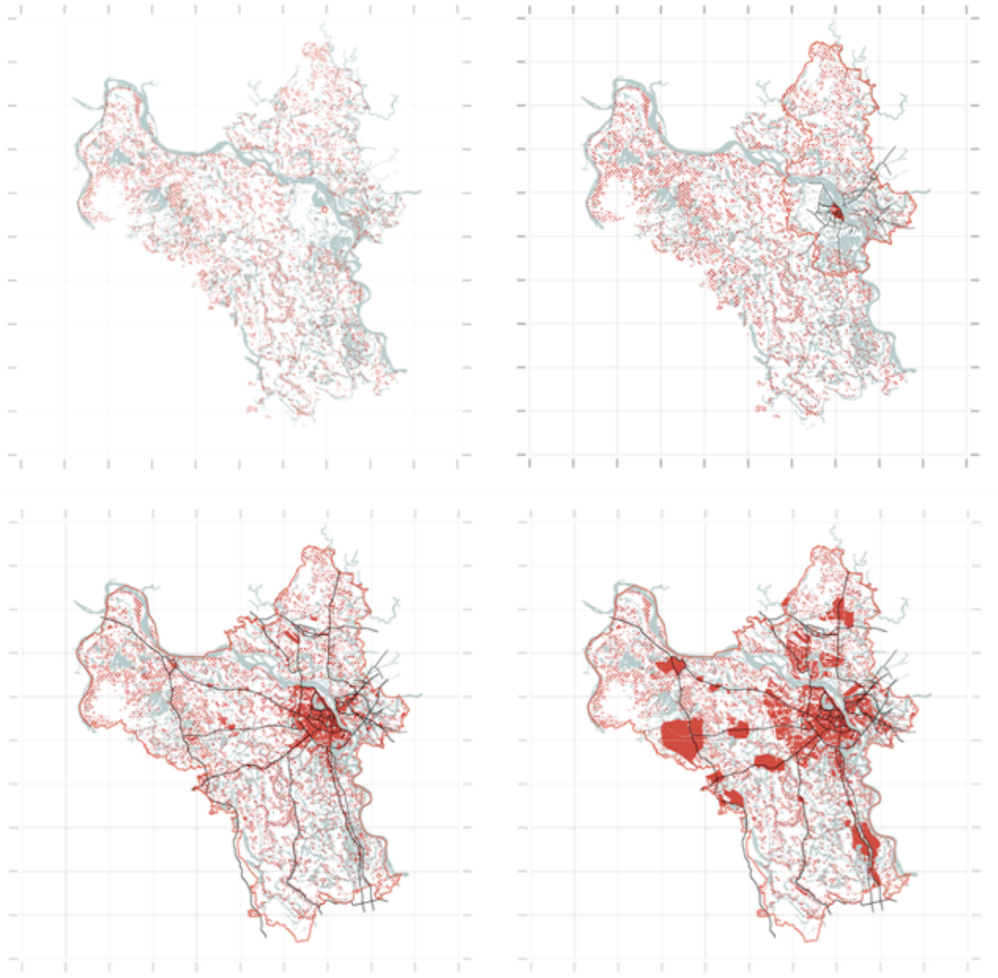
15.
Map of Hanoi (1876-1883)

For example, in the case of Hanoi, a city of which there is more substantial historical documentation than Cochabamba, the cartography I could source was particularly relevant for understanding how the city developed over time in relation to water. Water had a twofold significance: it was the element that allowed connectedness and transportation, thus fundamental for the country economy; at the same time, it played a defensive and separating role. The first ring of Hanoi was in fact defined by the presence of the Red River, minor waterways and lakes that protected the earliest human settlements and the citadel, the imperial core of the city. Its significance was also sacred, which is why -as can be read from the map below- all the main public and religious buildings such as the pagoda and temple stood along waterways or in the middle of water basins.

As for urban spatial information representative of the city's situation today, I asked the planning departments if they could provide me with city plans and the main planning instruments (the Masterplan in Hanoi's case).

The maps visible in the previous page represent some phases of Hanoi's development, which was redrawn based on a given cartography of the city that are showed major roads and waterways. the The first two maps (from the left) represent the city development in the 19th century, made from scattered villages and the earliest colonial expansion during the French domination. These were built superimposing the historical maps on top of the existing ones and redrawing by hand in the mode of red backgrounds the historical villages. The third map from the left shows the current state of the city and urban agglomeration while the one on the right depicts the future development as envisioned by the Master Plan to 2050. The two maps on the right, however imprecise, were essential in order to carefully select the 30 case studies under analysis: in fact, the choice sought a balance between those neighbourhoods that are more "urban" and those that are "rural" which as envisioned by the plan, are progressively integrated to the urban agglomeration in parallel with the extension of the centralized network.

In the case of infrastructure networks the existing cartography was generally provided by the water companies, even though, in the case of Hanoi, given the sensitivity of the subject, I could only have at my disposal the main water pipes and the main sewage networks, the treatment plants and the location of the resources used. In the Bolivian city, I was provided with a map of the entire centralized network. Thanks to the use



16.
Hanoi study on the evolution of the urban agglomeration (red) over time in relation to water (blue)

of Google Earth and the satellite images, I was able to observe the evolution of the city over time both on the urban and neighbourhood scale. This allowed me to verify the qualitative information that emerged from the questionnaires and interviews and to spatialize it through the GIS software. From satellite images, it was possible to see the ways in which urbanization processes have progressively modified the pre-existing rural agricultural fabric, the densification of the built environment, the demolition and reconstruction of settlements or portions of them, the evolution of surface water networks and irrigation canals, and to compare them with current cartography. At the neighbourhood level, cartography was generally not available. It was therefore produced through workshops that involved communities in mapping their own networks and built space.

1.2.9 PARTICIPATORY MAPPING WORKSHOPS

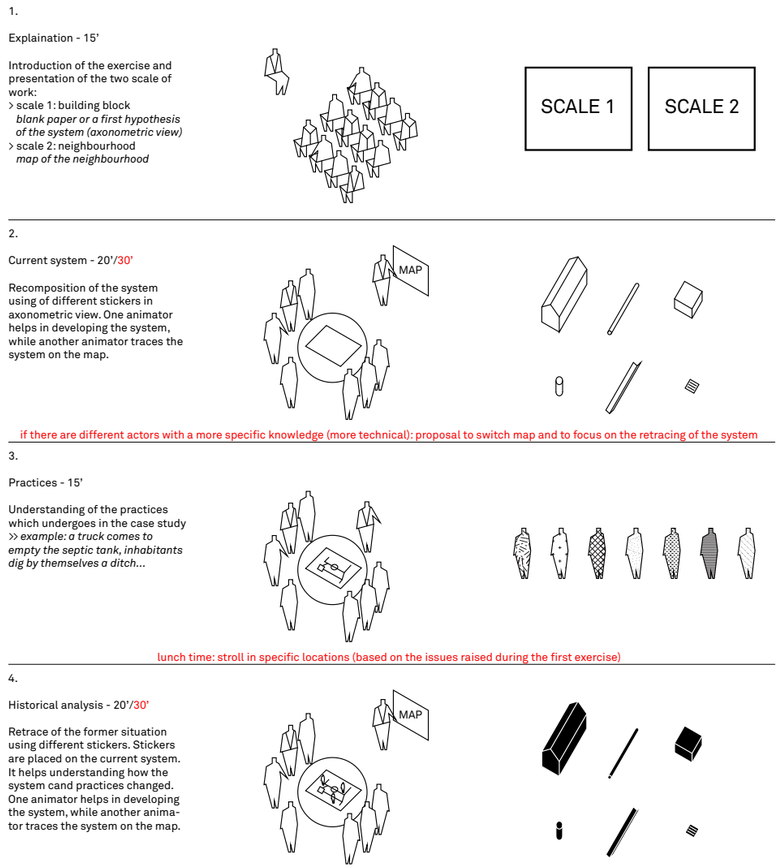
From the fifteen case studies initially selected in each city, three cases were appointed for further in-depth investigation through participatory mapping, technique implying an increased interaction with the inhabitants and a team of facilitators tasked with leading participants through the mapping activities. The first workshop in Hanoi was held from the 20thth to the 24th of June 2019, while the one in Cochabamba was held on the 28th and 29th of January 2020.

With the support of the researchers of Latitude Platform, a Brussels-based organization experienced in co-design and participatory approaches applied to urban development, inhabitants of the six local communities selected in the two cities have been involved in a series of participatory activities oriented to an in-depth exploration of certain issues related to the research.

The researchers helped us constructing a common and efficient methodology of inquiry and facilitating the mapping activities during the workshops.

A one-day workshop (approx. lasting from 8.30 a.m. to 6.30 p.m.) was organised in each of the case study around the following activities. An initial resident-led walk through the neighbourhoods in the modality of a walkscape (Careri, 2006), allowed for direct observation and preli-

minary understanding of the existing water and building systems and settlements. This was followed by participatory mapping activities, organized in three phases: a first phase of infrastructure mapping, a second phase of in-depth study of socio-technical practices related to infrastructure production and management, and a third retrospective phase meant at de-constructing and re-constructing the cartographic material by going back in time. The activities were concluded by inquiring the perception of the forms of co-production that emerged, their past evolution and future development, considering the environmental and urban transformations affecting neighbourhoods.



17.
Roadmap of the methodology employed. Courtesy of LatitudePlatform.Eu

Two large maps, 2m by 2m wide, were constructed around which participants, both residents and community leaders and representatives of local institutions were made to sit and interact. The first map to be discussed was that of the entire neighbourhood analysed.

In particular, participants were asked to indicate on the map the location of their homes, to identify the urban elements central to the development of the neighbourhood and to indicate the technical portfolio, namely technical devices key to the provision of water and sanitation services (e.g. the presence of collective tanks, pumping stations, treatment plants ...) Through this incremental work of drawing, it was possible to trace the water, drainage and sewage networks indicating the origin and direction of flows and the technical portfolio found in the neighbourhood.

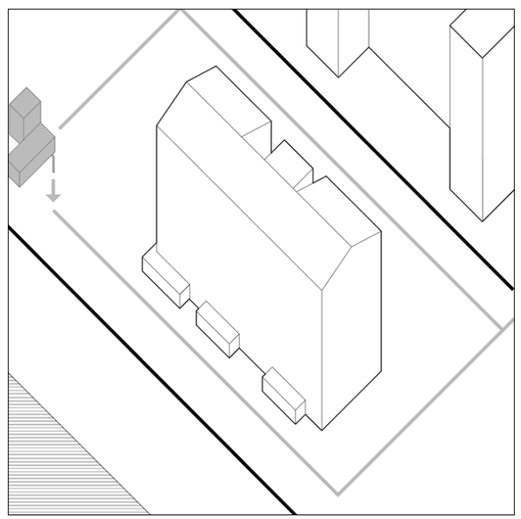
On the same map it was also asked to reconstruct, through the drawing, the phases of neighbourhood development, identifying the

18.
Map of the neighbourhood

first urbanized nucleus and the subsequent ones and indicating how, in parallel with the development of the building fabric, the infrastructure did changed over time adapting to it. The second map instead, at a more detailed scale, allowed the understanding of the relationship between the house units and the water networks and to enter the more domestic dimension of the infrastructure.

This map, an axonometric representation of a portion of the district, contained only a few buildings and the main hydraulic infrastructures in their current state as understood through the questionnaire responses and research activities carried out in preparation for the workshop.

This phase of mapping was an exercise in bringing to light the invisible, that is bringing out practices related to the management of physical space and water-sanitation infrastructures at both the neighbourhood and household scales in an intuitive and dynamic fashion. Through the superimposition of a series of stickers, the network has been built starting from the infrastructures located in the public space and the road system, up to those inside the houses as in the toilet and kitchen. The construction of this cartography took place through a continuous and circular process: our hypotheses, built from the information previously obtained, were constantly submitted to the verification of the inhabitants. Through several cycles of construction and deconstruction of the



19.
Map of the buildings provided as background for the mapping activity

maps, we arrived at the production of a cartography that not only contains technical information related to the analysed infrastructure, but that is also the repository of a series of qualitative information, for example related to the mechanisms of management of these.

This method was that better suited the research proposal of inquiring into the incremental nature of co-production. Through the mapping activities it was possible to trace that paradoxical "change in continuity" and to surface the multiple declinations of these incremental processes, starting from the observation of interdependencies between processes of reconfiguration of the built environment and technical infrastructures embedded in water and sanitations service co-production.

Moreover, the mapped spatialised data collected during the workshop represented a particularly significant contribution to a better understanding of:

› spatial and infrastructural values, perceived strengths and weakness of existing water and sanitation infrastructure systems and service provision, in addition to perceived problems and qualities of existing resource systems, collaborative or conflicting situations among the community related to water practices.

› everyday practices, infrastructure maintenance patterns and water-related habits related to their temporal characters thus to seasonality and climate factors.

› the multi-scalar evolution of the neighbourhood over time from changes at the city level affecting the case study areas to those happening in situ, in terms of built environment, infrastructures and governance systems

› spatially defined visions, desires and fears related to the current and future development of the city and water infrastructures.

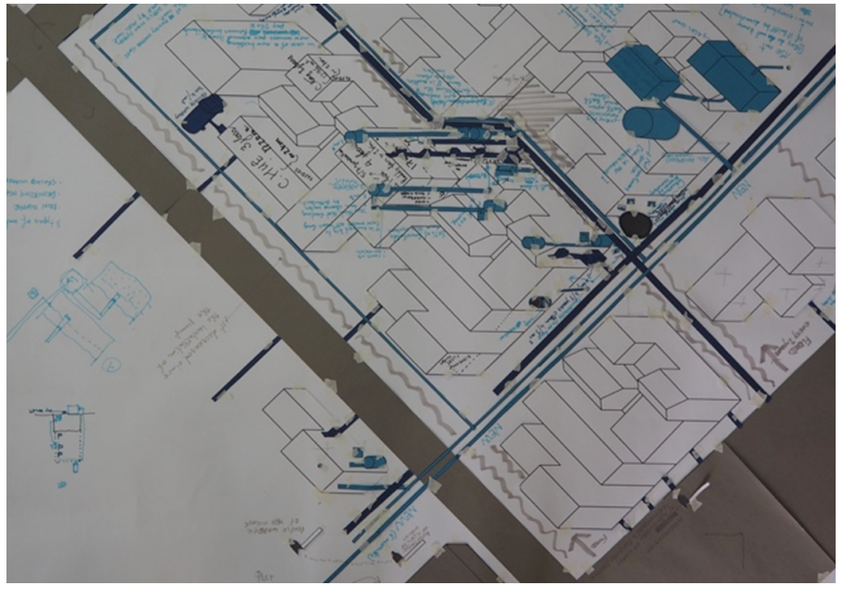
› to bring out conflicts and divergences as well as shared values with respect to the management of a resource.

Integrated with the other classical methodologies (quantitative and qualitative analysis) participatory mapping proved useful for a deeper social and spatial investigation and validation of the hypotheses and data found in the previous phases of investigation. Indeed, the construction of the map through this continuous process of feedback through drawing, has also managed to bring out the problems of existing infrastructures and practices, and a series of conflicts that had not

emerged in the previous phases of investigation. However, one must recognize the possible biases of this methodology. The choice of the attendants was made by the representatives of local organizations. The presence of the community representatives also caused the orientation of the dialogue by preventing the emergence of conflicts and disagreements between the community and its representatives that, on the contrary, often emerged in the individual interviews.

20. 21.
Pictures taken during the participatory mapping workshops in Hanoi, May 2019

22. 23.
Pictures taken during the participatory mapping workshops in Dar Es Salaam, June 2019



24. 25.
Outputs of the collaborative mapping workshop

1.2.10 FOCUS GROUP DISCUSSION

Finally, a workshop was organized in each of the two cities with institutional stakeholders in charge of infrastructure and urban development, both public and private, universities and experts, in order to validate the preliminary results of the research. Beside validation, the purpose of this workshop was to better frame the role the wss co-production in the current planning tools and to build up scenarios for the future development of the cities. In addition, participants were asked to comment on the results of the research carried out during the participatory mapping workshops, and to discuss the representativeness of the selected areas with respect to the entire metropolitan territory.

The integrated use of this entire series of tools described thus far, has allowed for the construction of the way to incrementally and from multiple points of view, an understanding of the various practices of co-production which are described in the following chapter.

26.
Surveys. Households in Hanoi village

27.
Surveys. Households in Hanoi condominium KTTs

28.
Interviews. A woman in Serena Calicanto

29.
Interviews. A woman in Ta Than Oai district.

30.
Direct observation. Drainage and water pipe renovation in Hanoi central areas.

31.
Direct observation. Farmers making their laundry on the irrigation canals.

1.3 Publications

Parallel to the research activities, several scientific publications have been co-produced over the years, which have partially fed into this manuscript, helping to structure reflections and produce advances in the definition of the research over time. It is important to point out that the various articles collected and subsequently reported have not been integrally included in this text. They have rather contributed to the construction of a base of composite theoretical and empirical material, which has been broken down and recomposed into the various chapters following the publication of the articles and during the writing of the thesis.

In particular, the analysis/discussion part contained in article 1 (Challenges of wss coproduction in the Global South) provided some elements for reflection and analysis that were integrated into chapters 7-8-9 of the thesis. These include the issue of Urban Fragmentation (one of the elements that is considered to describe the processual nature of wss coproduction and its impacts over territories at different scales); the issue of Citizenship, reconceptualised in chapter 8 and analysed by focusing on the issue of power in wss coproduction; and the centrality of technology in coproduction, which is mobilised in the light of the concept of conviviality in the concluding chapter.

Article 2 (A Comprehensive Framework for analysing co-production of water and sanitation services in the Global South) fed into the theoretical framework of wss co-production that defines Chapter 2 and at the same time fulfils the theoretical and methodological guiding function of the research project's broader work. Presented here is the general framework of investigation, AFA, which allows for the articulation of wss co-production into three main dimensions and sub-variables to guide the fieldwork. Articles 3 (The impact of decentralized water and sanitation services on the urban production) and 5 (An Incremental approach to coproduction) present case studies in the cities of Cochabamba and Hanoi and provide empirical material as a starting point for theoretical reflection on incrementalism which is then taken up in Chapter 4, (Hanoi-Cochabamba), Chapter 5 (Tales of coproduction), and Chapter 6 (Practices).

Article 4 on the sustainability of coproduction is partly integrated into Chapter 2 on the theoretical subject of coproduction and partly feeds into the concluding discussion: however, the concept of sustainability is sidelined in comparison to the question of adaptation, which seems to be the foundation of the entire research. The last article produced (Coproduced water services: when technical and governance hybridization go hand in hand) is instead partly fed into the earlier version of the manuscript.

Moretto, L., Faldi, G., Ranzato, M., Rosati, F.N., Ilito Boozi, P., Teller, J., 2018. **Challenges of water and sanitation service co-production in the global South. Environment & Urbanization** 30, 425-443.

Faldi, G., Rosati, F.N., Moretto, L., Teller, J., 2019. **A comprehensive framework for analyzing co-production of urban water and sanitation services in the Global South.** Water International 44(8)

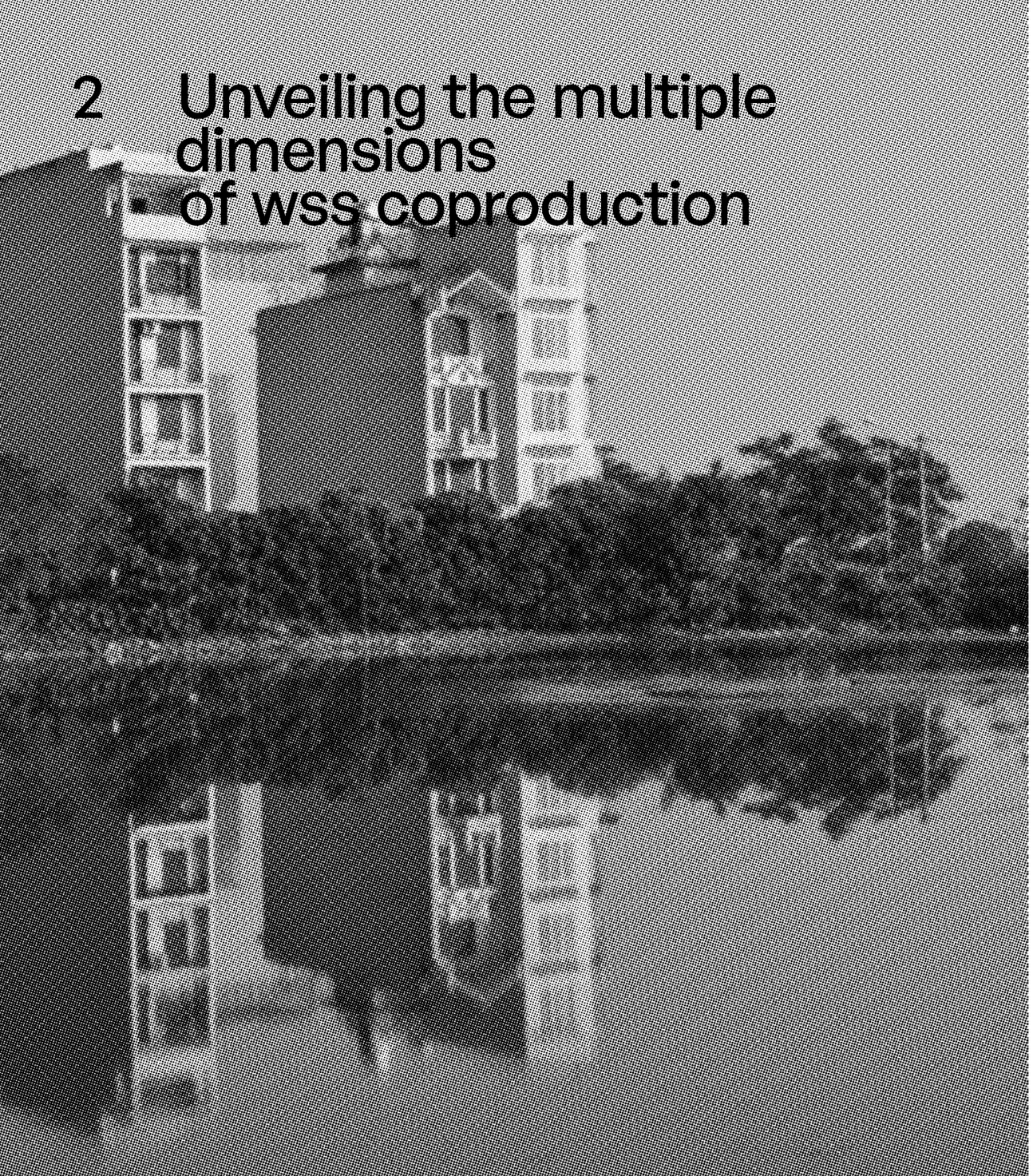
Rosati, F.N., Cabrera J. E., 2019. **The impact of decentralized water and sanitation services on the urban production. The case of the peri-urban municipality of Quillacollo (Cochabamba).** Geo-Eco-Trop 43(3), 421-427

Faldi, G., Rosati, F.N., Moretto, L., Teller, J., 2019. **A Multi-perspective Discourse on the Sustainability of Water and Sanitation Service Co-production in Global South Cities.** In book: Handbook of Quality of Life and Sustainability (pp.53-80). Springer International Handbooks of Quality-of-Life

Rosati, F.N., Moretto, L.,Teller, J., 2020. **An incremental approach to co-production: reading transformations of urban systems and water and sanitation infrastructures.** International Journal of Urban Sustainable Development

Moretto, L., Faldi, G., Rosati, F.N., Teller, J., 2023. **Coproduced urban water services: When technical and governance hybridisation go hand in hand.** Front. Sustainable Cities, 18 January 2023, Sec. Innovation and Governance Volume 4 - 2022

2 Unveiling the multiple dimensions of wss coproduction



2.1. WSS co-production state of the art

2.1.1 DEFINITIONS

Developed in the early ‘70s by Elinor Ostrom and her colleagues at the Indiana University Workshop in Political Theory and Policy Analysis, co-production has entered the debate on service provision as an alternative to the dominant models of urban governance in force at the time, that conceived policy making as a top-down process (Bovaird, 2007). The rise of the concept which occurred in a period in which the US were experiencing fiscal cutbacks and had to reorganize service delivery arrangements, contributed to challenge the Hamletian doubt between the market and the state, by suggesting a third way, namely, that citizens could play an active role in producing public goods and services (Ostrom, 1996). During the 80’s and 90’s the rise of the New Public Management reinforced the inquiry into co-production in both academic theory and professional practice (Osborne and Strokosch, 2013). Normann (1984, in Bovaird, 2007) once highlighted the fact that often professional operators were not able to deliver services effectively, without consumers contribution in performing tasks (e.g. learning processes in schools depending on student’s attitude) and that they would have acquired a more “enabling” rather than “relieving” role in service delivery (Bovaird, 2007).

In the 21th century co-production theories gained attention. On one hand, the recognition of the multi-sectoral nature of governance (expressed by the “new governance”) has emphasized more pluralistic models of service delivery, based on horizontal relationship and collaborative logics (Nabatchi et al. 2016); on the other hand, the global financial crisis has led to the spread of needs driven platforms which make use of the principles of “user engagement” in order to cut state expenditures. Co-production has therefore entered the public administration debate in the Global North, capturing the attention of a wide range of actors, from the policy sector to academia and practice in both non-profit and private sector.

As a 'heterogeneous umbrella concept' (Nabatchi et al. 2017, p. 769), co-production is associated to number of definitions within the public governance and management literature. Ostrom (1996) defined co-production as "the process through which inputs used to provide a good or service are contributed by individuals who are not 'in' the same organization"(p. 1073). Since its earliest conceptualization definitions of co-production have multiplied and over time more emphasis has been placed on users' participation in the service delivery process. Broadly, co-production is defined as the joint production of urban services by users and public providers, where the former become active asset-holders (Brudney and England 1983, Mitlin 2008, Nabatchi et al. 2017). In general, the 'co' side of co-production refers to a number of involved stakeholders: actors who are agents or representatives of the state, generally defined as 'regular producers or providers' who deliver services with 'professional capacity'; and members of the civil society, or non-state actors, who contribute in their capacities as citizens, consumers or clients (Nabatchi et al. 2017, p. 769). They are also called the 'co- producers'.

When addressing a number of experiences in the Global South, Joshi and Moore (2004) observed a number of organisational arrangements, defined unorthodox, which they could not simply classify as "relics of 'traditional' institutions, or as incomplete modern organisations". They thus defined institutionalized co-production as "the provision of public services through a regular long-term relationship between state agencies and organized groups of citizens, where both make substantial resource contributions" (Joshi and Moore 2004, p. 40). According to this interpretation, co-production cannot be understood independently from the role of state agencies.

Similarly, Bovaird (2007, p. 847) considers co-production as "the provision of services through regular, long-term relationships between professionalized service providers (in any sector) and service users or other members of the community, where all parties make substantial resource contributions". This definition includes and recognizes the role of other kind of 'intermediaries' other than state actors such as volunteers, community groups and NGOs, and private stakeholders, who frequently assume relevant roles in services provision for low- income households (Bovaird 2007). This variety of actor engagement in service delivery is extensively found in the Global South.

Research on service co-production, tends to disaggregate the service cycle in order to highlight the different stages of the service delivery in which state and non-state actors are involved and their respective roles. Co-production can therefore be applied to all or some phases of the service cycle allowing a distinction of co-production typologies according to the phase of the project in which it occurs (Moretto and Ranzato 2017). 'Co-planning' generally involves the identification of strategies and set-up of the objectives of service delivery that can include participatory budgeting, co-funding and direct involvement of citizens in the decision-making process (Bovaird 2007, Nabatchi et al. 2017). 'Co-design' refers to joint activities between users and providers related to the structuring of the services (Bovaird and Loeffler 2012, Nabatchi et al. 2017). 'Co-delivery' and 'co-management' concern the common provision and maintenance of the service and its infrastructure (Nabatchi et al. 2017). Finally, 'co-assessment' refers to joint activities related to monitoring and assessment of the performance and potential improvement of the service (Bovaird and Loeffler 2012, Nabatchi et al. 2017).

Most studies on service co-production have been carried out within the public governance and management domains. Although Ostrom's seminal work on co-production moved from cases in the South, the majority of the following studies have referred to cases of co-production in the North or have explored generalized aspects of co-production without specifically considering the differences between South and North (Cepiku and Giordano, 2014). To date, research has mainly addressed services such as health, education and security, with a primary focus on management (Osborne and Strokosch 2013, Pestoff et al. 2012) and facilitation of co-production initiatives through public governance and systems (Bovaird 2007, Bovaird and Loeffler 2012, Verschuere, Brandsen and Pestoff 2012).

In spite of a still blurred definition and controversies over its benefits, co-production is generally mobilized as a policy tool for integration into public services delivery schemes to improve service quality while promoting more horizontal governance forms (Joshi and Moore 2004, Mitlin 2008, Ostrom 1996). Although the concept of co-production is now increasingly mobilised in other areas of research, it still tends to be mostly applied to the economic and public policy spheres and in the delivery of non-networked services, while remaining under-explored in the spatial sphere, urban and infrastructural studies, and in the delivery of networked services.

2.1.2 THE SPATIAL AND TECHNICAL DIMENSION OF WSS CO-PRODUCTION

So far, researches on co-production addressing both management, spatial and environmental dimensions of conventional service coproduction are very limited. On the one hand, theoretical conceptualisation of coproduction has mainly concentrated on social and non-networked services, making environmental and spatial considerations not pertinent (Moretto et al. 2017). On the other, the lack of a clear and unambiguous definition of "coproduction" has led scholars and practitioners to apply the term to a wide and undefined range of areas and activities, which makes difficult to distinguish what does and does not constitute coproduction (Nabatchi et al. 2017). As a result, co-production is often addressed in literature on conventionally networked urban services (water and sanitation) in a latent manner and through a series of concurrent conceptualisations. A fragmented landscape of diverging definitions is generally associated to co-production practices. Community-based networks, (Madrigal 2011); splintered and decentralised sanitation networks (Van Vliet 2006); local government institutions (Anderies 2014); low-cost urban water and sanitation suppy (Mara and Alabaster 2008); hybrid service delivery configurations (Jaglin 2016) are just some of the terms that are mobilized in specialized literature on water and sanitation service provision, when referring to state-community synergistic relationships, that may fall under the concept of co-production.

From a techno-environmental perspective, in Global South cities, water supply co-production generally refers to socio-technical arrangements either decentralized (e.g., community urban well, rainwater harvesting system) or hybrid (e.g. unofficial network extensions of centralized piped water systems). Co-production is also found to bridge the gap left by the deficiencies of the centralized system, therefore implying the integration of municipal water supply with alternative water sources and/or the use of complementary technologies (Allen et al. 2017, Bakker 2003, Domenech 2011, Moretto et al. 2018). When referred to sanitation, it mainly involves on-site facilities (e.g., shared pit latrine and septic tank, biogas production system) or simplified sewerage systems connected to decentralized wastewater treatment plants (Allen 2010, Domenech 2011, Moretto et al. 2018).

Research on alternative water and sanitation services (wss) in the Global South cities has also been undertaken within urban studies. That

research mainly focuses on the relations between informal and formal systems of provision, considering co-production as one of the available options for involving a range of different actors in service delivery (Allen 2013, Katsongo 2012) and for securing citizens' political influence (McMillan et al. 2014, Mitlin 2008).

The multifaceted nature of wss co-production is even more significant when observed from a physical and spatial point of view. As supply forms sustain urban life and water infrastructures are embedded in the built environment, service co-production is also suitable for being addressed in the fields of architecture and urban planning, traditionally dedicated to the representation and analysis of the built environment (Faldi et al. 2019, Moretto et al. 2018). In this perspective, co-evolutionary dynamics between socio-spatial urban patterns and co-production arrangements may indeed emerge (Moretto et al. 2018, Rosati et al. 2020).

The majority of studies addressing water co-production are developed on a single-case basis and they mainly emphasize on the outcome aspects of the co-production model. Research focused on the transformation processes of co-production practices over time remains marginal, if not absent. The way co-production is influenced by and influences the reconfiguration of the built environment and how it evolves over time, in terms of space, technology and involved social structures, has not yet received extensive exploration. **In this research, service co—production is understood as an incremental process in which hybrid configurations of service provision, involving state actors, service users and a wide range of intermediaries, are interacting in an evolving socio-political, technical and territorial context** (Ahlers et al. 2014, Faldi et al. 2019, Rosati et al. 2020, Rateau and Jaglin 2022).

The analysis of these different literatures which, from different points of view, report on co-production has made it possible to identify a series of primary and secondary variables which represent the backbone of the conceptual framework that has allowed the definition of the survey methodologies.

2.1.3 OUTCOMES

Existing research on wss co-production can be divided in two complementary approaches. The first addresses the management and institutional dimension, and the second addresses the techno-environmental dimension. From a management and institutional perspective, it has been argued that the participatory nature of co-production of basic services, including water and sanitation, contributes to the development of skills and capacities and thereby empowers citizens (Allen 2013, Mitlin 2008). Many are the benefits associated to service co-production. For some authors co-production allows greater accountability, higher productivity and reduced costs of services, while minimizing all forms of opportunistic behavior and corruption (Ostrom 1996). On a social perspective, its participative nature contributes in building skills and capacities, which ultimately trigger citizen empowerment (Ostrom 1996, Mitlin 2008). By involving groups of citizens in civic action, it also enables a creative process similar to building social capital and encourages citizens to develop other horizontal relationships (Putnam 1993, Mitlin 2008). Moreover, by reducing the distance between development experts and communities, co-production contributes to challenge the existing state-society relationships and to raise the political capacity of the poor to claim their rights within appointed institution. It therefore enables individual members and their associations to secure effective relations with state institutions that address both immediate basic needs and enable them to negotiate for greater benefits (Mitlin 2008). As an example, Moretto (2010) shows how beyond the concrete outcome of improved water services, co-production of wss services allows residents of informal areas to claim and legitimize their presence on occupied land.

In this perspective, co-production is understood as a “means” to empower communities through the recognition of their grass-roots organisations, often taking on the role of intermediaries, and related decision-making processes. In the contexts of the global South, co-production often implies the institutionalisation of self-help practices and in the literature, this tends to be associated with collaborative actions occurring, by necessity, in the framework of weak states (Joshi and Moore, 2004). However, while co-production has the capacity to incorporate informal practices and state-community relationships in the process of services provision, it cannot be taken for granted that this model is capable to overcome state and market failures. It may also be subject to

resource capture by elites and to management conflicts among groups, resulting in discrimination and exclusion of certain groups from access to services (Ahlers et al. 2014, McMillan et al. 2014).

Studies on urban WSS in the Global South (De and Nag 2016, Domenech 2011, McGranahan, 2013, Opryszko et al. 2009) mostly associate benefits of service decentralization within its capacity to ensure users’ adaptability to contextual water stress problems and to reduce capital and distribution costs of the infrastructure. Shortcomings are found in relation to the challenges of guaranteeing a sustainable management of the system, maintaining service equity and efficiency, and ensuring water and environmental standards. Shortcomings are also found with regard to the ability to create forms of socio-spatial cohesion and promote spatial justice. Indeed, co-production can reinforce urban fragmentation (Cabrera 2015) when diversification of socio-technical infrastructures in the city fosters creation of urban service zones that are socially and spatially unconnected between each other (Moretto et al. 2018). Moreover, observed from an environmental point of view, co-production can lead to environmental decay and overexploitation of natural resources (Randazato and Moretto 2018), especially since localized socio-technical infrastructures generally fail to consider the circularity of the water service cycle (Moretto et al. 2018, Faldi et al. 2020). In other terms, while multiple benefits are associated to the co-production model, this thesis acknowledges that co-production does not necessarily guarantee sustainability in urban WSS service provision. It may indeed raise social, environmental and spatial issues, which challenge visions of co-production as a “panacea” and which have to be carefully evaluated. However, as mentioned above, it is not the outcomes but rather the “rationality” of the social, technical and spatial processes that characterise the multiple co-production practices observed in the cities of Cochabamba and Hanoi that are the subject of this research work.

2.1.4 AN INTRODUCTION TO THE AFA FRAMEWORK

The construction of a conceptual framework (Actor-Flows-Areas) represented a preliminary step that supported the definition of the research methodology for data collection and analysis of the different

co-production practices observed during the fieldwork activities. Indeed, the framework provided a reference for the identification of the main variables explored through field survey methodology (data, tools and techniques) and for the treatment of qualitative data (grounded theory). The framework did not aim to be a comprehensive, but rather an interactive tool of inquiry: a flexible and temporary reference that I used as starting point to systematise a collection of data which may be improved and deconstructed by other scholars in the field of wss coproduction studies.

The framework was built in two steps. In a first phase, the review of existing literature on public service co-production allowed to identify the main variables within the social/institutional context. At the same time, existing theoretical frameworks that tried to conceptualise the physical side of coproduction of water and sanitation services were addressed, in order to identify the main dimensions and variables within the environmental/infrastructure and urban/spatial contexts.

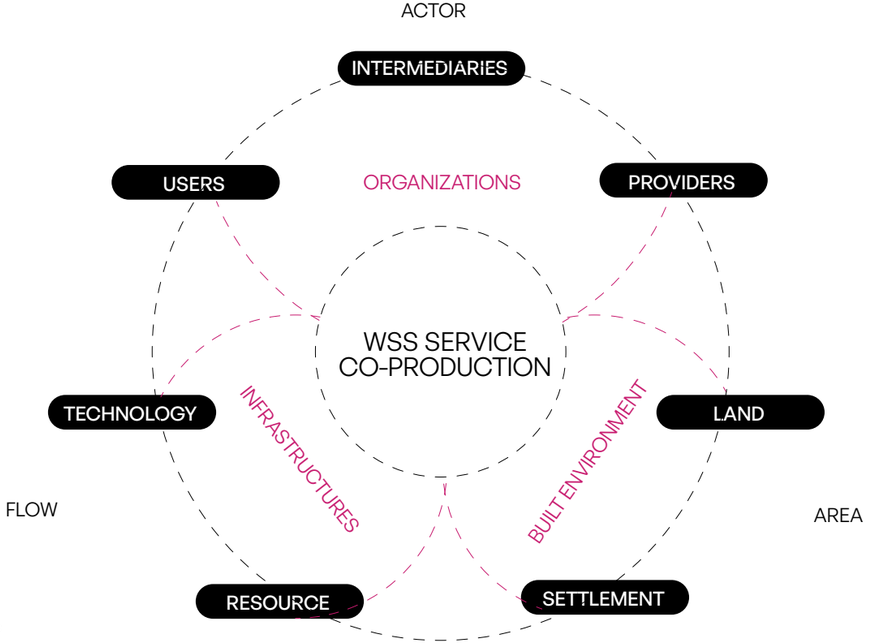


Figure 32.
The Actor-Flow-Area framework main dimensions and variables

2.2 The actor dimension of wss co-production

2.2.1 CHARACTERISTICS OF PROVIDERS AND INTERMEDIARIES

As highlighted in many studies, service provision in the Global South includes a variety of intermediary actors mobilized in different phases of the service cycle (Allen et al. 2006a, 2006b, 2017, Cabrera 2015, Verschuere et al. 2012, Moretto and Ranzato 2017). They vary in terms of the body in charge and the type of collaboration with state actors.

Intermediaries might involve community organizations, as for resident groups or local associations (e.g., water user associations, water committees, cooperatives) that generally play a relevant role in constructing, managing, upgrading and repairing water, sanitation and drainage infrastructures (Cabrera 2015, Joshi and Moore 2004, Moretto et al. 2018). These informal or semi-formal organizations generally become institutionalized service providers, namely entitled actors responsible for neighbourhood water and sanitation services provision (Allen et al. 2017, Cabrera 2015). Semi-professional civil society organizations, such as third sector or for-profit organizations working with communities can also be involved as ‘mediators’ in the service cycle (Verschuere et al 2012, Moretto and Ranzato 2017). Intermediaries might also involve diverse actors or organizations belonging to the private sector, as for informal local vendors, large formal companies or medium- sized municipal water firms (Allen et al. 2006b).

This landscape of intermediaries is characterized by different degrees of institutionalization, and spans from formal to informal organizations. With “informal schemes” literature generally refer to those self-help initiatives developed by households or communities, in absence of any formal status or agreement with public institutions and local authorities (Allen et al. 2006b). In these cases, water and drainage services, rarely sanitation, are generally developed through community mutual help relationships (Allen et al. 2006a, 2006b, Joshi and Moore 2004).

Formal schemes can be legitimised and recognised by the public

sector under a regulatory framework. When institutionalized, co-production practices generally transfer administrative, management and technical maintenance activities to the intermediary organizations. The private sector is similarly heterogeneous in its institutionalization. It may include private informal or licensed water vendors (Allen et al. 2006a, Cabrera 2015) and small companies to perform desludging service or install septic tanks (Schramm, 2011).

Service providers can be either centralised authorities (i.e. national or municipal agencies established for service provision) or decentralised institutions generally delegating a number of tasks at the local level (Allen et al. 2006a, 2006b, Joshi and Moore 2004, Schramm 2011). If service operation and maintenance is assigned to specific community or private agencies, the state usually retains the main role for policing and monitoring (Allen et al. 2006b).

However, different institutional architectures and public–private-community organizational arrangements can be simultaneously present at the city level. This may result in fragmentation of the service (Lorrain, 2000), hybrid configurations (Rateau and Jaglin 2022), multiple scales of complexity of infrastructure (Allen et al. 2006b) and different power dynamics for safeguarding private interests (Ahlers et al. 2014). Involvement of the private sector in regular water service provision is usually argued on the basis of efficiency and effectiveness, with limited consideration of social equity and environmental sustainability (Allen et al. 2006b). In sanitation, the need of high technical and managerial skills for operating decentralized wastewater treatment system, often implies the involvement of private operators in co-production.

2.2.2 USERS ENGAGEMENT AND THE “CO” SIDE OF CO-PRODUCTION

The scale of users’ involvement is a fundamental qualifying element of co-production. Individuals, groups and collectives may engage in co-production, influencing the size and collaborative nature of the co-production activity and the distribution of benefits (Nabatchi et al. 2017). In individual co-production, a state actor and a lay actor, generally a client or a customer, work synergistically to deliver personal benefi-

ts for the latter (Brudney and England 1983, Nabatchi et al. 2017). Drinking water can for instance be supplied through household/compound connections from the main distribution system, based on individual requests to the water agency and an active contribution by the citizen, including capital (e.g., materials and technological devices) and in-kind contributions (i.e., time and work-force) (Moretto and Ranzato 2017). In group co-production, state actors collaborate with a certain group of lay actors sharing common interests, as in the case of a group of citizens operating and managing a shared water tap or toilet, co-funded by the local authority (Allen et al. 2017, Moretto et al. 2018). Even if this type of co-production activity leads to personal benefits, it may also generate “spillover effects” and a wider distribution social benefits (Nabatchi et al. 2017, p. 770). In collective co-production, defined as “the joint action of citizens to support public services and achieve outcomes” (Bovaird et al. 2016, p. 51), the benefits are enjoyed on a broader communal scale, even if several dynamics may impede their equal distribution (Nabatchi et al. 2017, p. 770, Cabrera and Teller 2022). As a number of researchers have reported, community water networks operated and managed by small scale community operators, as water user associations, cooperatives or private contractors may follow market logics and patronage dynamics may here develop (Ali 2010, Moretto et al. 2018). Indeed, public-community and public-private-community partnerships are not exempt from the risk to develop inequality, as they place a strong role in the economic and managerial skills and interests of the intermediaries (Dos Santos et al. 2017). A number of studies have demonstrated that the role and number of users are crucial factors for the development of co-production practices (Cabrera 2015, Nabatchi et al. 2017, Ostrom 2009, van Vliet 2006).The group size has an impact on the costs of co-production: the larger the group, the higher are generally the costs of transactions related to self-organization and decision-making processes (Ostrom 2009). Larger groups are indeed generally characterized by a “heterogeneity of interests”, which makes the bargaining and decision-making processes within organizations more difficult and costly (Ostrom 1990, p. 146). On the contrary, for smaller groups with relatively homogenous interests, decision-making processes are generally more rapid and less costly. At the same time, if construction or the management of a service system is very costly, such as in the case of large-scale water and sanitation networks, larger groups may be beneficial to provide the labour and resources needed (Ostrom 2009, Bookchin 1973).

Ostrom (2009) also stressed that norms and social capital, as well as user motivation/willingness, are important factors to be considered when characterizing co- production. Socio-economic capacity and availability of time affect users' possibility to participate in co-produced initiatives (van Eijk and Steen 2014). Among users of resource systems, mutual trust and shared values originating from existing forms of collaboration can imply lower transaction costs in community-based service provision (Ostrom 2009, p. 421). Willingness to participate in service delivery can descend from individual or pro-social motivations (van Eijk and Steen 2014). Indeed, in areas disconnected from centralised networks, co-production may represent the only available solution to access WSS services. In such contexts, motivation to co-produce can simply originate from the dwellers necessity to get access to basic (vital) services in the shortest time, whatever may be the associated operational costs. Moreover, through appropriate policies and incentives, citizens can be encouraged to devote more time to collective co-production of services (van Eijk and Steen 2014). In a number of cases it has been reported that, communities have been incentivized by state actors to develop community services (in water, sanitation and drainage) and to improve their settlements through different incentives (Anderies et al. 2004, Winayanti and Lang 2004). These incentives included the granting of legal housing titles (Winayanti and Lang 2004), subsidised tariffs or involvement in the election of public infrastructure providers (Anderies et al., 2004). The use of such mechanisms might increase participation, prevent free-riding on infrastructure and improve maintenance, thus reducing barriers to successful co- production (Anderies et al. 2004).

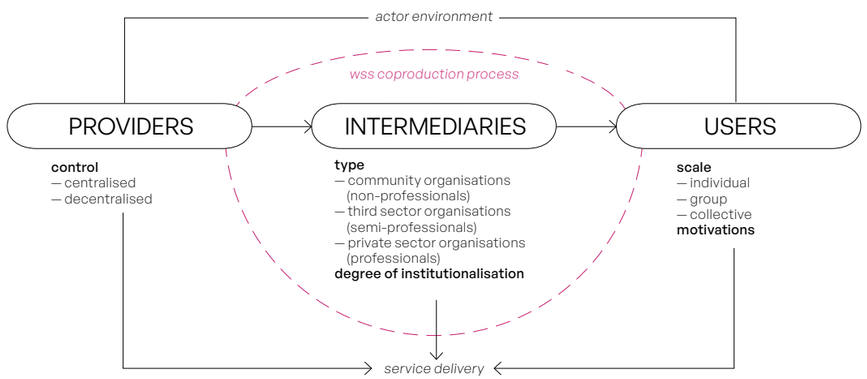


Figure 33.
The actors involved in service co-production

2.3 The flow dimension of wss co-production

Resources and technologies represent central dimensions to be considered when analysing co-production of water and sanitation services (Moretto and Ranzato, 2017). Most research addressing the techno-environmental aspects of service co-production have adopted either a socio-ecological or a socio-technical perspective.

The socio-ecological perspective considers conventional services as complex systems whose functioning and quality depend on ecological characteristics of their environments, the infrastructure solutions employed and the different policies and institutions which regulate the management of the territory and related resources (Anderies et al. 2004, Ostrom 2009).

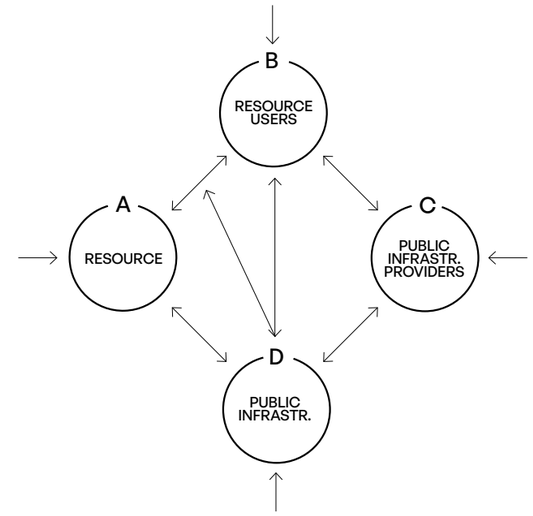


Figure 34.
A conceptual model of socio-ecological system (Anderies et at. 2004)

The conceptual framework developed by Anderies et al. (2004) explains how the characteristics of the resource system, the resource units generated by it, the attributes of the system's users and its governance structure work together to achieve particular outcomes at any

time and place. Their framework conceptualizes a socio-ecological system as being composed of four elements: the resource, the resource user, the public infrastructure providers and the public infrastructure. This helps bring together physical and social capitals in a single approach (e.g., engineered works and governing/managing rules). These elements are influenced by external forces (e.g., environmental resource hazards and major political changes), while being intrinsically linked through multiple internal dynamics.

The interrelations between resource users and public infrastructure providers are multiple. In simple systems, the actors may overlap when, for example, resource users form a small group with common interests, operating as both users and infrastructure provider. Complex systems may involve more structured organizations managing the ecosystem at multiple levels (Anderies et al. 2004). The relationship between the resource users and infrastructure providers underpins co-production arrangements and its form may determine the sustainability of a socio-ecological system.

Studies developed in the field of socio-technical services (Hegger and van Vliet 2010, van Vliet et al. 2005, van Vliet 2006, 2012) have mainly focused on understanding technology–behavior interactions and the role of social actors. From a socio-technical perspective, utility services—such as water, waste and electricity—are conceptualized as technological systems linking natural resources, providers and consumers. They can assume different configurations: from centralised service provision, where the resource is provided (through a specific technology) by a monopolistic institution/company to citizen-consumers, to a splintered provision system where multiple resources can be associated with different providers using standard and new technologies (van Vliet, 2006,; 2012). Van Vliet (2006, 2012) stresses that the sustainability of such innovative service provision implies a differentiation not only of resources, providers and technologies but also of consumer functions, thus recognizing the active role of citizens involved in the daily consumption of the service. Co-production practices are therefore conceptualized as social practices that change the relationship between consumers and providers by modifying the socio- technical and environmental dynamics of the services. Yu et al. (2011, 2012) first applied this conceptualization, as a framework for service co-production, to the design of governance arrangements for decentralized storm water systems in Australia.

The framework describes relationships between elements within

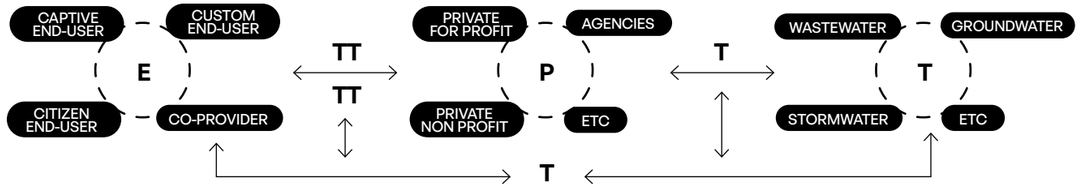


Figure 35. The socio-technical framework: E-End-users; P-Providers: R-Resources; T- Technology (Yu et al. 2012, p. 2734, adapted from van Vliet et al. 2005)

a socio-technical system (Figure 35). Effective user involvement in decentralized water service provision requires context-specific solutions that can be obtained through “mixes of scales, technologies, payments systems and cultural and institutional structures that are both economically and environmentally sustainable” (Hegger and van Vliet 2010 in Yu et al. 2012 p. 2734). The framework highlights how “the use of alternative sources of water and diverse scales of infrastructure is linking end-users more closely with providers, with the small-scale technology and the water resource” (Yu et al. 2012 p. 2733).

In this perspective, the design and governance of co-production is dependent upon the nature of the different providers (both traditional and new) and forms of provision and their links with the multiple ways of involvement of users in the co-production of the same good or service (from citizen to co-provider). An effective ‘mix’ and/or ‘fit’ of water production options implies “the use of diverse resources and/or qualities of water”, and—in turn—the combination of various technologies applied at different scales. Technology can assume different physical (e.g., type and connection of devices) and social (e.g., the actors and their expertise) structures and is conceived as a mediator that connects all elements at the functional and the behavioural levels (Yu et al. 2012, p. 2734).

2.3.1 CHARACTERIZING THE RESOURCES IN WSS CO-PRODUCTION

Both frameworks, the one proposed by Anderies et al. (2004) and the one proposed by Yu et al. (2012), recognise resource availability as a fundamental element that shapes and at the same time is shaped by governance arrangements and infrastructural services. The characte-

ristics of the resource system influence the relationships among actors and therefore the co-production arrangements. At the same time, co-production of WSS services impacts the manner in which resources are processed and ecological systems are preserved. In other words, it acts as a feedback loop influencing resource availability.

The diversity and quality of resources characterise the environmental dynamics of co-produced services (Yu et al. 2011). Wss service co-production can rely on different kind of resources, such as surface water, groundwater, rainwater and wastewater (Allen et al. 2017, Button 2017, Pilo' 2017). Types of available resource are context-specific and affect local solutions for co-production. As an example, higher groundwater table in urban areas can facilitate the use of urban wells as the main technology for co-produced arrangements. Conversely, pollution of shallow aquifers in high density areas lacking sewerage system is a considerable concern for the sustainability of such wells (Moretto et al. 2018).

Regarding the quality of the resource, the authors refer to the availability and the qualitative features of the resource mobilized in co-production. Water quality, the physical-chemical and biological characteristics of water, depend on natural and anthropogenic drivers at multiple spatial scales that determine the various pressures on the resource (e.g., increasing population and urban density; pollution from domestic, industrial and agricultural activities; groundwater salinization; and technological devices employed in the water and sanitation service) (Allen et al, 2017). The quantity of water available in a specific area similarly depends on anthropogenic and natural drivers, from local to urban and hydrogeological basin scales (e.g., urban sprawl, growing water demand, soil waterproofing, climate profiles) (Falkenmark 1997, Milman and Short 2008). When co-produced services do not ensure adequate standards of water quality and quantity, it can drive users to fulfil some of their water demands through more expensive supply modalities (such as purchasing bottled water).

Co-production can operate at different scales of the urban water cycle. In decentralised systems, such as urban wells or on-site wastewater treatment, most resources mobilised through co-production can be considered local as they are usually extracted, channelled, used and disposed in the proximity of territories of production. Such a short-flow cycle can provide benefits to inhabitants in terms of service flexibility and enhanced water security by reducing dependence on shortcomings of external infrastructures (Moretto and Ranzato 2017). However, the risk to fail to close the local water system in a sustainable way due to poor wastewater treatment and lack of control, can strongly jeopardize the relevance of previous benefits. In co-produced systems connected to the centralized network, such as co-managed secondary water and sewer networks, co-production can entail the direct involvement of users within the urban flow circulatory processes, by collecting, reusing or recycling the water or the wastewater mobilised by the service (Moretto and Ranzato, 2017). Such a closed loop can generate benefits to the city's overall metabolism (Allen et al. 2017, Button 2017, Pilo' 2017), although the common imbalance between a low care for sanitation facilities and wastewater treatment compared to high interests in water supply sharpens the risk of environmental contamination and public health problems at the urban level. In addition, co-produced services can contribute to, and be affected by hazard phenomena occurring at the local and drainage/hydrogeological basin scale, such as reducing the quality and quantity of surface and ground water due to untreated disposal, uncontrolled groundwater extraction, or flooding (Allen et al. 2017, Moretto et al. 2018). The multi-scalar nature of water resources and the interconnectedness of service components therefore makes the level of operation of co- production into the urban water cycle, a relevant element for assessing the environmental benefits and the limitation of such practices on a long term.

Finally, direct involvement in the service provision can foster a closer relation between recipients and resource. In both rural and urban areas, users' knowledge of the resource is an important factor for the sustainability and resilience of community-based initiatives (Anderies et al. 2004, Ostrom 2009). In fact, in many cases of water and sanitation co-production, users can develop relevant ecological knowledge by directly managing/using the resources that sustain their livelihoods (Ostrom 2009). With reference to urban contexts, still various studies highlighted how recipients' awareness of the resource quality and of the service dynamics has been an important element in technological development of the co-produced system. It is specially the case of Water User Associations that need to prioritize their investment for the improvements of their secondary networks (Allen et al. 2017, Kyessi 2005, Moretto and Ranzato 2017, Moretto et al. 2018).

2.3.2 INFRASTRUCTURES AND TECHNICAL DEVICES

The framework developed by Yu et al. (2012) specifically integrates a technological dimension into the understanding of co-production in the use of natural resources. It does so by highlighting the role of technology as a mediator between different institutional configurations of users/providers and different resources mobilized in the service cycle. It suggests that the conceptualization of WSS service co-production should include an understanding of how existing resources and technologies mediate the definition of user/provider arrangements and how, conversely, institution and user preferences, involvement and role influence the scale and nature of the technologies adopted for processing natural resources. Consequently, the scale, complexity and connectedness of the technology are important factors to be considered for charactering co-production.

The scale of a technology refers to the extent of the physical artefacts involved in the service. It is generally considered as an intrinsic factor of decentralized and hybrid water systems. Service co-production may occur at different scales: from the primary level (e.g., the household) up to more collective levels (e.g. the compound or the settlement) (Moretto and Ranzato 2017, p. 7). This has consequences for the technical options, which can range from an on-site technological system serving single households (such as a rainwater tank, filter columns or a septic tank), community devices serving a street or a block (such as community well, condominium septic tank or water tank, co- managed secondary water network, public fountain connected to centralized network, neighbourhood drainage system), up to more extended technological systems serving a settlement or multiple areas of the city (such as drainage facility, simplified sewage system, decentralized wastewater treatment) (Warnkenet al. 2009, Moretto et al. 2018, Yu et al. 2011, 2012).

The complexity of a system is related to the kind and number of technologies used in the service delivery as well as the governance system required to manage them. Technical complexity here refers to ‘the level of expertise, the number of actors and/or the size of an organization needed to run it’ (Yu et al. 2011, p. 12). Different system scales may imply more complex technical devices and consequent changes in the respective roles of users, intermediaries and providers. Van Vliet et al. (2005) suggest that the size of an organization depends on the scale of the technology. Systems with higher technical complexity usually require larger organizational support, but an inverse relationship is also possible (Yu et al. 2011).

Connectedness relates to the structure of the technology: both its physical decentralization and its management within a larger socio-technical infrastructure (van Vliet et al. 2005,; Yu et al. 2011). Technologies can function as separated stand-alone systems (e.g., community wells, shared pit latrine) or as grid-connected systems that combine with larger infrastructures (e.g., community-based network extensions of centralized piped water systems, local storm water facilities connected to the primary drainage system) (Yu et al. 2011). The structure of the technology can be determined by the ‘architecture’ of the socio-technological system, distinguishing between distributive systems (‘flow from a central node to the user’, such as with water) and accumulative systems (‘flow from the user to a central node’, such as with sanitation/waste and, again, water) (Frantzeskaki and Loorbach 2010, p.1295).

The infrastructure portfolio represents another factor to be considered when looking at the environmental and spatial dimensions of co-production practice. It refers to the taxonomy of devices employed in the different stages of the service provision, from resource extraction to treatment, delivery, maintenance and disposal. Technologies mobilized in co-production can emerge as separate systems, through mechanisms of hybridization or by reconfiguration of the conventional networked system (Geels 2002, Monstadt and Schramm 2013, Moretto and Ranzato 2017). They can contribute to amelioration of the current conventional system or introduce a further level of complexity in the network (Allen et al. 2017, Moretto and Ranzato 2017, Jaglin 2012). Still complexification of the technological systems can increase management challenges, especially in the case of introduction of new decentralized wastewater treatments (Sapkota et al. 2015, Wilderer and Schreff 2000). Available technology for co-production strictly depends on contextual characteristics, such as the urban morphology, the distance and/or connection to the centralized networks, as well as the cost of devices and the technical skill of the involved actors (Moretto et al. 2018).

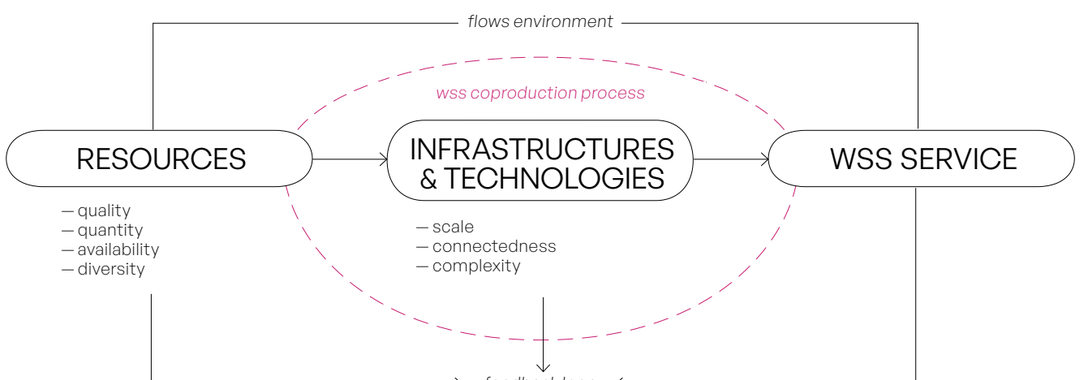


Figure 36.
The flows of service co-production

2.4 The area dimension of wss co-production

In addition to the actors and the flow (techno-environmental) dimension of co-production, the framework includes an area dimension, which is often disregarded in the literature on wss co-production in the Global South, even though practice-oriented research is mainly location-based. Existing research usually highlights the role of local factors—actors, resources, practices, representations—in shaping the range of co-production options. Such an approach finds its roots in path-dependence analysis. Accordingly, technologies adopted in the past influence the choice of methods, designs and practices in the present (Walker, 2000). Hence, a close reading of urbanization dynamics, and other spatial factors, may help understanding of the later adoption of specific technologies, as well as of the governance and techno-environmental arrangements found in co-production.

The field area concerns the relation between the coproduced service and the forms of territorial organization, in terms of land and morpho/typological characteristics of the built environment. In line with Dubresson and Jaglin (2005), Moretto and Ranzato (2017) highlighted how spatial characteristics can affect service accessibility, proximity and resource distribution and reveal how, on the other hand, socio-technical services shape the territory. Service coproduction can take place at different spatial scales and in different types of human settlements, with consequences for the service socio-technical options. For the authors, the relationship between territorial organization and socio-technical services sociotechnical services is ambivalent. On the one hand, socio-technical systems can be understood as polycentric physical systems characterized by an archipelago of technical options influencing space production, and, on the other hand, they are influenced by availability of resources, land and the characteristics of the human settlements in which they inhabit. The threefold conceptual framework proposed by Faldi et al. (2019) and used as a reference in this research, has clearly the merit to introduce the spatial conditions that affect, and are affected by, the coproduction of services that rely on natural resources (and thus

expanding the SES model), as well as to underline the specific link amongst service accessibility and environmental sustainability (including spatial considerations) in the coproduction of conventional services.

2.4.1 LAND ISSUES

In cities of the Global South, access to land is a pressing concern. Lack In cities of the Global South, access to land is a pressing concern. Lack of financially available land and housing for the low-income household's forces the development of squatted settlements and spontaneous developments, which are not always recognized by governments and consequently not served by centralized services (UN, 2016b). Land tenure, land use and environmental risks are elements that have emerged in many studies as central to understanding co-production practices. Wss co-production can develop both in marginalized and informal settlements and in formal and "official" ones. Regulatory frameworks guiding urban planning can influence access to water and sanitation services for the poorest inhabitants. A settlement identified as informal/illegal can be denied connection to the centralised service supply (Allen et al. 2006b). As suggested by Allen et al. (2017, p. 35), formally recognized settlements, often through intermediary bodies, have more secure "access to municipal resources and to develop their own WSS services", while "informal settlements have to manage co-production with their own resources" or with the support of local associations, NGOs' or private for-profit groups. Moreover, perception of security of tenure is fundamental in fostering community investment to improve the infrastructure and housing systems of their settlements (Winayanti and Lang 2004). Densely-populated urban areas are often exposed to multiple climate-related hazards which mainly affect the urban poor, often settled in areas at risk. Within hostile environments, shelter consolidation is a slow and incremental process for the majority who are denied land titles, security of tenure, use of basic services and access to building material and credit. Strategies for mitigating the effects of natural hazard in those areas are addressed by governments mainly through relocation, but at the same time developed at the community level. In these areas, co-production of water and sanitation services might be triggered by mechanisms of mutual help and self-organization, developed due to the necessity to respond to natural hazards (Winayanti and Lang 2004). The presence of frequent disasters (i.e. floods, landslide, etc.) impact on the technical arrangements, which are developed in those areas and might be considered and included in the co-production systems that are adopted.

In this context of unequal urban growth, acute competition for land and pressure from real estate speculators often results in conflict, eviction and resettlement of the poorest communities. In this situation, obtaining legal authority to build infrastructure may be difficult (Bakker 2003) and institutionalized co-production might hence be hindered in such areas.

Moreover, characteristics of land also impact on the infrastructure portfolio mobilized in wss co-production. For example, service decentralization may represent a viable option for sanitation in peri-urban areas or highly dense neighbourhoods (Parkinson and Tayler 2003). The topography of the terrain, i.e. the presence of slopes, also determine the adoption of certain water and sanitation infrastructures at the household level. For example, on-site treatment facilities at the household level (i.e. septic tank) are suited for city's flat terrain and high dense urban contexts or in low-dense areas in order to avaid long sewage pipes, because their installation under the buildings allow for the vertical flow and the separation of solids from the wastewater before entering the sewerage or drainage systems (Schramm 2016).

2.4.2 FORM AND CONTROL OF THE BUILT ENVIRONMENT

The spatial patterns of human settlements, together with cultural and social factors, are important for understanding the drivers of co-production arrangements in relation to environmental and ecological processes. In particular, the built environment within the co-production framework can be explored by analysis of urban morphology, especially when one considers path dependence. Urban morphology (plot, street, constructed space, open space) shapes the choices and typologies of

water and sanitation service infrastructure solutions (Schramm 2011, Faldi et al. 2019, Rosati et al. 2020). Sanitary networks have been originally developed in dense cities, in order to prevent the spread of water-borne diseases. However, in dense slum areas, defined by narrow streets and lack of public space, limitations in the extension of sanitary networks and housing systems may lead to the development of clusters of communal toilet blocks and on-site waste water treatment as the only feasible solution (Yatmo and Atmodiwirjo 2012). Density and housing typologies should be also considered determinants of water and sanitation co-production as they influence the technological systems and devices that can be employed (Schramm 2011).

The location of the settlement and its topographic features, including proximity to the official centralized network, also influences the accessibility and quality of the resources and the choice of technology to deploy. Along with lack of economic resources, physical conditions (i.e., environmental risk, high altitude, unsuitable settlement morphology, proximity to industrial sites, soil-contamination or large distance to the resource) can contribute to unfeasibility in constructing, operating or maintaining water and sanitation networks. In these cases, communities have to rely on alternative, decentralized solutions, which can be more expensive; as, for example, when the water must be purchased from vendors (Allen et al. 2017).

Finally, the history of the settlement provides information about the level of consolidation of the settlement and related infrastructure. This history may contribute to the robustness and solidarity of relationships between community members. As discussed, technologies and arrangements adopted in co-production services may be framed by previous solutions. For instance, water irrigation networks may have once influenced the network of streets, and this, in turn may determine the distribution of small-scale water networks in the urban settlement (Cabrera 2015).

Conversely, the development of wss networks is often viewed as an important step in the consolidation and further institutional recognition of informal settlements.

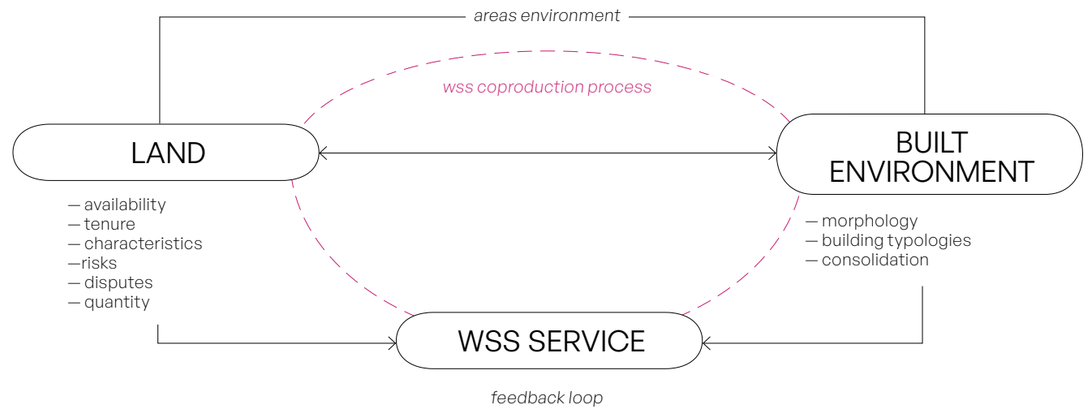


Figure 37.
The area of service co-production

2.5 Incremental adjustments in the AFA framework

"The distinctive quality of continuous change is the idea that small continuous adjustments, created simultaneously across units, can cumulate and create substantial change. That scenario presumes tightly coupled interdependencies."

Weick and Quinn, 1999

The proposed framework of analysis serves to highlight and explore, through a case-study approach, the main dimensions and related variables that contribute to the configuration of certain practices of co-production of water and sanitation services. It is not a static and descriptive tool, but an interactive and dynamic tool that serves as a reference to explore the relationships and interplay within and between the different dimensions. The three main dimensions observed (Actors-Flows-Areas) are indeed dynamic and evolving dimensions, whose variables characterising them are subject to transformation.

In terms of actors, changes might affect the way co-production stakeholders operate, the scale and nature of their involvement, the degree of institutionalization of their organizations and the way they allocate resources (Weick and Quinn, 1999).

Co-production practices, in the organizational geometries they assume, are informed and shaped by relationships between the state (service providers) and the society (service users). As such, wss co-production practices form and evolve in context of socio-political, and spatial and dynamics, often translating into institutionalized governance processes, with the different decision-making processes and actions undertaken by organizations entangled in these changes.

❶ The evolutionary nature of the actor dimension in WSS co-production is primarily linked with the changing role and positioning of the state with regard to urban policies and service provision. State-society relationships are evolving, by nature. Institutional and technical changes are generally interpreted as main drivers for the evolution of co-production practices. Governance drivers, as changes in the political environment at the national or local scale, might trigger a decline in state provision (institutional deficit) and therefore engage citizens in co-production. Logistic or technical drivers, such as peri-urban development distant to the urban core, might also explain why communities, disconnected from networked infrastructures, get involved in service delivery (Joshi and Moore , 2004). The evolutionary nature of the actor dimension is also found in relationship with changes in decision making processes opted by organizations and their functions with respect to water and sanitation services. Indeed, co-production might evolve as a substitutive practice (i.e. government retiring from being service provider) or as an additive practice (i.e. institutionalisation of self-help practices or conventional service provision models supported by users) (Bovaird and Loeffler 2012).

Changes are also found in respect with the size of the organization and the scale of users' involvement. Research has discussed how organizations are continuously recreating their boundaries, scaling up or down their operational networks and consequently redefining their roles and internal norms. Co-production organizations are continuously addressing changes and responding with incremental strategies, adapting over time their boundaries and decision-making processes with respect to internal (size, role, norms) and external (institutionalization, regulation) configurations.

❷ The second level of inquiry relates to the relationship between the flow dimension and the configuration of wss co-production practices. The framework can be used to look at the role played by urban infrastructures, namely technical devices supporting resource flows and

transforming them into services, in processes of reconfiguration of co-production practices. Infrastructure networks found in WSS co-production develop within a paradoxical process of change in continuity, building from pre-existing networks and evolving towards new configurations (Offner 1999, Rosati et al., 2020). The evolution of WSS co-production is linked, on the one hand, with the unfinished nature of technical networks (Button 2017, Faldi et al. 2019, Zérah 2000). Existing literature shows how incremental development of infrastructures can take different shapes. It can act as an upgrade of the technical portfolio used in co-production (Moretto et al. 2018) or as a multiplication of supply systems and related technical devices used in co-production (Button 2017). It can act as an extension of co-produced services to include new dwellers (Cabrera 2015) and as a stop-gap solution, to cover the gaps between conventional and networked infrastructures (Jaglin 2002, Zérah 2000).

On the other hand, processes of reconfiguration of wss co-production pratices, are linked with changes in resource systems. Indeed, changing relationships with resources mobilized in wss co-production condition processes of infrastructure re-configuration. Increasing water contamination, salinisation, ineffective wastewater collection and treatment emerge in the literature as some of the pragmatic issues that service users have to confront, by adopting adjustments in the co-produced practices (references).

❸ The third level of inquiry thus relates to the relationship between wss co-production and mechanisms of production and the reconfiguration of the built environment. As water and sewerage infrastructures (tanks, pumps, pipes) are embedded in the physical boundaries of the built environment, there is a relationship between this the form and structure of this built environment and the territorial boundaries of co-produced practices (Habraken 1998, Ostrom 1990). Dwellers may operate in different ways with respect to their built environment at a local scale (Habraken 1998, Moretto et al. 2018, Silver 2014). At a broader spatial scale, echoing Cornwall (2004), co-production can take the form of “invited space” (i.e. government supporting incremental transformations of the built environment) or “popular space” (i.e. bottom-up initiatives occurring outside regulatory frameworks). However, the “boundaries between ‘invited’ and ‘popular’ spaces are mutable, rather than fixed. ‘Popular spaces’ can become institutionalised, with statutory backing, and ‘invited spaces’ may become sites for the articulation of dissent, as well as

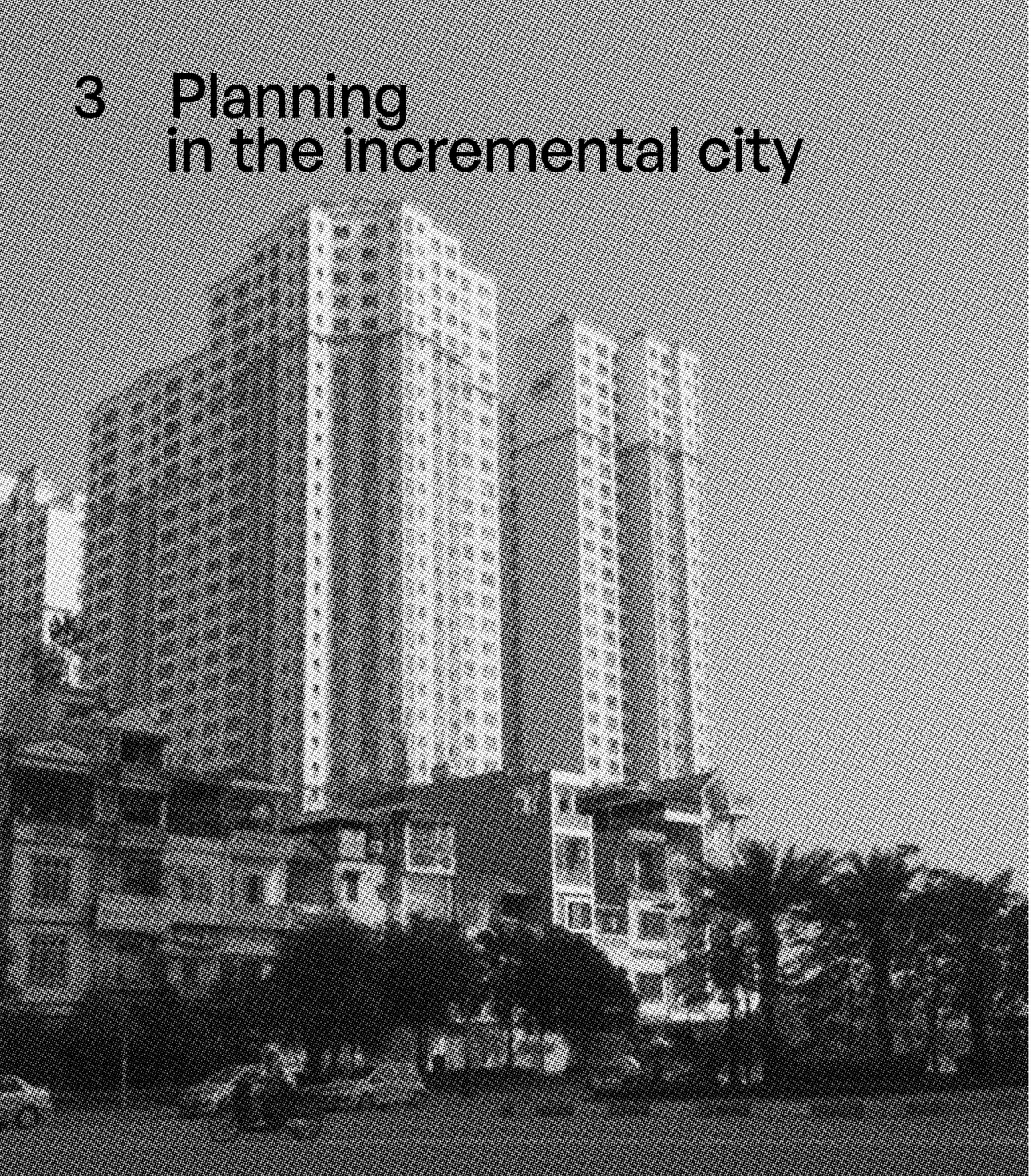
for collaboration and compromise” (Cornwall 2004, p. 2). The evolution of the built environment may influence co-production that keeps “in-the-making, undergoing constant adjustment and intervention, and in a permanent state of flux” (Silver 2014, p. 788). Wss Co-production forms and evolves in relationship with different human settlements (i.e. peri-urban areas, new residential areas, historical urban cores) and building typologies (i.e. individual housing, collective blocks, apartment towers). This path dependency is observed at different scales.

While these observations tend to show intra-dimensional evolutionary characteristics, in the same way one can detect forms of interdependencies at the inter-dimensional level in WSS co-production. In particular, the thesis aims to highlight the dialectic of the relationship established in the dynamic evolution of the three dimensions Actors-Flows-Areas. Namely, the interplay between governance structures, technical infrastructures and flows and urban fabrics.

As said, the adaptability of infrastructures and changes in resource systems plays an important role in the socio-technical and spatial reconfiguration of co-produced water and sanitation services. On the one hand, technology informs the structure and activity of organizations involved in wss co-production (Van Vliet, 2006). On the other hand, changes in the resource systems impact on decision making processes and structures of organizations (Anderies 2014). This path-dependency might be related to changes in the spatial patterns found in the area dimension.

Literature shows how local factors, such as available resources or dwelling typologies, shape the evolution of the different co-production options, along path-dependency trajectories (Faldi et al. 2019, Monstadt and Schramm 2015). Changes in territorial configuration (form and control of the built environment) as well as changes in resource systems on which co-production rely, might require adaptation of some water infrastructures. This in turn may contribute to challenge existing evolution of co-production practices (Habraken 1998, Offner 1993).

3 Planning in the incremental city



3.1 Rationality and incrementalism in decision-making processes

3.1.1 THE RATIONAL-COMPREHENSIVE APPROACH

" The idea of rationality has been central to the theory and practice of decision-making in the post war era. Models of decision-making which focus on rationality argue that, if we wish to understand the real world of decision, we must consider the extent to which a decision has been the outcome of rational processes."

Parsons, 1995, p. 273

As a human activity and theoretical model, “planning” has developed drawing on various sectoral knowledge and different traditions over time. On the one hand, the planning activity has its roots in the tradition of physical design of the city and the territory and, on the other, in the governing of individual behaviours, with respect to collective interests and with particular regard to the government of organizations, the public sphere and economic activities (Rispoli 2012).

The rationalist approach to planning derives from the historical matrix of rational decision-making, the theories on the scientific planning of societies and the discourses on social reformism. The idea of rational-comprehensive planning has represented one of the most powerful

foundations of the political and planning culture of the post war Western countries, inspiring paradigms, models and analytic approaches in various fields of knowledge. Paradigms that have not been limited to the western geographical context, but which have been exported globally.

The basis of this planning and decision-making model is that the problems that characterize the complexity of reality can be solved by making rational choices on the basis of a means-end scheme, achieving set objectives through an optimization of resources. Reference is made to a comprehensive or synoptic rationality, which presupposes:

❶ complete knowledge of the system in which choices are made (cognitive capacities),

❷ the possibility of predicting its future evolution through increasingly sophisticated calculation systems (prediction capacities)

❸ and the political ability and power to conduct choices (political capacities).

As Simon (1955) argues, rational-comprehensive planning is drawn on traditional economic theory and it develops around the notion of the *Homo economicus*, who, in the course of being economic is also "rational", that is capable of mobilising cognitive resources and performing political choices to pursuit his goals.

Following the synoptic or means-end model, in relation to the objective, a choice is made between alternatives that maximise the result (Simon 1955). Associated with this notion, the decision-making process appears as a consequence of rigidly sequential steps, starting with the establishment of objectives and the development of a list of possible alternatives (setting values and objectives), the analysis of costs and consequences of alternative solutions, and finally comparison and selection of the "best" choice in view of the objectives.

This reference background is generally endorsed by public policies, aimed at developing decision-making processes and leading political choices through rational decisions that may be defined as the ones that pursue "a logic of consequences" (March 1994). In other words, a decision is considered more rational if the process leading to it is based on insights into the consequences of alternatives, and the selection follows the logic of choosing the alternative that is expected to best achieve one's goals or objectives.

3.1.2 BOUNDED RATIONALITY, INCREMENTALISM, STRATEGIC ANALYSIS

" The question of how it is to behave rationally given these limitations, is distinct from the question of how its capabilities could be increased to permit action that would be more rational judged from the mountain-top of a more complete model."

Simon 1955, p. 112

Although rational choice theories are grounded on the anthropological assumption of the homo economicus (Simon 1993) and that of the calculated self-interest of individuals (Parsons 1995), a number of empirical researches shows that decision-making processes in practice are rarely capable of following a means-end scheme, as indicated by the synoptic approach. Multiple cognitive and behavioural constraints limit rationality even in cases where significant efforts are made to improve it (Kørnøv and Thissen 2000, March 1987, Simon 1955, Lindblom 1959).

As Simon (1957) states, the values and objectives of organizations are often complex and further complicated by the individuals who populate them: individuals may have diverging values and objectives, thus they may implement choices and actions in a way that causes them to drift with respect to the criteria of optimality as initially planned. Moreover, it is not easy to analyse all the available options and their implications. First because the environment in which organisations move is often bearer of a high degree of complexity and subject to existing pressures. Second because it is often difficult to separate the ends from the means.

In the need to develop a more appropriate organizational model for the public administration theory, after research and observations in

a number of organizations, Simon (1957) leans towards a more practical model with “bounded” rationality. According to this approach, decision-makers select a particular alternative from those available, on the basis of initial inputs calling for decisions and after analysing possible alternatives. Following a three-phases analysis of strategies-consequences-comparison, which represents an ideal-type anyway, among the objectives and values given, the path chosen by the decision maker is the one that most “meets his needs”. Decision-makers can be concerned only with finding a *satisficing* compromise between values and goals. As such, the model of “bounded rationality” appears in reality a simplified process which deliberately ignores a plurality of options and pressures because it is not realistically feasible to include them in the analysis.

This stance is the basis of Lindblom’s theories on incrementalism, first elaborated in 1959 in his influential work “The science of Muddling Through”. Informed by market analysis theories, Lindblom reasserts Simon’s understanding of bounded rationality, proposing the approach of successive limited comparisons or marginal analysis. Even if humans are intently rational, they confront with “small brains” (1959, p.82). Because of the limited nature of rationality and the weak power of human cognition, humans cannot achieve the of their goals through rational calculation. Likely, decision-makers constantly confront with limitations when developing policies: limited human capacity to solve problems; insufficient knowledge; high cost of analysis; often incomplete evaluation method; interconnection between acts and values in the political-administrative process; presence of external variables that influence the process; non-standardisable forms in which policies arise (pressures, environment, actors involved) (Pal 2017). Confronting such constraints and especially when dealing with complex problems, decision-making processes rather tend towards “muddling through” trials, where the administrators simplify the decision-making process by comparing a limited number of alternative policies.

Lindblom (1979) integrates the incremental approach with the concept of partisan mutual adjustment that is, a method of mutual adaptation and coordination between subjects with autonomous decision-making power different from the hierarchical authority. In this process, the subjects seek to adapt and influence others’ choices through various strategies to be "played" in the bargaining process including manipulations, negotiations and adaptations. Partisan mutual adjustments, found

in varying degrees in all political systems, are grounded on the recognition that within decision-making processes the various somewhat autonomous participants mutually affect one another, with the result that policy making displays certain interactive characteristics. As a corollary of this theoretical model in administration theory, one can say that in reality a good policy is not the one that allows to reach the established goals, but the one that guarantees an agreement between the diverging interests of the involved parties. “Once that policies are resultants of mutual adjustment, they are better described as happening then as decided upon” (Lindblom, 1979 pp. 522-523)

Lindblom's conception of incrementalism represents the picture of a decision-making method, in an environment characterized by a plurality of power centres. In the initial phase of his analysis, Lindblom positively approaches it considering it a method that characterise decision-making processes in democratic contexts and therefore bearer of positive results for the science of administration. In later times, from an empirical observation, it emerges that "strong" interests of organizations which are able to impose their choice in bargaining prevail through a plurality of methods to the detriment of other subjects unable to "play" in the process because of their lack of representation. Incrementalism is then accused of favouring power elites, which would have more weight in the bargaining process (Forester 1984); of being excessively conservative, by neglecting “basic societal innovations” (Etzioni 1988); and limiting possibilities of social reform (Dror 1964).

New theories and approaches move beyond Lindblom’s earlier understanding of incrementalism. Dror (1964) suggests that, in situations of uneven distribution of power in decision-making process, a mix of techniques (i.e.judgments, creative invention, brainstorming) is needed to drive the decision towards new paradigms, forcing the will of the subjects to collaborate, for example, through meta-decision-making process (i.e. deciding and agreeing on how to take decisions). Etzioni (1967) integrates Lindblom’s analysis proposing a combination of the two visions, namely the broad horizon of rational planning and the incremental steps that serve to achieve it, which finds its expression in the "mixed scanning" method. With the "mixed scanning" method Etzioni considers the decision-making processes an interplay between long-term strategic decisions and incremental decisions, where the latter are often used to implement strategic decisions.

Despite criticisms and with growing publications and reflections

over incrementalism, Lindblom (1979) clarifies that incrementalism does not oppose to rationalism and, indeed, in policy making the two strategies are supporting each other. In order to add some level of rational analysis to the “muddling through” process, he reworks his theoretical propositions by developing two concepts, that of strategic analysis and that of disjointed incrementalism.

Endorsing Simon's limited rationality which implies that “the decision maker chooses the alternative he deems satisfactory by stopping the research before having examined all the alternatives and all the consequences”, Lindblom (1979) introduces the term strategic analysis to describe a form of incrementalism similar to strategic rationality. This model allows to compensate for the unequal distribution of power in decision-making centres, by using the planning and the thoughtful choice to remedy these dysfunctions. He argues that it is necessary to distinguish between "simple incremental analysis", which the analysis of alternatives other than the status quo incrementally and "disjointed incrementalism", the analysis of a few alternatives intertwining of objectives and values, attention to the problem rather than to the objectives and a sequence of trial and error, division and distribution of tasks and decisions among many participants. What he proposes is an analysis - not comprehensive - of the marginal consequences expected by the policies, that is the comparison of policies that differ from each other and from the status quo incrementally. In his perspective:

“Incrementalism is a method of social action that takes existing reality as one alternative and compares the probable gains and losses of closely related alternatives by making relatively small adjustments.”
Pal 2017, pp. 82

This analysis for social action implies going back to the decisions (a feed-back loop) and modifying them in itinere in order to adapt them to the context. In this view, disjointed incrementalism as proposed by Lindblom approaches the pragmatic orientation of Wildavsky (1987) which claims that "problems are not solved but replaced with other problems" at various decision levels that are often perceived as uncoordinated (Ham and Hill, 1986). He proposes a strategic analysis limited to a series of carefully selected mechanisms to simplify policy complexity.

Lindblom therefore supports an incremental/strategic approach, believing that this approach must integrate the rational component consisting of the thoughtful choice of methods that simplify the problem (for example creative operational ways to deal with the problem).

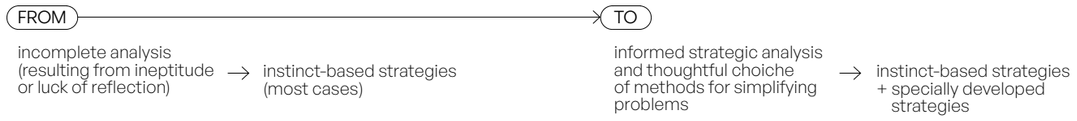


Figure 38.
Lindblom strategic analysis in Ham and Hill, 1986

In this perspective, “muddling through” is a process that allows policy analysts and policy makers to avoid serious errors by comparing the specific policies and assessing whether they will achieve the objectives without pursuing the impossible totality of the synoptic means-ends model. In this framework, policies are understood as endlessly re-made in a continuous decision-making process that, although imperfect, is mostly practiced in the real world. Similar to the Etzioni mix-scanning method, incrementalism, as intended by Lindblom in his later contributions, is therefore a hybrid and corrective model that does not oppose to rationality. This clarification is important, as this thesis supports the understanding of incrementalism as a rational, way of proceeding of the organizations co-producing water services.

The advantages that incrementalism offers as a decision-making process, are double fold: rational and cognitive benefits, to the extent where by limiting alternatives, it is easier to evaluate the consequences of an action or choice; process and institutional benefits, since incremental policy decisions are deemed to guarantee reversibility and ultimately to ensure stability to an organization over time.

The concepts of mutual adjustment and bargaining, characterizing the “muddling through” process, are particularly relevant to address the decision-making mechanisms and the implementation of actions in our case studies from the Global South. However, one important aspect should be emphasised. While incrementalism has become a rather appealing theme to describe urban processes taking place in the Global South, it cannot be said that this lens was born in this context. In fact, as presented so far, the conceptualisation of incrementalism comes from theories developed in the 1950s in the Global North, mainly in the world of public administration and public policy implementation. Notably, incrementalism is not a "second-class" decision-making approach, tailored to the Global South: It is based on a radical criticism of the comprehensive planning, based on its ideal character that is far from reality. Indeed, while comprehensive planning is inherently normative (and never applied, neither in the North or the South), bounded-rationality is inherently analytical (and mostly applied in the real world).

3.2 Rationality and incrementalism in the urban planning discipline

3.2.1 REWORKING THE COMPREHENSIVE PLANNING ACTION

" Modern life demands, and is waiting for, a new kind of plan, both for the house and the city."

Le Corbusier

Some elements of public policies analysis and implementation also influence the approach to the urban planning discipline. In particular, the irrelevance of the rational-comprehensive method and the recognition of the incremental nature of planning (Lindblom, 1959). What incrementalism suggests is a redefinition of the way of building knowledge; the analysis of policies, intended as analysis of local practices; finally, the recognition of the importance of investigating the interactions between the actors that contribute to decision-making processes.

Although the incremental model has entered the analysis and formation of public and urban policies, the synoptic, comprehensive approach to urban planning remains largely dominant. Either to support individuals or social systems, planning can be defined as a decision-making method that identifies objectives (ends), determines the means or programs to achieve them, and makes use of analytical techniques to verify the congruence between ends and means and the consequence of their application (Gans, 1987).

The urban planning discipline applies these methods to identify problems, define public investments and determine policies aimed at supporting the future growth of cities. According to the model of scientific rationality, urban planning is delegated to an expert and technical knowledge while the leadership in society is given to the central state (custodian of public interests), according to strict hierarchical models and effective control systems that guarantee the infallibility of the system (Rispoli 2012). As a decision process, the planning activity is intended as function and responsibility of the state, considered as a neutral agent, invested of traditional trust and guardian of the collective good. Crosta (1987) compares it to the beneficent ruler that is, a neutral mediator and peacemaker of different interests, to whom a value of pluralism is recognised.

Rational-comprehensive planning originates in the 20th century, flourishes during the Keynesian period and helps the spread of a model of regulation and coordination of urban development across the Europe and the USA, where It develops, in a moment where the country is experiencing major shift from the rural to urban condition. Metropolitan regions begin to dominate the landscape and to respond to the development of industrial production and technological innovations. The ideology that underlies rational-comprehensive planning has its roots in the positivist confidence that humans can determine the environment in which they live, through science and practice, principles on which the notion of the modern state is based.

According to the rational-comprehensive model, urban planning is conceived as a form of scientific management of the transformations and growth of the city, to be designed by professional and specialised knowledge, to be implemented through the control and regulation of land, and to be forecasted through techniques and sophisticated models based on calculation.

Several criticisms are moved against these functionalist tools and approaches to urban planning, beyond the consequences they have on the development of the territories. First, this model tends to a centralization of power and control over urban transformations in the hands of a few individuals, not considering the values and historical representativeness of that spontaneous and self-determined consciousness of land manufacture that throughout history has determined the development of the various building cultures (Muratori 1963). In this sense, referring to Dahl (1958), rational-comprehensive planning schemes contributes to reinforce the “theory of elites”. In other words, these planning schemes maintain the power of decision in the ends of a minority made up of subjects at the top of public and private organizations, by excluding dwellers and communities from the city-making process.

Furthermore, the model provides for physical or environmental determinism (Crosta 1987) points out. The environmental determinism

embraced by urban planners was grounded on the idea of planning as an exquisitely physical action of intervention on the city as well as on the belief that through planning it is possible to modify social behaviours. In this view, planning is understood as a means of overcoming certain problems in a causal relationship. The professional actors (politicians, town planners and technicians) are the promoters of the plan, that is, the result of the rational end-means process that they administer.

To summarize what has been said so far, four main factors, influenced by rational-comprehensive decision-making models, inform the conception of the city and urban planning.

First of all, trust in scientific rationality and in the means-ends approach through which planning, inspired by the logic of choice, is rational with respect to the goal, and therefore through appropriate tools, it becomes an analytical-regulatory procedure and is configured as a technique. Secondly, planning assumes that the city can be analysed and confronted with a holistic approach based on an approach that we have called physical determinism. Third, the long-term perspective and determinism that is the trust in the ability of urban analysts and planners to predict its development over time, fuelled by sophisticated computational methods. Finally, the planning discipline is linked to the responsibility of the arbiter State to protect the collective interest, and its capacity , in terms of skills, means and power to intervene on the city.

3.2.2 INCREMENTAL SETTLEMENTS AND SERVICES IN THE URBAN SOUTH

" You've shown me problems that are solutions and solutions that are problems"

John Turner, 1960

It is in 1960 that the English architect John Turner after visiting informal neighbourhoods (favelas) and new social housing programmes in

Rio de Janeiro commissioned by the military government and financed by US Aid, makes this critical statement. At the heart of his critique is the state's obsession with eliminating urban informality through eviction, demolition and relocation of low-income dwellers into standardised public housing estates, located far from the city and from the eyes of the wealthier neighbourhoods.

As I have recounted in the previous paragraphs, the origin of the term incremental is to be found in the field of public policies to indicate those decision-making processes based on small steps, negotiation procedures and mutual adjustments, starting with Lindblom earliest reflections (1959). In the 1960s, the term is rapidly introduced into urban studies by western architects and urban planners who began to travel and document unplanned settlements across the Global South. John Turner is the pioneer, and starting from studies made in Latin America in the 1950s and 1960s, with his first important reference text *Freedom To Build*, he proposes a perspective reversal on the theme of urban informality, an issue that currently concerns at least one billion people on earth, particularly in the metropolises of the southern hemisphere where it affects at least 50% of the urban population (UN).

By working in informal settlements, Turner becomes fiercely critical of modernist planning and the centralised models it proposes, considered autocratic and inefficient. In particular, he argues that the state and technicians should not take the place of citizens in the construction of neighbourhoods, but provide them with tools (financial and infrastructural) to be able to conduct the process autonomously. In line with this idea, what the architect proposes is a re-conceptualisation of dwelling, through a shift of the conception of housing as a reference to the practice of living and to housing as a device of social transformation, well expressed in the sentence "from housing as a noun to housing as a verb" (Turner, 1972).

In 1965, the city of Lima was the site of a major experiment PREVI (Proyecto Experimental de Vivienda). Promoted by architect Charles Correa, PREVI represents the first experiment of planning for incremental development. This experimental district consisting of 1,500 dwellings, was collectively designed by a generation of radical avant-garde architects who converged on Lima in the late 1960s, was a pioneering attempt to reconcile the conflicting forces of informal growth and top-down planning. The planning of the neighbourhood was commissioned to international and Peruvian architects to develop prototypes of urban

housing that would internalise programmes for any future transformation. It is a model that has become an important reference for the definition of various programmes promoted by international development agencies.

From this moment on, “incremental” development, typical of the consolidation of human settlements throughout history, has been explored and integrated until the 1990s in the development policies carried out by international bodies such as the United Nations and the World Bank. New ways of producing housing and services were experimented, by recognising the economic and technical capacities of urban dwellers to build and improve their neighbourhoods through punctual and small-scale interventions distributed over time.

In 2011 Report Cities Alliance "A case for incremental housing" critically reports on the various policies adopted by international bodies since the 1960s and those now emerging that have allowed incrementalism to be accommodated in top-down planning policies. Three main approaches have been implemented to address the issue of informality and incrementalism in Global South cities.

In the 1960s governments tended to promote public social housing schemes, following the idea that the state should intervene in the formal housing sector, by enabling low-income dwellers to access housing. In this view, governments have produced dwelling and applied subsidies to make them affordable for the poor. At the same time, the phenomenon of urban informality should be contained, if nor eradicated. It is right in this moment when the tabula rasa model prevailed, allowing for the demolition of slum/squatted settlements across the Global South. However, this model was abandoned since it required high costs from state budgets, insufficient house units were provided as well as the state could not compel with maintenance of the existing housing stock.

The 1970s marked a shift from slum clearance to slum upgrade programmes, which started to be promoted worldwide by international agencies. The upgrading programmes generally entail the granting of secure tenure of land and housing, the installation of infrastructure networks (i.e. electricity, water and sanitation) and the provision of public services and facilities. The vision that Cities Alliance shows towards this phase of planning and approach to the theme of urban informality is critical. It highlights a whole series of problems concerning the suboptimal distribution and organisation of the territory, the inadequacy of housing conditions, and the environmental risks often associated with slum are-

as. The sites and services schemes represent the third approach/phase. They are still considered the best programmes, since they combine elements of the two previous approaches trying to overcome the limitations and problems that characterised them. Multilateral donors including IDB, ADB, WB, USAID have therefore started to support incremental housing strategies by implementing Sites and Services Schemes in a number of cities. The objective of these programmes was minimising public costs and subsidies demanded by social housing programmes, by providing what could not be easily achieved for households residing in informal settlements: land, infrastructures and basic services. In other words, these schemes legitimise co-production practices in housing (often providing minimum housing units that can be extended by residents over time) and basic infrastructure (water and sanitation).

The underlying hostility to technocratic state intervention and reliance on individual action eradicated in the anarchic-liberal thinking to which Turner adhered, has been somewhat hijacked by the development policies subsequently undertaken by international organisations, for which the author has worked (Rocco and Van Ballegoijen 2013). The emphasis on self-help, the legalisation of informal settlements, vernacular fashion and the experimentation with settlement and housing prototypes that accommodate self-building practices ended up being appropriated by neo-liberal discourse and ultimately used to justify the disinterest of institutions in the issue of access to housing and basic services.

Urban incrementalism went from being a critique of the dominant neo-liberal city development model to a development strategy largely manipulated by it.

The problem of exporting the incremental model to the contexts of the global south, characterised by rapid and dramatic urban growth, opens up a series of considerations that risk converging into the aestheticisation of poverty, where the question of urban informality is removed from issues of power, spatial injustice and systematic exclusion from political decisions that characterise the daily struggle of the urban poor. “In short, informality is increasingly mystified as an ideal image of anti-authoritarianism, and a flexible, aesthetically desirable and perhaps unavoidable” (Rocco and Van Ballegoijen 2013, p.1795)

3.3.1 THE SELF-ORGANISING CHARACTER OF ORDINARY ENVIRONMENTS

" In growing and changing through time, the built environment resembles an organism more than an artefact"

Habraken 1998, p. 6

Habraken's research, assuming the metaphor of the city as a living organism characterised by continuous processes of change, is mainly oriented towards understanding, through an operation of simplification and decomposition, the self-organising character of the built environment and its complex functioning mechanisms. As Lefebvre (1967) and Turner (1972), the author claims that the urban planning activity, as advocated by the comprehensive model, killed urbanity. Incrementalism appears as a better framework for understanding and intervening on the cities over rational calculation as it is based on reality and experience of the built-environment. Main statement of Habraken's book *The structure of the ordinary* (1998), is that the built environment often transforms regularly and coherently (rationally) without much professional intervention or a priori design, in a bottom-up, incremental process. A large part of Habraken's architectural-theoretical research is based on the investigation of these processes . He proposes an articulated lens to read the built environment as self-organising.

Concerned with the rigid, uniform character of mass housing and, in general, of the structuring planning discourses and practices advanced by the rational-comprehensive policy analysis, Habraken (1998) was convinced that centralised control, not technology, produces uniformity and rigidity in the contemporary cities. If inhabitants have no control, the urban fabric results excessively uniform and rigid, while if communities have no control, chaos and conflict emerge. Healthy, regenerative environments are the product of balanced control and interaction between individuals and communities, what he calls conformity. Opposed to uniformity, conformity is reached when a number of parties acting independently decide to follow the same model/pattern. Conformity therefore recalls to the level of interaction between the various actors participating in the planning process.

According to Caniggia and Maffei (1979), in historical moments of greater stability men tends to operate in their environments following a *spontaneous conscience*. In these consolidated phases of history, transformation processes occur in conformity to inherited culture and it is from these that the building culture proper and typical of each place originates. This basic and spontaneous construction becomes increasingly complex and specialised over time. While in moments of crisis, in the absence of a collective codification, a critical transition takes place that no longer allows one to proceed following “a rooted way of doing”.

The environment is considered by the two scholars as a repository of critical knowledge that allows societies an adaptive capacity: through a process of trial-and-error and preservation of historical variations, the environment sets the conditions for subsequent transformations. Built environments are thus the spatio-temporal synthesis of civilisation while architecture is considered a language of transformations, or as stated by architect Saverio Muratori (1963, p.5) “is the self-determining society, that is, it is society as seen by man, it is civilisation”.

The concept of cyclicity proposed and addressed by Muratori (1963), refers to a continuous process of urban construction that takes place through successive grafts on a system of pre-existing structures. A mode of development that is based on two paradigms: that of permanence and that of cyclicity, the former definable as a texture of consolidated beliefs and actions while the latter as a set of all the new needs that are grafted onto this constantly changing texture.

The authors mentioned above conceive history a self-regulated process that unfolds its own functioning through its own making. They also recognise that the industrial mass production of housing that characterises modern construction has prevented the full unfolding of the civic role of dwelling and that the city should therefore regain the quality of a living organism that is, to recover its condition of a reality capable of adapting to the transformations of its surroundings if a reconciliation between society and the built environment is to be found (Marzot 2016). The time factor becomes central because the fabric of the built environ-

ment allows for processes of mutual adaptation between society and the environment that hosts it, confirming in substance the collective character of every anthropisation process.

3.3.2 INFRASTRUCTURE LIFECYCLES

The complexity of the infrastructure landscape in the cities of the Global South is particularly clear when looking at the assemblage of hybrid, localised, often decentralised, infrastructural solutions that characterise water service provision to an increasing number of urban dwellers. Connected, disconnected, pre-connected, and re-connected configurations characterise the so-called post-networked city (Coutard et al. 2014).

In line with Offner (1998), this process of assembling that characterize infrastructures networks and related management practices has a cyclical nature. That is, networks can be read through cycles of coming and going, birth and decay, in the system of grafts on which they evolve, reaching different configurations by means of a constant reshape of boundaries.

This process of infrastructure lifecycle allows for increasing hybridization can take the shape of downscaling the key technologies and infrastructures providing water and sanitation services. It can lead to compensatory or concurrent networks, but it can also contribute to the disruption of existing technical systems and their substitution with new ones. As a consequence of those processes, the centralized provision of water and sanitation and localized solutions become mixed up (Van Vliet 2012, Jaglin 2014,).

Technological hybridization as a "situated combinations of incomplete infrastructuralisation and uneven hetereogenisation" (Rateau and Jaglin, 2022:7, figure 2). In this definition, infrastructuralisation rests on the consolidation of networked systems through stabilization, extension, or merging of more local networks, and the heterogenisation lays on co-production processes for new socio-technical devices and arrangements. Technological hybridisation mobilises, on the ground, not only multiple technical devices, but also multiple actors' capacities,

expertise and contribution in water provision. This reveals the assemblage character of the incremental city, in which its constituent parts are constantly being reconfigured (disassembled and reassembled). Such reconfiguration processes are not necessarily rapid or "revolutionary" by nature. Instead, they are often the outcome of a series of small, incremental adaptations over time, whose cumulative effect can be at least as substantial as the effect of abrupt innovations (Geels 2002). Both forms of innovation require users to "play an active role in adsorbing, coordinating, and even orchestrating the disruption" (Furlong 2014, p. 143).

3.3.3 CO-PRODUCTION AS AN EVOLVING ASSEMBLAGE

Where the functionalist paradigm considers the planning activity as a research oriented at solving problems and aimed at a specific purpose, the idea of planning as an interactive process places emphasis on knowledge, or the social learning dimension of the planning activity. Planning is therefore understood as cognitive activity, constructed through the interaction between the various actors participating in the process. In contrast to the synoptic approach to planning which is carried out on a large space and time scale, incrementalism appears as a shortening cycle between experimentation and learning.

Social learning, as emerges in the works of Crosta (1986, 1998), Lindblom (1979), Balducci (1991), Healy (2003), implies a relationship between theory and practice, knowledge and action. Where knowledge diverges from the functionalist conception of the expert knowledge, but is produced by the same action, which creates learning and innovation. In other words, it can be said that the planning activity moves away from the idea of 'problem solving', to that of 'problem setting'.

Another concept that influences the idea of the planning activity is that of *negative capability*. This term, as used for the first time by the poet Keats indicates "knowing how to be in uncertainties, in doubts, without being impatient to reach facts and reasons". This concept is taken up and developed by Lanzara (1993) to indicate a certain type of action that arises from emptiness and loss of meaning given by indeterminacy. It is not understood in a negative sense, as a lack of competence to interpret

reality, but as a cognitive sensitivity to better engage with the complexity of reality, capable of grasping its multiple dimensions and meanings and the hidden conditions of possibility. In this sense, planning is configured as a constructive and exploratory activity that feeds on situations of rupture, discontinuity and asynchrony. The creative counterpart of indeterminacy paves the way for the idea of the planner as bricoleur. Lanzara associates the figure of the bricoleur with the idea of negative capability because his action is oriented to build bridges between realities or contexts that often appear distant or incompatible. It is not with the big project, but with the daily bricolage with which through expedients and improvisations, reality is built and understood. The figure of the "bricoleur", opposed to the "expert", the "engineer" (Levi Strauss 1962), or the "urban artist" supported by the rational-comprehensive approach, appear as the one that better fits to the new approaches to the planning discipline. He represents the ability to adapt the design choices to the available equipment and conditions in a closed universe open to infinite experimentations and possibilities. The cities, intended in this sense, are "unstable laboratories" where innovation and experimentation but also insecurity and disruptions coexist (Farah and Teller 2012).

The three components of co-production analysed in Chapter 2, i.e. organisations, infrastructures and urban fabrics, are in a constant state of becoming, and in this process of continuous transformation, the city is configured as a vast assemblage in constant mutation. These physical and non-physical dimensions constituting the co-production system are continuously addressing changes and responding with incremental strategies: thus, organisations are adapting over time their boundaries and decision-making processes with respect to internal (size, role, norms) and external (institutionalization, regulation) configurations; infrastructures and built environments expand and contract and develop over time on top of each other (figure 39).

Incrementalism offers us a key to reading the phenomena of urban and infrastructural growth in the cities of the Global South. Similarly, the idea of interactive planning, understood as a learning process and policies as common goods practices, gives us an equally interesting observation point for framing the phenomenon of co-production of urban services.

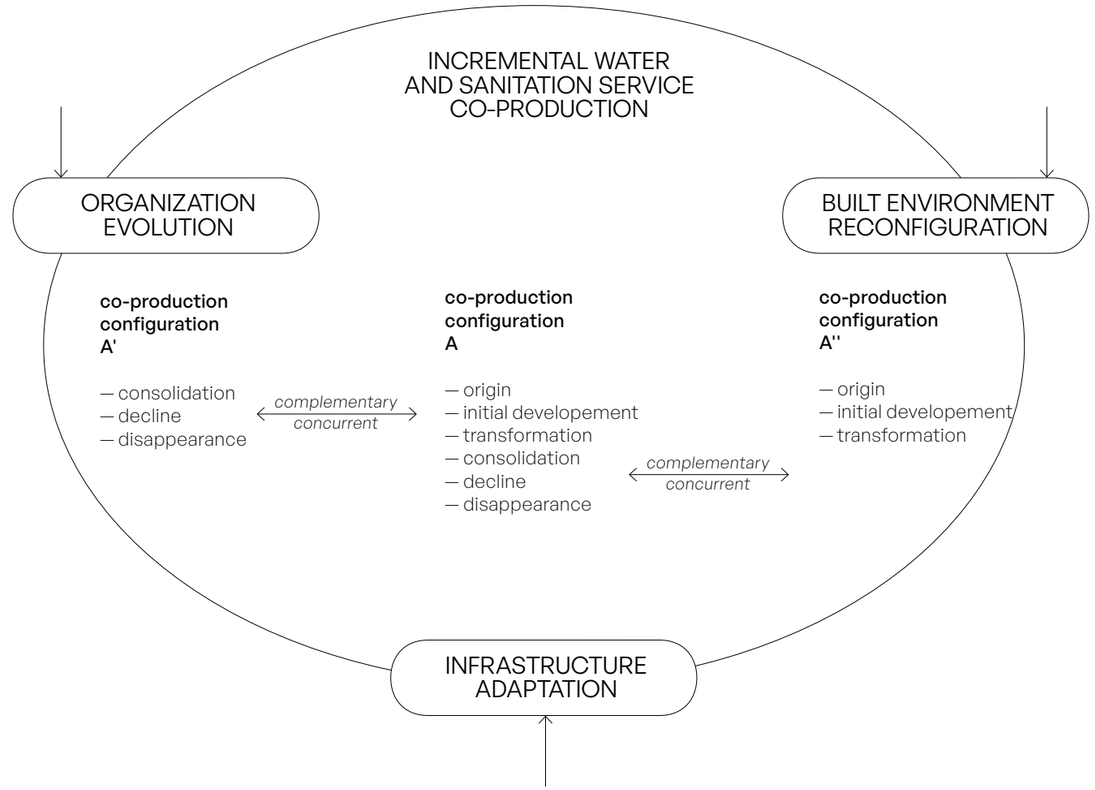


Figure 39.
Framework of analysis of wss co-production

4 Profile of the two case study cities

4.1 Hanoi “between the rivers”: the legacy of an hydraulic civilization

The deltas have historically attracted human settlements because of their hydraulic richness and soil, their unique ecosystems, and their advantageous location on maritime and river trade routes (Fanchette 2014). In Vietnam, where the word *nuoc* simultaneously means country and water, the fluid element is an integral part of daily life and a deeply rooted element in the history of land production by early human settlements. Ancient legends reworked by the Vietnamese folklore over the centuries, tell of the ancestral link between the divinities of the land and the genies of the waters inhabiting the Red River Delta. A founding myth that attests the necessary domestication and mastery by humans of land and water to allow survival of human life (Papin 2001). The first sedentary settlements in the delta in the first millennium BC, are characterized by houses built on stilts and long boats used to drain swamps, ponds and rivers (Montresor 2016).

Human settlements in the Red River Delta had been developed in a relationship of ambivalence with water: on the one hand, the abundant resources provided fertile land for agriculture and fishery, on the other hand it was an element that must be controlled and from which it was necessary to protect. Tthe Asian civilization itself arose through massive feats of hydraulic engineering and the need to coordinate large pools of labour as well as the centralized bureaucracies governing such waterworks (Montresor 2016). The Frankfurt school theorist Karl Wittfogel (1957) developed the term “Hydraulic Civilization” to qualify a civilization whose agricultural production depends on irrigation-drainage works and large-scale flood control (dams, levees) which is the cornerstone of spatial control. In this form of land management, a centralized government dominates the economy, making it possible to assemble sufficient manpower for the construction and maintenance of all hydraulic works, combining large collective facilities set up and managed by the state with smaller scale technical infrastructures, i.e. pumping stations for irrigation and drainage networks resulting from local initiatives. As observed by Bookchin (1973), this form of land management in Asia was

possibly the most ancient class society, emerging when the traditional clan society began to disintegrate in light of economic development. According to the anarchist theorist, the Asian land system testifies that exploitation of human by human preceded the privatization of land and resources. Moreover, he argues that the need for a collective management of the hydraulic networks led over time to the centralization and bureaucratization. It is the case also of the Vietnamese state apparatus, of which even today, despite the opening of Vietnam to market economies, an indelible trace remains in the political structure of the country. This modality of territorial control around water management allowed for a natural food and health security for the agglomeration of people in the Red River Delta. This society was organized around the management, distribution, and drainage of water, in a country almost entirely rural at the time, where agricultural production was the most important source of income for the state through taxes paid by peasants (Montresor 2016, Fanchette 2016).

The city of Hanoi, which literally means “city inside the waters” is a witness to this process. Because of its location on the floodplain of the Red River Delta, where the water level fluctuates between 2 and 14 meters during heavy rainfalls, Hanoi is subjected to regular floodings and land subsidence. The control of water represented the driving force for the organization of the urban fabric. To protect the settlements from flooding, a whole system of dykes has been developed since the establishment of the city in 1010. From its foundation, the city was surrounded by an earthen rampart system, acting a protection from invasion but also from water. As in other Southeast Asian areas, Hanoi development is considered the cradle of pile dwellings. The characteristics of this hydraulic civilization, of which very few traces remain today, resulted in the development of "water sensitive" settlement models and housing types. The floors of the houses were raised by stilts to free the ground of construction. This was a simple technique of raising houses out of the water, which was particularly well suited to the floodplain of the delta. Later, settlements began to develop on natural or cut mounds, which allowed them to excavate an irrigation system while generating raised platforms to install villages or more vulnerable crops such as horticulture (Pham, 2013). The city's relationship with water resources in the face of rapid urbanization and modernization is profoundly changed today. The current forms of urbanization, i.e. the construction of new residential areas funded by the private sector, do not follow a water resilient approach.

First, the rapid urbanization has led to the progressive disappearance of ponds and lake for a total of 330 ha out of the 850 ha of water surface in Hanoi central areas (Pham Anh and Shannon 2009). This process, which already started during the French colonial time, has contributed to the disappearance of 21 of the 40 lakes in the city centre, particularly those of symbolic importance to the Vietnamese culture (Logan 2000). Second, the expansion and densification of the city in flood-prone areas and the replacement by concrete and asphalt of the water systems and soft surfaces . The decreasing permeability of the ground through the mushroom-kind explosion of new high-rise buildings, contributes to increasing subsidence and inner-city floods (Schramm 2016).

The swift rural-urban transformation has adverse impacts on the environmental complex water management system of dikes, pumping stations, and sluices. Construction upstream along the major rivers, inside and outside of the country, lead to dramatic and unpredictable changes in the water regimes, which in turn lead to the frequent occurrence of severe floods and droughts, that increasingly threaten the territory and undermines the traditional ecological balance between human settlement and water resources.

4.1.1 BETWEEN POPULAR AND INVITED DEVELOPMENT

Today Hanoi, the second largest city in Vietnam, is a rapidly growing Asian metropolis, occupying an area of 3.300 km2 in the Red River Delta (Labbé and Musil 2014). According to several authors, urbanisation processes in Hanoi are the outcomes of socialist approaches and market mechanisms characterising the fluid and contrasting nature of state-society relationships in space production logics (Geertman 2003, McGee 2009, Tran 2015). On the one hand, there are large-scale urban plans, representing globally circulating visions of modernity and characterised by connectedness to centralised infrastructure networks (Schramm 2016b). The plans drawn by French colonials, supporting the image of a sanitary city, were the first to develop a sewage system in the colonial district. Likely, the interventions drawn with technical and economic support from the former Soviet Union and the current master-

plan, partially funded by the private sector, fall into this category. On the other hand, and in contrast to these planned forms of city development, urbanism in Hanoi is also produced on the local scale, determined by site-specific social and spatial instances, in a pragmatic and incremental way (Geertman 2007, Kerkvliet 2001, Koh 2006). A number of policies adopted from the 1980s, in contrast with the progressive retreat of the government in the provision and maintenance of the housing stock, de facto invited and institutionalised, for a certain period, unplanned and popular urban growth (Cerise 2009, Geertman and Kim 2019). In 1986, the Vietnamese Government underwent a phase of complete socio-economic transition applying a series of political reforms, under the name of Doi Moi (trans. Renovation) aimed at increasing the national productivity while attracting foreign investments. The opening of the country to the market economy contributed to generate and distribute economic opportunities for the inhabitants, also in light of a radical change in land use patterns. The liberalization of the real estate sector, encouraged the private sector's housing production. From 1993 to 2001 80% of the housing stock in Hanoi was driven by the popular sector, namely individuals, self-organizing and producing urban space in a spontaneous and incremental way. However, with the revision of the Land Law, this policy has been ceased to re-assign a larger role to state planning authorities. The year 2000s marked the beginning of a new phase of urban development, supported by the rise of foreign and state investments in the real estate and in large scale infrastructures. The current form of urban re-ordering consists in densification of already built areas and massive construction of New Urban Areas (NUAs), urban mega-projects proliferating at the rapidly growing edges. Indeed, those mechanisms of reconversion of rural land into urbanized land occur through large expropriations of agricultural land, filling of existing lakes and ponds and through mechanism of disconnection from the existing urban environment. Built without adequate transportation facilities, these high-rise building complexes break the dense urban fabric and the traditional structure of villages. They reveal the ongoing tensions in the processes of urban production, suggesting that much of the built-up city had yet to come, and that this densification would not come without contrasting forms, possibilities and desires.

4.1.2 INCOMPLETE NETWORKS: A SPACE FOR CO-PRODUCTION

figure 40. 41.
Hanoi water (left) and sanitation (right) networks with the location of the main case studies

The current municipal networked water infrastructure is mainly based on the exploitation of ground water (700,000 m3/day) and surface water (300,000 m3/day) from the Red River (Wright-Contreras et al. 2017). Four water supply enterprises (state owned Hanoi Water Supply Companies) are responsible for piped water (the largest operating is Hanoi WSC, HAWACO), and 19 small water supply stations. 3000 km pipeline serves about 93% of population living in urban districts, while in districts stipulated as rural, only the 26,6% of population is connected to the municipal water supply [1] . Groundwater has been traditionally the primary source of domestic water in Hanoi city. With rapid urbanization and population growth and the evolution of lifestyle, the water demand is expected to increase from 900,000 m3/day in 2011 to 2,359,000 m3/day in 2030 (Kuroda et al., 2017). In order to meet this growing demand, the water infrastructure network has included in 2008 surface water supply system, and has extended into urban areas.

However, in Hanoi the inefficiency of the public water supply network is evident by a more than 40% losses due to leakages (non-re-

1. http://hawacom.vn, accessed on March 7, 2018

venue water), low pressure in the pipes which does not allow the water to reach upper floors as well as an often interrupted and irregular water flow. Moreover, according to regulations, the water company only guarantees that the water meets the national quality standards set by the Ministry of Health at the output of the treatment plant. Since the infrastructure is obsolescent and encounter frequent leakages, and since the most common sanitation facility is on-site septic tanks, contamination of drinking water occurs on a regular basis. In order to contrast those gaps in the service delivery, the majority of households implement/re-adapt 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 receive an improved quality of drinking water. In spite of being connected to the centralized networks, Hanoi dwellers, as in many other cities across the south, are actively engaged in the service delivery process, especially at the household level. Indeed, one of the most striking images while observing Hanoi from above, is its skyline, characterized by heterogeneous architectural forms upon which storage tanks rise up. Echoing Marie-Helene Zerah (2000) Hanoi dwellers make use of a number of compensatory strategies in the absence of a reliable and adequate water supply. The most common household devices consist of a pump, masonry storage tank at ground level, storage tank at the top of the house and galvanized steel pipes from the pump to upper storage tank. It is accounted that 30% of Hanoi houses are equipped with masonry water tanks built of local materials on site, and the 70% of houses are equipped with stainless steel tanks or plastic ones. Water pumps are mainly imported from South Korea and China (Homäki et al. 2003). The cost of a water tank varies depending from the capacity and the material (plastic ones are generally much cheaper than steel ones) between 50 and 100 EUR. The survey we conducted in Hanoi urban and peri-urban areas in 2017-2018 reveals that more than 80% of households have installed roof water tanks and pumps, turned on once in a while to refill the tank from the underground city water supply, while 31% have underground water tanks. In few other cases, when economic capacity of households is very limited and in case of lack of property title which make living insecure and little investment in housing upgrade, alternative handmade solutions have been developed. These solutions generally rely on cheap or recycled material to store water. Moreover, according to the survey, the most common treatment method is boiling, however the 15% of the household surveyed is equipped with filter columns to treat the water before consumption. Kangaroo filter columns price, especially found in middle-high income areas, vary according to the function, the size of the “suspended particles” and the duration of the filter. In peri-urban areas filtration systems vary from more rudimental systems (using sand and small stones) to filter columns depending on the water source and its perceived quality, and economic capacity of the family.

In those peri-urban and rural areas disconnected from the centralized network, groundwater is still the predominant source of domestic water. Dwellers access water in a number of ways, relying on community-based piped water systems, households’ tube wells. However, the excessive abstraction of groundwater has led to severe land subsidence, estimated to be >50 mm/year (Nhan et al. 2004). According to Hanoi Masterplan[2] , connection to water pipe lines in both urban and rural areas is expected to reach the 100% mainly due to extensions of provision in NUAs. The pursuit of a networked city and ubiquitous infrastructure is embedded in the vision of a rational and planned global city. According to the legislation, in those area the installation of decentralized infrastructures for water and sanitation has to be integrated in the construction of new real estates. This arrangement called “land-for-infrastructure” is a land-based financing mechanism through which planning authorities use land as in-kind payment for the construction of technical infrastructure and public services (Labbè and Musil , 2014). The extension of the infrastructure networks in these areas will allow the progressive inclusion of peri-urban villages and the progressive dismantling of traditional community-based systems for water supply.

The neighbourhoods observed in the following chapters illustrate how the tensions between planning models and material improvisations that arise in the city’s incremental development emerge at different scales and determine the way infrastructure is produced and reconfigured and the ways that water and sanitation services are currently delivered to urban dwellers (Schramm 2014). While expanding and transforming to sustain the rapid pace of urbanisation, Hanoi water and sanitation networks are leading to anguish over constant shortcomings, which have generated ingenious and localised alternative systems. Those alternative systems engage citizens at different scales in the production and management of the technical infrastructure for the delivery of water and sanitation services. This engagement involves economic resources (co-funding), maintenance and repair (co-management) and

2. Water supply masterplan of Hanoi Capital through 2030, with a vision until 2050” approved in 2014, through resolution No. 499/QĐ-TTg

planning (co-planning). They do not necessarily develop against a lack of centralised water and sanitation networks. On the contrary, they coexist and dialogue with existing infrastructure networks (Rao 2015).

42,
Royal City apartment towers and the informal tube house constructions. Hanoi, 2018

43.
View of the To Lich River

44.
Super-block in Linh Dam. Courtesy of Jacques Teller

45.
Hoan Kiem lake in the centre of Hanoi.
Courtesy of Jacques Teller.

46.
Tube houses in Hanoi centre

47.
Construction of NUAs in the peri-urban fringe

48.
Densification of Hanoi villages

4.2 Cochabamba: a marshy plain under urbanization

Located 2500 meters above the sea level, in the eastern Bolivian Andes, Cochabamba derives its name from the Quechua words *khucha*, swampy, and *pampa*, plain. Cochabamba owes its ancient agricultural vocation to its favourable location in an area surrounded by three contiguous valleys (the Upper Valley, the Lower Valley and the Sacaba Valley). As a marshy plain, the area is generally recognised as being the agricultural heartland, one of the most fertile areas of the country due to a soil that produces an abundance of wheat, cereals and fruits. The city was founded by Spanish settlers at the end of the 16th century on the foundations of the previous pre-colonial village of Canata. Since then, it has achieved importance due to the development of agricultural estates, which had the purpose of supplying food to the mining industry in Potosi (Ledo, 1986). Its particular geographical position has made it historically an extremely dynamic city: a land of passage, crossed by important migratory flows and lively commercial and cultural exchanges. The fertility of its lands has made it a territory coveted by Spanish settlers who implanted an agricultural system of haciendas, around which for a long time revolved the economy of the city (Cabrera, 2015).

Today the city accounts for 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 appeared as an agglomeration of small villages whose main function was 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 was complemented with commercial and industrial activities and a process of urbanization started. It is during the 1980s, overcoming the deep economic crisis resulting from the decline in mineral prices, that the entire country experienced the transition from a statist model to a free market economy (Cabrera 2016). The government, by transferring the country strategic state companies to the hands of private entrepreneurs, caused 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 pushed Bolivians into cities to find work, Cochabamba received the major part of migration and squatter settlements start to arise in the water-poor south side of the city (Wutich 2010).

After 2006, as a consequence of new economic model, i.e. the shift from a liberal development model to a mixed economy, and land reforms, economic and population growth due to the nationalization of hydrocarbons and foreign demand for raw materials, the city underwent a great dynamism in the construction sector. A new phase of rapid urbanization followed, which led to the proliferation of informal settlements in the peripheral areas of the city. Between 1962 and 2016 the urban footprint of the metropolitan area grew from 2,481 to 19,487 hectares, or 17,004.6 hectares in 54 years, with a growth rate of 314.6 hectares per year and 26.24 hectares per month (Cabrera and De La Fuente 2017).

As a result of this dynamic, the crisis of access to basic services has increased in the last years. The densification of certain areas of the city has saturated existing systems and exacerbated problems related to access to water. A number of authors have tried to observe how forms of local, 'contractual reciprocity' largely found in Bolivian rural areas, were indeed translated into urban environments in order to sustaining and reproducing local water management systems in absence of state service provision (Wutich 2010). In the city of Cochabamba, beside its pragmatic orientation, which will be articulated in the case studies analysis, this collective reciprocal action around water management has also contributed to create strong basis for broader political alliances and in backing particular water policies aimed at privatizing and individualizing water rights (Bustamante 2004). The 2000 Water Wars in Bolivia is the most relevant witness of this process.

4.2.1 DECENTRALISATION AND INSTITUTIONALISATION OF COMMUNITY ORGANIZATIONS

On a number of recommendations of the World Bank, the Bolivian government decided 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 (small scale water operator), including cooperatives, territorial based organisations, water and peasant associations who had built their own water systems, were required to be connected to the concessionary's network, without any form of compensation. 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). The increase in the water tariff was justifiable by the World Bank to cover the costs of the network extension, represented by the Misicuni project, a new water system designed to bring water to the Cochabamba valley through the construction of a dam and a pipeline under the mountain. The cost of the dam, combined with a contractual ruling against public subsidies to protect customers against price hikes, meant that bills increased by 200 per cent in some communities within two months of the concession being granted (Walnycki, 2015). Numerous urban and rural communities that relied on local water sources rose up in opposition to the concession and the appropriation of resources. Through resistance movements and widespread violent oppositions which are known as Cochabamba Water War, Aguas del Tunari was expelled and the water system returned 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. 40 % of SEMAPA water is supplied by well-fields located in the alluvial fan system in the northwest of the valley (groundwater), and 60% by reservoirs located outside the valley and by the recently constructed Misicuni [3] dam (surface water) (Interview Senior Officer SEMAPA, 2018). Misicuni is a state enterprise set up to provide potable water, irrigation and power generation in the metropolitan area of Cochabamba.

Although this large water supply project 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. The obsolescence and inadequate section of the current water network and the lack of pipes prevents this water from being adequately distributed.

3. Misicuni is a state enterprise set up to provide potable water, irrigation and power generation in the metropolitan area of Cochabamba.

SEMAPA has been unable to keep up with the pace of urbanisation, and has been undermined by institutional and infrastructural challenges and chronic water shortages. In areas disconnected from the centralized network, self-provision and co-production, under different governance structures, are still the main strategies for communities to access to urban water supply. Cochabamba water company (SEMAPA) still lacks good quality water, chlorination is the only treatment performed before distribution. Today only the 30% or less of the metropolitan population use water services provided by the public operators, (SEMAPA, EMAPAQ, EMAPAS) while the rest is produced by decentralized systems and managed by small-scale operators (Cabrera 2015). 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. In the absence of universal provision, an uneven landscape of service provision characterises the city. In areas disconnected from centralized water network, water services have been self-developed by local groups in all seven municipalities.

In 2008, the World Bank in its WSP Water and Sanitation Program defined Small Scale Water Operators (OLPEs) as private or mixed operators providing water and sanitation services in rural, peri-urban and urban areas with less than 30,000 inhabitants.

In Bolivia, these operators started offering services as early as the 1950s. Today they take different forms: Cooperatives, Associations or Committees and water organisations internal to the OTB or Junta Vecinales (Cabrera, 2015). While cooperatives and associations are autonomous organisations, the organisations internal to the OTB and Junta Vecinales (JVs) have a dual role as service providers and as a political and territorial administrative unit.

It is accounted that more than 600 informal and quasi-formal community water service providers that exist across the city are providing water in wealthy suburbs and low-income and informal settlements (Walnycki, 2015).

The operators providing drinking water and sanitation services in the city of Cochabamba are distinguished between public operators and community operators. While the former are articulated directly by public entities, generally by municipal governments, the latter are managed by the communities, according to customs and traditions. Article 8 of Law 2066 defines all these operators as EPSAS (Entitades Prestadoras

of Law 2066 defines all these operators as EPSAS (Entitades Prestadoras de Servicios de Agua Y Saneamiento), i.e. public, private or community actors, only with the recognition of legal personality.

The Neighbourhood Councils (JVs) define informal associations or groups of people who live in the same neighbourhood of the city and organise themselves to improve access to basic services (water, electricity, sanitation), infrastructure and public services. These organisations, which have an ancient origin in the history of self-organisation in Bolivia, were institutionalised in 1994 with the Popular Participation Law: with the enactment of this law, the state legally recognised these organisations, giving them the legal personality of Grassroots Territorial Organisations, (OTBs). In order to be given legal personality, the representatives of these organisations had to apply to the OTB register, presenting documentation proving the number of families belonging to the Junta, the register of assemblies, the regulations or statutes and the appointment of a board of directors. Recognition as an OTB, as part of a wide-ranging decentralisation policy implemented at national level, allows these organisations to access resources from the municipal Annual Operative Plan (POA) and prioritise investments in their neighbourhoods. The idea of institutionalisation was to create the conditions for combating poverty and better management of public administration. However, several controversies have been raised by a number of researchers who have studied the effects of the LLP on the "democratisation" of the country and poverty reduction, an ambition to which the LLP aspired in its definition. While the government's stated objective in implementing the LLP was to foster democratisation and to bring the community closer to political decisions, several authors argue that the hidden objective was quite different. That is, to weaken and disperse the trade unions, which were very strong in the country, thus creating a fertile ground for the implementation of the neo-liberal agenda aimed at guaranteeing transnational companies access to resources and cheap labour (Kohl 2002, Altman and Lalander, 2003).

4.2.2 FRAGMENTED WATER SUPPLY LANDSCAPES

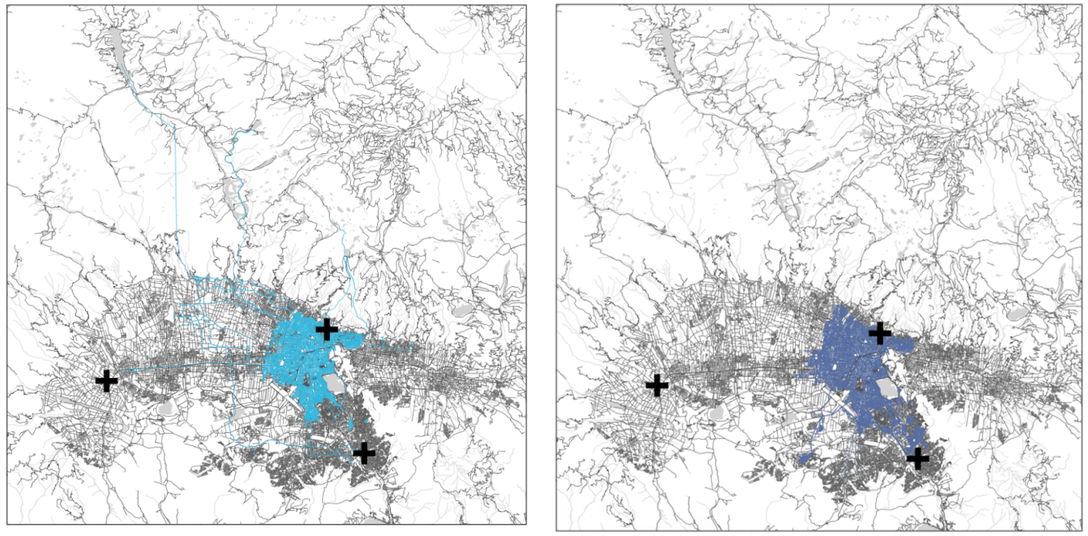


figure 49-50. Cochabamba water (left) and sanitation (right) networks with the location of the main case studies

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 disconnected from the centralized networked systems.

OLPEs may be organized along three main legal lines: as cooperatives, associations or water organisations internal to former Neighbourhood Councils (JV) and Grassroots Territorial Organisations (OTBs). The latter, OTB, is acknowledged in the Bolivian Constitution as the smallest territorial unit with official status, is partly funded by the national government and the municipality through the Annual Operative Plan (POA) in order to support their costs and organization related to urban and infrastructure development.

OLPEs are at the core of WSS co-production in the Bolivian city. 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 signifi-

cant impact on the environment. As regards political representation, OLPEs are officially represented 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, 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, when in the figure of the OTBs 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 (Cabrera 2015). 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. Moreover, these organisations have generally no responsibility as regard with wastewater collection and treatment, thus they fail to close the water cycle.

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 area with complex

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The next paragraphs will present three different case studies observed in the metropolitan area of the city of Cochabamba. The cases were selected because of their diversity, both at the level of geographical location and consequent diversity in terms of environment and resources, and because they witness various phases of the urbanization process of the city.

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51.
View of Cochabamba from the Northern part

52.
Urban neighboruhoods in the north of the city

53.
Urban crossing in the north of the city

54.
Street vendors in La Cancha market

55.
Public toilet in La Cancha market

56
Spontaneous settlements in the south of the city

57.
Peri-urban villages in the north-east of the city

4.3 Baseline characteristics of WSS coproduction in the two cities

This section provides a comparative reading of the WSS coproduction landscape in Hanoi and Cochabamba. It aims to explore overall dynamics as well as recurrent and divergent features of WSS co-production in the selected urban typologies, addressing both social and technical dimensions.

The urban, socio-spatial, tech-environmental and economic contexts of WSS co-production are explored with respect to the urban and infrastructure development, socio-economic dimensions and distribution of household expenses for the service (equity). The aim is to check the underlying features of co-production in the two cities, in order to better contextualize the detailed case studies.

This study is based on a statistical analysis of a total of 600 questionnaires in the two cities. We interviewed 20 persons randomly selected in 15 study areas in each of the cities. The study areas were selected in collaboration with local experts so as to identify a wide range of urban and coproduction solutions, from the most formal to the more informal ones. The survey was directly conducted by the researchers in collaboration with students and members of local partner universities. The responses were encoded locally and a quality check was realized by the researchers of the project. Data has then been merged and crossed between each city through the use of R software. The following variables have been considered in the analysis:

1. Urban context: settlement typologies, settlement origin, distance to city centre;

2. Governance and management: involvement in local community groups, and more specifically in groups dedicated to water and sanitation management;

3. Water and sanitation infrastructure: connectedness, type (number) of water sources, technological portfolio, toilet type and uses;

4. Water and sanitation services: water frequency and quality, frequency of desludging;

5. Economic variables: household income and water expenses per capita;

6. Satisfaction level of inhabitants as regard with the service, its quality and its cost.

In general, data are representative of areas and typologies selected for the survey. As case studies were selected with local experts as regard with their potential value for in-depth studies, the results may not be representative of all city situations. Moreover, information related to sanitation service can be subject to more biases, compared to water service. That is because in the case of water, we can find some practices of co-production, may these be individual or group co-production, in all the areas we selected, while this is not always the case for sanitation.

This section is structured along four sub-sections. I will first present the sample of 60 cases across the two cities. I will then compare the involvement of households in the management of water and sanitation, and the WSS infrastructures observed in the different cases, considering both water and sanitation infrastructures, at a collective and an individual level. The following section will be dedicated to the WSS services as regard with case typology and infrastructures. The last section will be dedicated to the satisfaction of inhabitants as regard with the service, considering its cost and quality.

A clarification is necessary at this point. The data presented in this session recounts only two cities out of the four that were subject to statistical analysis. The questionnaire was also administered by my colleague, PhD Giuseppe Faldi in the cities of Addis Ababa and Dar Es Salaam. This comparative section therefore extrapolates some insights from the broader investigation that also covered African cases.

4.3.1 THE URBAN CONTEXT OF WSS CO-PRODUCTION: SETTLEMENT TYPOLOGIES, DENSITY AND CONSOLIDATION

Different settlements selected include all types of urban typologies found across the two cities. They range from core settlements, slums, collective blocks, apartment towers, collective private housing, gated settlement to village settlement. They represent recurrent urban typologies which are also found in other cities of the Global South. Access to water and sanitation services and practices of co-production may profoundly vary across these typologies, both among the different cities and within the same city.

The selected cases also differ in terms of temporal origin (historical: more than 15 years / consolidating: 3 to 14 years ago / recent: less than 3 years ago) and density (low, middle, high). These three variables (settlement type, age and density) were categorized by the researchers in collaboration with local experts.

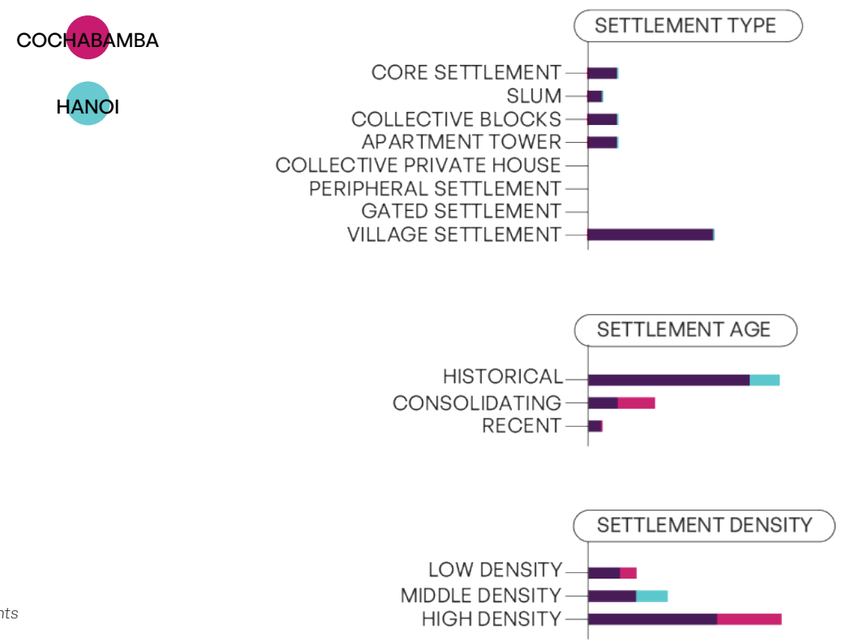


Figure 58.
Types of urban settlements considered in the survey

It can be seen from *Figure 58* that some of the selected typologies are not present in both cases as the history, morphology and urban development of the two cities is highly different. However, it should also be acknowledged that this is influenced by pre-existing knowledge of potential cases by researchers and local experts. I know for instance that there are gated settlements in Hanoi and Cochabamba, but these could not be selected because of difficulties in accessing the management boards and obtain information about water and sanitation coproduction, given they are built and managed by the private sector.

The 60 case studies selected in this research have hence to be addressed in a comprehensive way and results can be analysed either by city, by settlement type or by settlement origin in the rest of the text.

The co-production landscape in Cochabamba is largely explored in a predominant urban typology, informal peripheral settlements. Indeed, this urban typology is the one that mostly contributes to qualify the rapidly evolving peri-urban interface (Cabrera 2016, Rosati and Cabrera, 2020). The reason for choosing to work mainly on one urban typology is the research interest in one particular form of co-production,- almost disappearing in Hanoi-, that occurs through community organisations, which are largely found in these peripheral settlements. Generally built on pre-existing farmland and inhabited by migrants, co-production of water services (sometimes also sanitation) in these areas of Cochabamba is characterised by a variety of local water operators (OLPEs) engaged in service provisions, resource systems and management models. In Hanoi, the landscape of urban typologies selected for the survey is much more variegated. Here, central areas, traditional villages, colonial neighbourhoods, slums and collective blocks inherited from the socialist period have been selected and explored. Likely, in the peri-urban interface of the Vietnamese capital two new real estate developments (counting diversified housing types, although with the predominance of tower buildings) have been selected. These tupologies of settlements are widespread at the city level and progressively built in the agricultural interstices between historical villages (Fanchette 2016).

The majority of cases addressed in the research may be considered as historical (figure 58). Accordingly, the forms of coproduction considered in this study do not necessarily appear as a temporary response to a lack of access to centralized services due to a recent urban growth. In most cases, co-production practices develop in historical or consolidated settlements, may it be in combination with the centralized

network or as a palliative to its absence.

One may further observe that coproduction develops in different urban density typologies, with a dominant presence in middle-density in Cochabamba and in high density areas in Hanoi. It should be acknowledged that the two cities highly differ in terms of density. While in Cochabamba the population density accounted for 31.69 persons/km^2 in 2012, in Hanoi the population density accounted for 2,098.8 person/km^2 in 2013.

Village settlements in Hanoi indeed witnessed a strong densification over time, either though vertical extensions, land subdivision or conversion of agricultural fields (Fanchette 2006, Koh 2006). Besides this, the demographic pressure in central urban areas often implies an overcrowding of housings. In Cochabamba, the explosive growth of the city and of their surrounding towns has mainly occurred through the conversion of agricultural land, within a framework of a lack of political leadership, chaos and improvisation, resulting in urban sprawl.

In Hanoi the process of urbanization has occurred in the framework of a centralized state with strong control over urbanization processes, although through the government-led program “the State and the people building together” informal growth was supported and sustained.

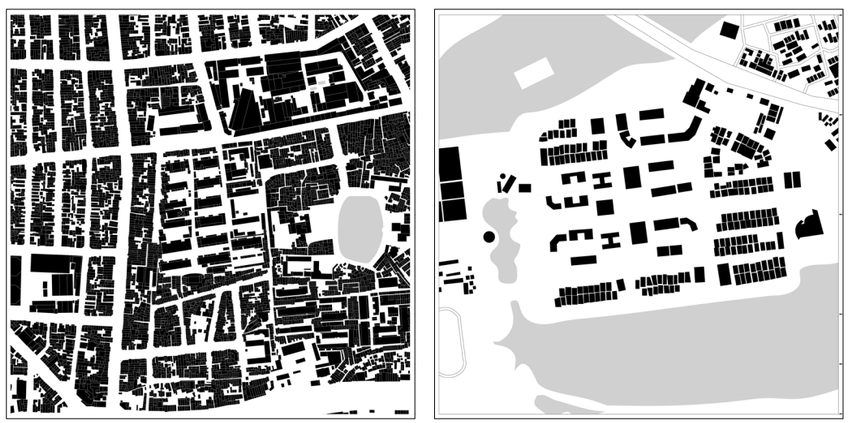


Figure 59.
Comparing densities.
On the left an urban district in central Hanoi, on the right a New Urban Area in the peri-urban fringe

Obviously, the level of consolidation and density are somehow related in both cities. Historical settlements tend to be denser. Still there are significant departures as regard with this relation, as in the case of peripheral settlements in Cochabamba that may be quite old but with low density, unlike New Urban Areas in Hanoi which are usually recent, high density developments.

Most peripheral households are privately owning their houses, with a percentage of families sharing facilities below 20% (figure 60). Given the difference between the typologies observed in Hanoi, the own built is around 50%. This is because a number of centrally planned and built settlements, i.e. Soviet neighbourhoods (collective blocks) and New Urban Areas (apartment towers), were considered in the analysis. Shared facilities are nowadays almost absent in Hanoi. Even if collective blocks were spatially organized around shared cores of facilities (kitchen and toilet), the liberalization of the housing market and the privatization of the housing stock led to the subdivision and privation of most shared facilities (Koh 2006, Cerise 2009, Rosati et al. 2020).

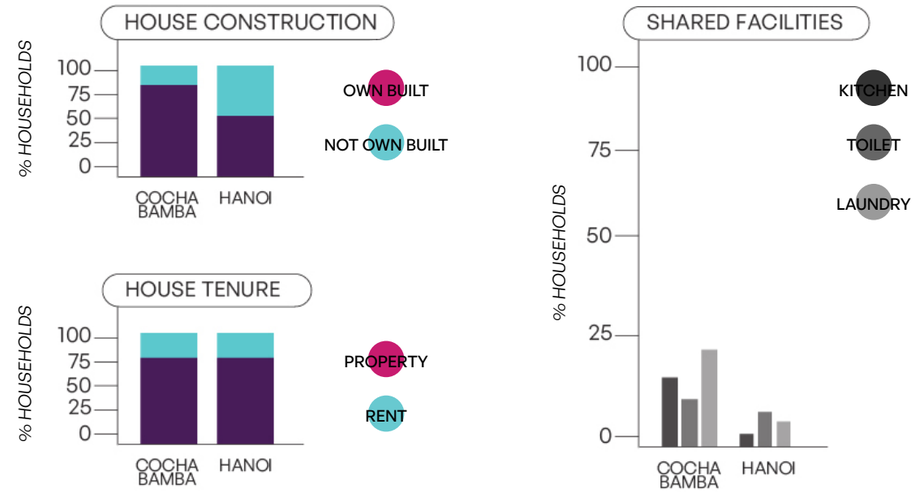


Figure 60.
Dwelling characteristics (house construction, house tenure, shared facilities)

4.3.2 INVOLVEMENT OF LOCAL COMMUNITIES IN WATER AND SANITATION SERVICES

WSS co-production develops at different scales: it can develop at the household level or as a community practice (group or collective level), with an increased degree of collaboration between service users. Interaction and cooperation are usually framed within community-based structures, organizations, may these be specifically dedicated to water and sanitation management, as mostly found in the case of Cochabamba or not, as in the case of Hanoi. Generally speaking, the level of involvement of inhabitants in some form of associations is very high in both cities (100% in Hanoi and > 90% in Cochabamba - figure 61).

In Cochabamba, the involvement of inhabitants in resident (OTBs) and water associations (OLPEs) is at the core of water service co-production (Wutich 2010, Cabrera 2016, Allen et al. 2017; Moretto et al. 2018). It reveals the strong community-based dimension of land and water management in the city that can be observed in most urban settlements (figure 5). Water co-production is mainly collective and operated at the neighbourhood level, often complemented with individual forms of co-production in order to increase service accessibility and quality. Sanitation co-production is rare and when the municipal sewerage system is not accessible, dwellers resort to individual or shared facilities (mainly holes). When the provision of water services is under the responsibility of resident councils (OTBs), the funds collected from the water bills are also invested in social activities (funerals, health, education) and in the costruction or improvement of local infrastructures, as for instance road paving or children playgrounds. A large number of community organizations in Cochabamba are engaged in the management of common areas, including those collective buildings and public spaces required for the operation and maintenance of water services.

In Hanoi, water co-production is mainly operated at the individual level, although forms of collective management are still present in rural areas, especially in historical villages not yet absorbed by the urban agglomeration. In urban areas, community involvement is primarily channelled through resident groups (TDPs) and women unions. Resident groups are mostly dedicated to the management of common areas and public spaces, may it be for renting spaces to street vendors or for the cleaning and management of common areas. They also are responsible for the maintenance of the drainage system and, in the case of soviet

living neighborhoods, they take the responsibility to collect funds for the periodic cleaning of the collective septic tanks. In rural villages co-production of water is generally related to the presence of agriculture cooperatives, a legacy from the collectivist period, are also responsible for managing the irrigation system and the technical devices related to water distribution and control, both for water supply and irrigation. While these organisations were once community-based, today they are in reality private enterprises. In New Urban Areas community involvement in water and sanitation services is mediated by management boards, forms of residents' organizations operating in parallel to the resident groups, which are not an extended arm of the government but operate as technical subjects to manage the complex infrastructures found in these large- scale urban developments (Schramm and Contreras 2017, Rosati el al. 2020).

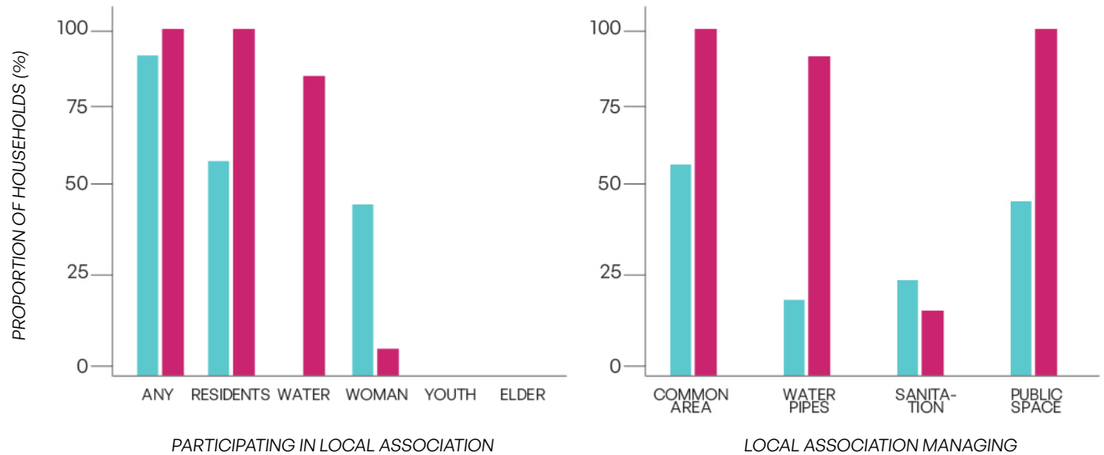


Figure 61.
Involvement of households in local associations

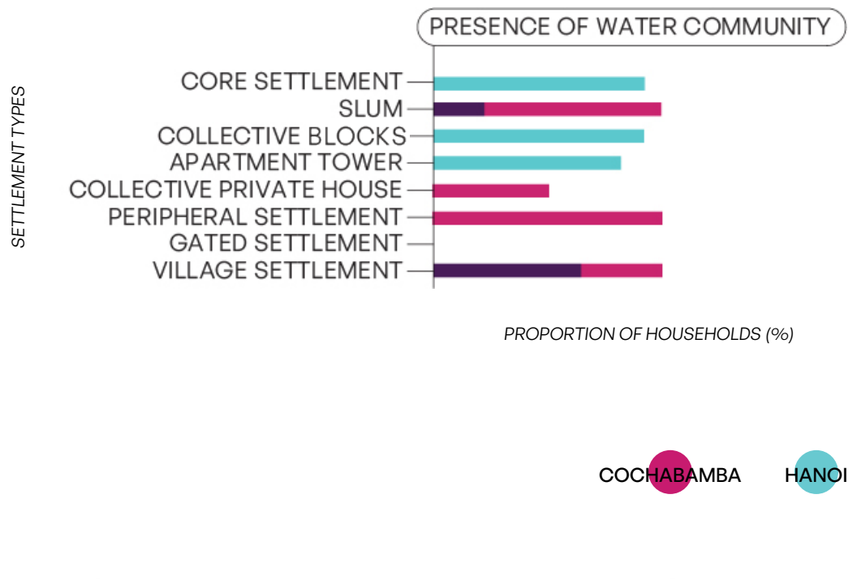


Figure 61A.
Presence of water community by urban typologies

Sanitation co-production is rarer, especially in the Bolivian city. Notably, in Cochabamba the extension of the sewage network exceeds the one of the water network. This is the opposite situation to Hanoi. Group or collective sanitation co-production is not so widespread in peripheral settlements where most of the small- scale water operators are active. There are almost no cases of local water providers handling the entire water cycle, from the extraction to the sanitation and treatment stage. Septic tanks and holes are generally self-built, sometimes shared among different families and typically handled by private operators.

In Hanoi, shared management of sanitation and drainage systems is not widespread across the different urban typologies, although in apartment towers and collective blocks, management boards and resident groups are involved in the maintenance of the shared septic tanks and the drainage system at the block or building level. The active involvement of local communities in sanitation can be explained by the typologies of collective housing, planned with shared infrastructures, by the scale of the building blocks and the high density of concerned urban areas. Sanitation co-production is different in village settlements, both urban and rural, where individual, group and collective practices coexist:

while each household is generally responsible for the maintenance of septic tanks, groups or collectives (under resident groups or cooperatives or village) are responsible for the management of the drainage networks, either at alley or neighbourhood scales.

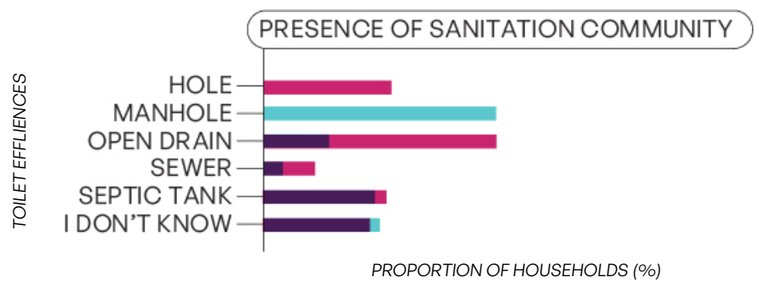


Figure 62.
Involvement of households in sanitation associations according to infrastructure systems

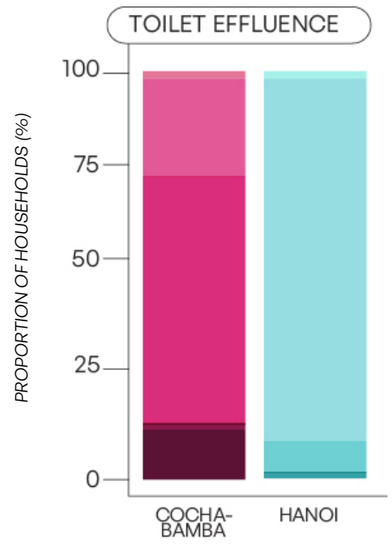


Figure 63.
Involvement of households in associations according to sanitation type

4.3.3 WATER AND SANITATION INFRASTRUCTURES

The involvement of users in water and sanitation services appears as a pragmatic solution that complements or overcomes deficiencies of the infrastructural of the municipal centralised service in both cities considered in this study. Service co-production thus present different characteristics and develops according to urban and environmental conditions. Addressing the technical infrastructures mobilised in water and sanitation services at the urban and neighbourhood scales may help to understand potential trends of users' involvement, in relation to access to centralised water networks, water sources and wastewater disposal.

In particular, water co-production differs in function of the access to the municipal networks. The relation between connectedness to centralised networks and urban typologies is explored in *Figure 64*.

In Hanoi urban agglomeration, where most of the case studies were selected, almost 100% of the inhabitants access the municipal water network, with an exception of the villages located in the outskirts of the city. As a complementary practice, water co-production in these cases mostly consists in a series of small-scale technical devices and tertiary pipelines plugged in the municipal network and mainly handled at the household level. Few collective extensions of the network at the street or block level can be found, such as in the case shared fountains in Hanoi slums.

In Hanoi peri-urban fringe, increasing connectedness to the centralized network goes hands in hands with the development of New Urban Areas (NUAs). The extension of the centralized network is indeed planned to reach these areas in priority, through an involvement of real estate developers in the funding and installation of the main infrastructure networks (road, water, sewerage systems) (Labbé and Musil, 2014). Accordingly, historic village settlements located nearby network extensions will benefit from these large-scale developments in terms of connectedness. As NUAs are developed at various distances from the city centre following land availability and development opportunities, this mechanism generates serious inequalities in terms of accessibily to the centralised networks from one village settlement to another (Labbè and Boudreau 2011, Moretto et al. 2018, Rosati et at. 2020).

In Cochabamba, the municipal centralised network covers a very limited part of the city, reaching some 20% of the population (MMAyA, 2013). Its coverage is mainly concentrated in the middle-high income

areas of the city, the northern part. When there is a connection to the centralized network in central areas, water co-production is mainly found in the distribution phase, consisting in individual pipes connected to the municipal network. Sometimes collective co-production is also found in areas connected to centralised water network: these are generally situations where the pre-existing collective networks drawing on local resources are maintained as back-up systems.

In peripheral settlements and in the southern part of the city water co-production is characterised by the involvement of a myriad of small-scale decentralised systems. When underground resources are available, co-production is covering all the water production process (from water extraction to delivery). When local resources are not available, like in the southern parts of the city, co-production covers some phases of the water cycle, from storage to delivery and is generally a collective practice. Individual co-production is also found in these cases to complement or improve decentralised systems.

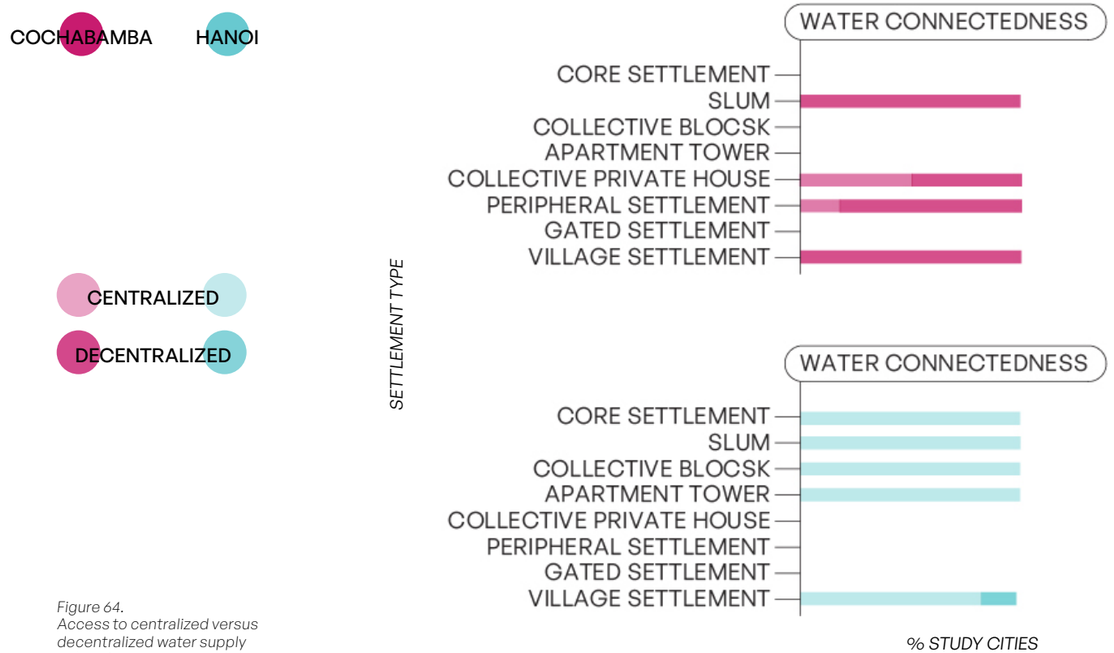
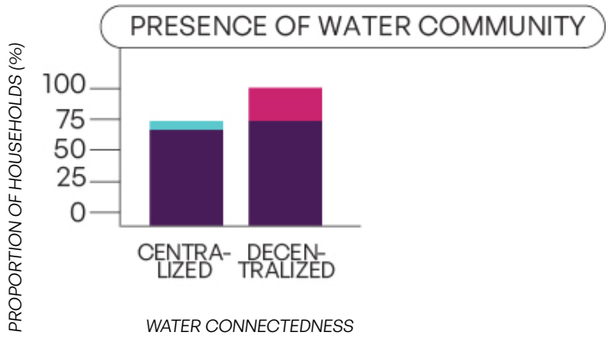


Figure 64.
Access to centralized versus decentralized water supply network

COCHABAMBA HANOI



In Cochabamba, the involvement in water communities is higher in those neighbourhoods disconnected to the centralized network (*Figure 65*).

The diversification of water sources is the most widespread strategy for maintaining a certain level of water supply for all the households across the two cities (*Figure 66*).

In Hanoi, most households use municipal piped water for all indoor purposes, while in Cochabamba collective wells are the main source of water. The reason for the development of collective infrastructures for supplying drinking water is the difficulty of accessing the resource in the mountainous region. The water table in the Bolivian city is indeed located at around 100 m depth, unlike the city of Hanoi which, being located in a delta, has water from a depth of 6 metres. The accessibility of the resource is therefore a central variable in understanding the collective nature of water service provision in Cochabamba and the proliferation of individual wells in Hanoi peri-urban areas. Shared and individual wells were indeed largely used in the past, before the development of the centralised network and the high degree of contamination of underground resources. Purchasing water generally helps to complement water supply in both cities and mainly occurs at an household level. Mainly used for drinking and cooking, this practice is generally widespread in case of water shortages and water pollution both in situation of access to centralized and decentralized systems. Purchasing water is largely found in the Southern part of Cochabamba as a both individual and collective practi-

Figure 65. Involvement in water associations against centralized versus decentralized water supply network

ce. Given the impossibility of accessing the centralised network while drawing on underground resources, in the most recent peripheral settlements studied here households have to rely on water vendors. Water is usually sold on an individual house-by-house basis where settlements are under construction. Where neighbourhoods are indeed more consolidated, it is not uncommon for settlers to build collective storage tanks and a distribution network. In these cases, the purchase of water from water vendors take place in bulk and collectively and tanks are refilled almost every day.

Rainwater harvesting is still quite common in both cities, mainly for indoor uses, laundry and gardening. In Hanoi peri-urban villages the increasing contamination of underground water with heavy metals (especially with arsenic) is making rainwater an alternative to drinking water sources to decentralised networks.

In Hanoi, when the centralized piped network is widespread, water co-production is mostly connected to main network and occurring at individual level (prevailing piped and purchasing types of source). In Cochabamba, where the centralized network is limited instead, water co-production is mostly occurring at group and collective level (prevailing public well type of source) with the usage of more diversified water sources. This is often the case of settlements located at the peri-urban interface, which generally allows the implementation of decentralized systems, because of higher infiltration capacity and accessibility to water sources.

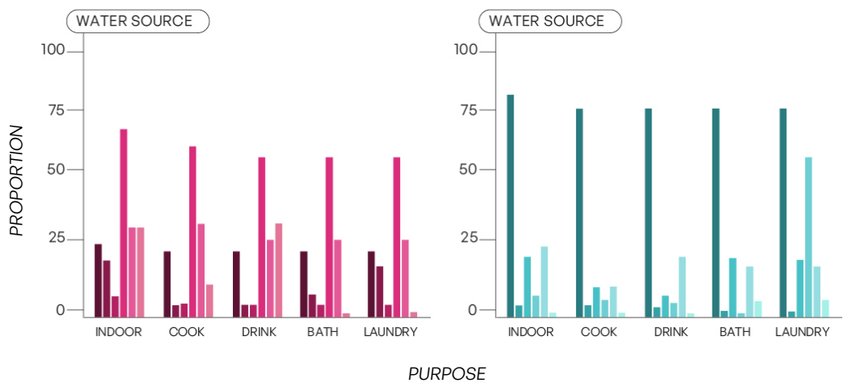


Figure 66. Diversification of water sources at the city level

COCHABAMBA HANOI

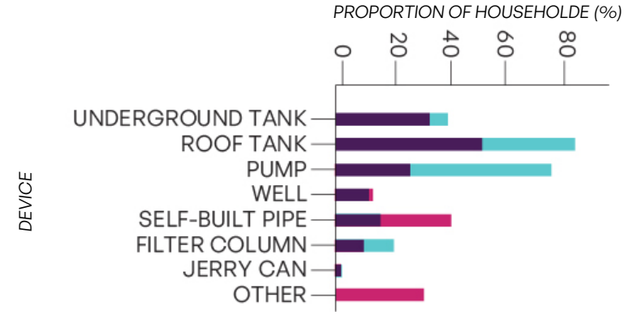
The use of complementary technologies at the household level is widespread in both cities, as the way of improving quality and regularity of water supply.

Households tend to combine the use of pumps, rooftop and underground tanks in order to maximise storage capacity and thereby compensate the irregularity of the service, may this one be centralized (Hanoi) or decentralized (Cochabamba - *Figure 67*).

Individual pumps associated with underground and rooftop tanks are very common in Hanoi for compensating the lack of pressure in the centralized water system. Due to the rapid decrease of pressure in the distribution network, water can only flow into underground tanks and therefore the use of pumps is needed to provide water to the upper floors. Elevated storage tanks are present but much less common in Cochabamba, where the hilly topography of the terrain and the system of water distribution through valves, allow water to reach the upper floors without the need to increase mechanically the water pressure. Rainwater storage tanks are also widespread in Cochabamba and in Hanoi village settlements. While in Cochabamba these are mainly barrels located on the ground floor, at the downpipes, in Hanoi a double system of tanks is frequently found. The water, conveyed by the downpipes into an underground storage tank, is settled and pumped to another located on the roof from where it is distributed inside the house. Rainwater is used mainly for drinking and cooking.

As regard with water treatment practices, in both cities households usually have to boil and filter water, may it come from the centralized (piped) or decentralised (public well) network. Those households who have private wells also have to filter and boil water given the high contamination of underground water resulting from the lack of treatment of residual waters. Boiling has been widely adopted as a common daily practice by most households of the two cities and in Hanoi filtering systems are included as a standard equipment in most houses/kitchens. This “double layer” of collective and individual coproduction means those households often have to pay for both the local water operators and the complementary services they adopt at the household level.

It is more difficult to analyse coproduction of sanitation than water service. Whereas some forms of coproduction of water, either at the individual or collective level, were found in all the 60 case studies, coproduction of sanitation services is less frequent and could not be



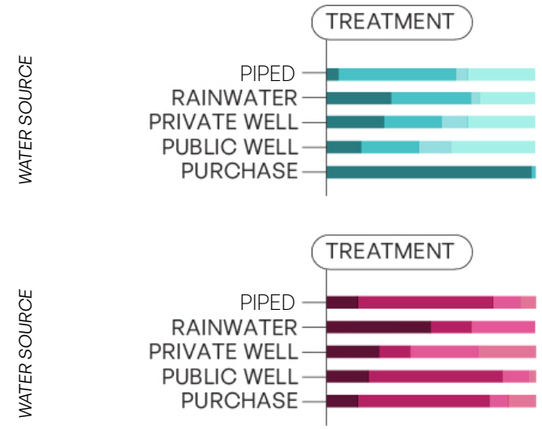


Figure 67.
Complementary delivery technologies at the city level

Figure 68.
Complementary treatment technologies at the city level

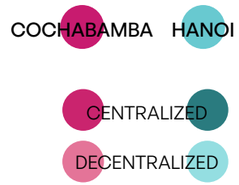
identified in all cases.

Sanitation infrastructures may differ in relation with the connectedness to centralised sewerage systems or to decentralized systems locally operated, may them locally networked or on-site disposal systems. The relation between connectedness and urban typologies shows the distribution of centralised sanitation infrastructures in the city *(Figure 69)*.

In Cochabamba, the municipal sewage system operated by the public operator only covers up to 53% of the territory (Zegada et al., 2015) forcing a large part of the population, especially those living in the southern part of the city, to adopt decentralised and generally individual solutions. With the exception of a few neighbourhoods that have developed their own sewerage systems operated collectively by the OLPEs, most households use on-site facilities such as holes, septic chambers associated with individual toilets or pit latrines shared between several households, generally located outside the house.

The situation in Hanoi is somehow different. In the Vietnamese city the combined drainage/sewerage network has been expanded over the years and is serving at present 65% of the population of greater Hanoi and almost the 100% of the urban districts (Anh, 2005). In fact, it can be observed that the majority of households we interviewed are connected to the network, mostly in core settlements and collective blocks. Decentralised sanitation infrastructure is frequent in rural and peri-urban villages, not yet absorbed by the urban agglomeration and New Urban Areas. While vilages mainly see the implementation of locally networked systems with combined drainage and sewerage; the NUAs should be separated and connected to decentralized wastewater treatments. Indeed, in their case real estate developers are required by law to provide sewerage and wastewater treatment infrastructure in their development plans. While the installation of a separated drainage and sewerage network is generally provided by the investors, wastewater treatment remains poor or often lacking. Even when sewerage treatment is performed, it is still inefficient especially since treated water is recombined with untreated one as soon as it leaves the perimeter of the settlements (Schramm, 2016; Moretto et al., 2018).

Flush toilets are the majority in Cochabamba, where sharing toilet is a practice of 25% of the respondents. In Hanoi, flush toilets are the majority and sharing a toilet is not a widespread practice for the inhabi-



tants all the considered areas.

On-site treatments are the most widespread option for toilet effluents disposal in Hanoi, where some 90% of households declare using septic tanks. These may be individual or collective, according to the ur-

Figure 69.
Access to centralized versus decentralized sanitation network

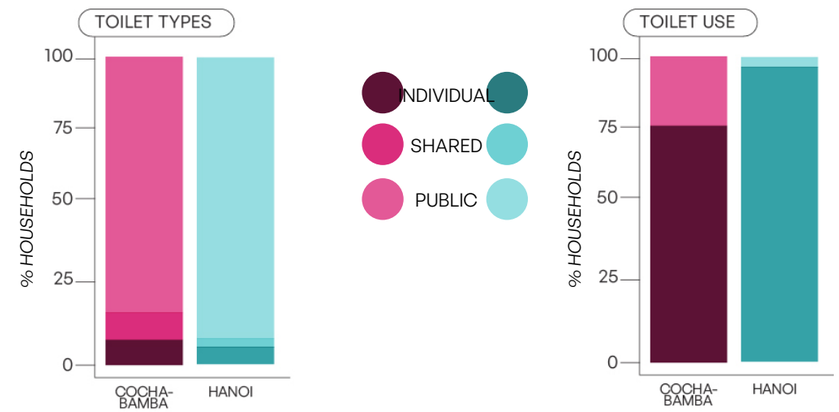
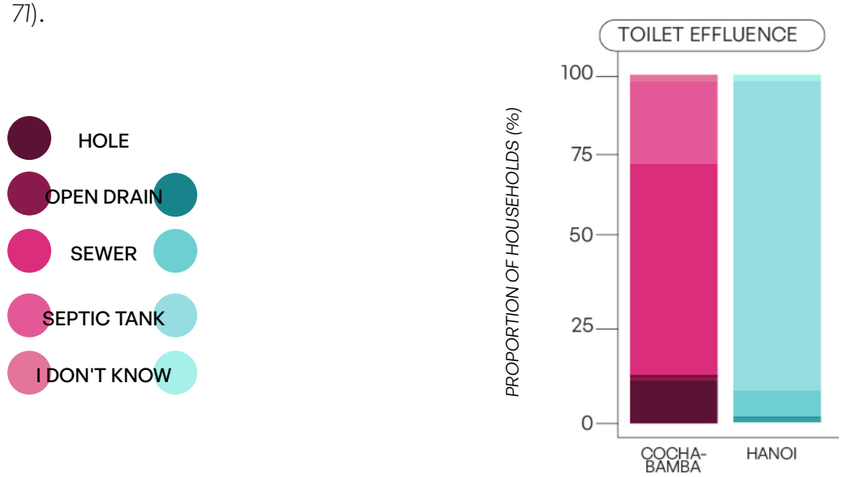


Figure 70.
Toilet types and use in the four cities

ban typology and density. In Cochabamba, more than 50% of the respondents have connection to a sewer line and 25% to a septic tank, while manholes and holes are not so largely found in both cities (*Figure 71*).



In general, in the poorest areas of Cochabamba (slums, peripheral settlements, and villages), sanitation co-production involves very simple technologies: shared pit-latrine or shared pour flush, and septic tanks or holes for the disposal. They are often the easiest and only infrastructure for ensuring a basic service in such areas to avoid the health risk connected to open defecation. In more affluent areas and in recently developed areas of Hanoi (apartment towers and some collective blocks), sanitation development implies the presence of more water-demanding infrastructures (individual flush toilet). In such areas, sanitation co-production appears mostly at the level of toilet effluents disposal (shared secondary sewer lines and septic tanks).

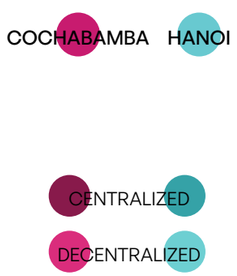
Figure 71.
Wastewater disposal

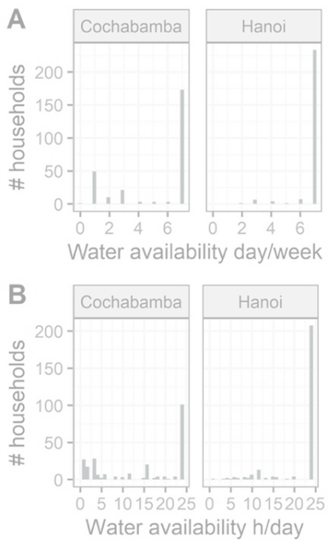
4.3.4 WATER AND SANITATION SERVICE

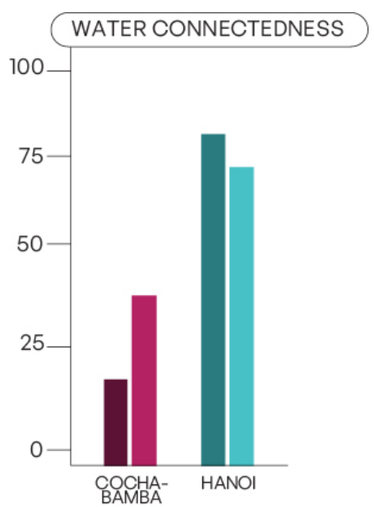
Coproduction organizations and complementary infrastructures presented here above often appear as a local response to inexistent or inefficient centralized water and sanitation services (Furlong 2014, Moretto et al. 2018, Faldi et al. 2019). As a consequence, we should acknowledge that these practices are not rooted in a transformative political project meant at empowering local communities and that their pragmatic role is often that of compensating for the unsuccessful implementation of the “modern infrastructural ideal”. However, there are wide differences as regard with the modern ideal of providing a 24/7 services to all citizens, between the two cities.

The water frequency by city cases reveals the shortcomings of the water supply systems due to poor infrastructure or limited water resource (figure 34). In Cochabamba, water frequency is more variable as it is largely dependent on local water operators that may have diverging policies at this regard. Furthermore, there is a wide gap between northern and southern settlements as regard with accessibility of underground water, which implies water restrictions in the south of the city. However, in the majority of cases water distribution is limited to few days a week and some hours a day. In Hanoi, the majority of respondents declared that water frequency is 24hx7 days/week. Still, it has to be stressed that individual co-production practices through storage and other add-on devices play a decisive role in sustaining these levels of water frequency in the city.

It should further be stressed that this variable is independent from water consumption. In other words, having access to a 24/7 water frequency does not mean that households have a sufficient water consumption to satisfy all their needs. That will also rely on the price of water, amongst other factors.





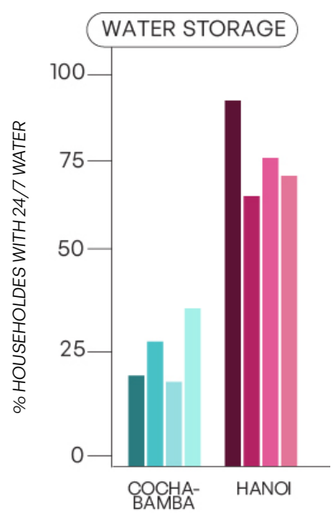


It can further be observed from *Figure 72* that access to 24/7 water frequency is generally greater for those households connected to decentralized water networks in Cochabamba. Indeed, in the limited capacity of the centralised network due to poor quantity of the resource and poor infrastructure, co-production provides a more regular supply in settlements located far from the inner city, mostly peripheral areas and villages.

It is not the case in Hanoi where the centralized water network, when available and combined with complementary infrastructures, appears to provide a better service than the decentralised one. This later one is mainly developed in villages and peripheral settlements. Its operation is restricted by underground water availability, collective storage capacity and significant pressures related to urban densification. As more households and small companies are connected to decentralized networks, the quality of the service is progressively declining.

The relation between water frequency and the use of storage technologies may help better understanding the distribution of water supply problems of the centralized systems in the cities (*figure 73*).

Figure 72.
Water frequency across cities and water frequency according to connectedness



In both cities, roof and underground tanks generally allow household to improve the service regularity, which is generally very limited, whatever may be the urban typology considered, and the type of infrastructure (centralised/decentralised).

In Cochabamba, the use of water tanks is fundamental to improve average water frequency in peripheral and villages settlements where local water operators are managing decentralised networks. The share of households with 24/7 service increases by 10% amongst those who have both roof and underground tanks.

The quality of water services is generally higher in Hanoi, where the observed relation between complementary technologies and regularity of service is the opposite as compared with Cochabamba. Those households that do not have individual storage facilities are usually connected to a modern centralized network, with a good level of service. Although this was not revealed in the questionnaire, many tower buildings in the NUAs also have collective storage tanks.

Across all the urban typologies of Hanoi, the use of water tanks emerges as a compensation strategy as regard with deficiencies of the centralized system. In such cases, even the use of storage technology is not enough to increase the frequency at the levels of a good centra-

Figure 73.
Water frequency according to complementary infrastructure

lized service. Around 90% of the households who have 24/7 service do not have water tanks. This is typically the case of households living in NUAs, who would not have the opportunity to adopt complementary infrastructure anyway by lack of space inside their house. Some 60-75% of the respondents with roof or underground tanks or both have 24/7 service.

If co-production appears to be rather effective in improving access to water, the same cannot be said for sanitation. The lack of maintenance of sewers and drains often becomes problematic in the analysed districts especially when the system gets clogged and neighbourhoods are flooded. The lack of warning does not mean that it is actually performing from a technical and an environmental point of view. Desludging frequency of septic tanks, holes and manholes is very low in all the city cases: 50% in Hanoi and about 30% in Cochabamba, declared that the septic tanks they are using have never been desludged in the past 10 years. Only 25-30% in Hanoi and Cochabamba declared that septic tanks are desludged once every two years or less, which is the recommended practice (Mehta et al. 2019).

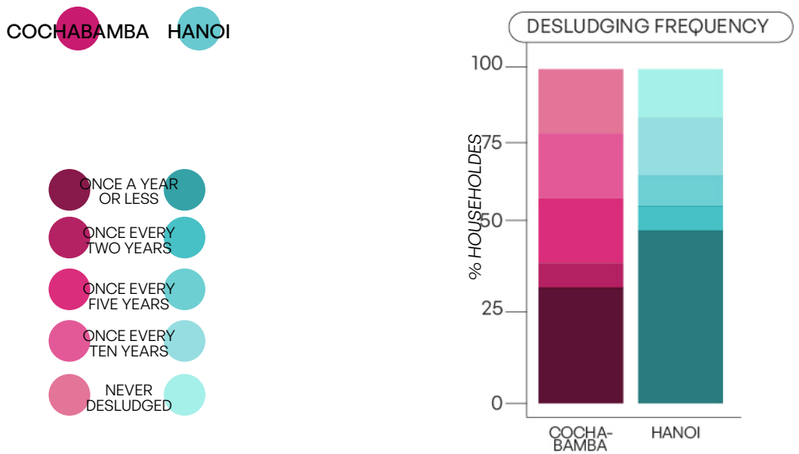


Figure 74.
Desludging frequency

In both cities, the presence of a sewerage network is not necessarily related to an adequate treatment of waste water. Quite the opposite, these are usually discharged in rivers without any form of treatment.

These results reveal a lack of control of the entire water circle in most cases analysed, may these be operated through centralized or decentralized water/sanitation systems.

4.3.5 THE ECONOMIC CONTEXT OF WSS COPRODUCTION

I explore here the economic context of co-production in the city cases, namely the diversification of water expenses and households' purchasing power with respect to settlements types, origin, connectedness and WSS technological portfolio.

In general, there is no significant difference in average expenses for water and sanitation services between different income groups. Generally speaking, water expenses per capita doesn't seem much related to income categories (*Figure 75 - left*) while the relation of water expenses per capita with urban typologies provides useful information.

In Hanoi, expenses in apartment tower and recent urban settlements are generally higher. This may be related to the fact that these are usually higher income groups and that maintenance costs related to such large infrastructures in apartment towers are higher. Besides this, dwellers in NUAs have lower access to individual complementary infrastructure, which goes with a more consumerist approach of water. By contrast, water expenses are quite constant for other urban typologies and income groups.

In Cochabamba, there is a high variability of water expenses within income groups. Water expenses are higher in recent settlements, in slums and collective private housing. They are lower in peripheral and village settlements, where water is usually distributed by local water operators. Newer settlements, especially those located in the South of the city, still lack connection to any kind of piped system. They rely on water vendors, which tends to be more expensive even though inhabitants have lower incomes. Generally speaking, water expenses per capita in Cochabamba is quite high when compared to Hanoi. Even though the city has been recently connected to a major dam (Misicuni) whose supply is deemed to cover the water demand for the whole Metropolitan area, the municipal water company is still unable to guarantee the distribution of water from this source and neither has it been able to extend

the coverage of its network, especially given the resistance toward the centralization of water supply that started with the Cochabamba 2000 water war. Inhabitants of the southern part of the city do not have the possibility to draw from underground sources, the main resources used by OLPE in decentralized systems in the rest of the city. Forced to buy water individually or collectively in tanker trucks, these inhabitants pay a much higher price than inhabitants in other parts of the city, where they can rely on centralized networks or community wells.

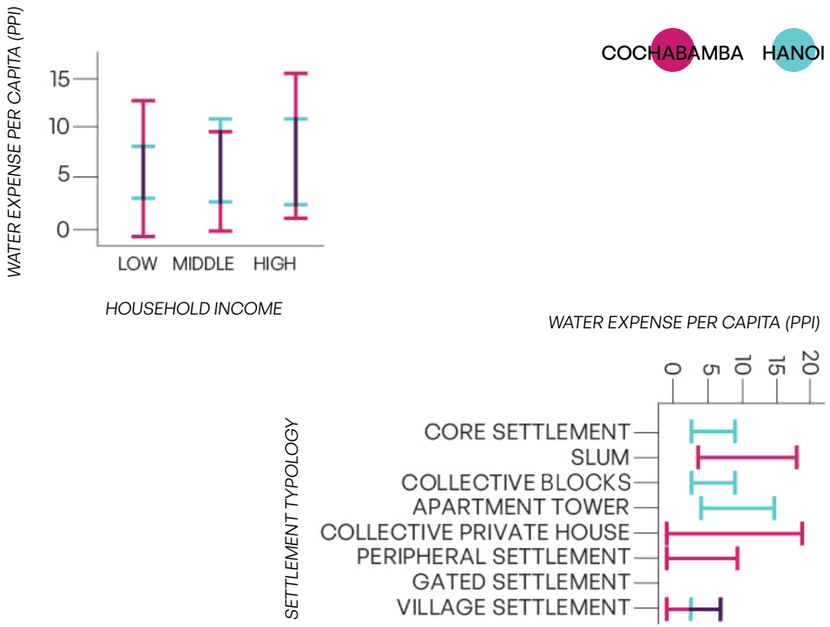


Figure 75.
Water expenses per capita as a function of the income (right) and urban typology (left)

In the surveyed areas of Hanoi, access to centralised water service is more widespread among high-income groups (*Figure 76*). In Cochabamba, I mainly addressed cases of decentralized systems in the OTBs, which include variable income classes.

The relation between income and technological portfolio shows if a higher income can give the chance to access to complementary de-

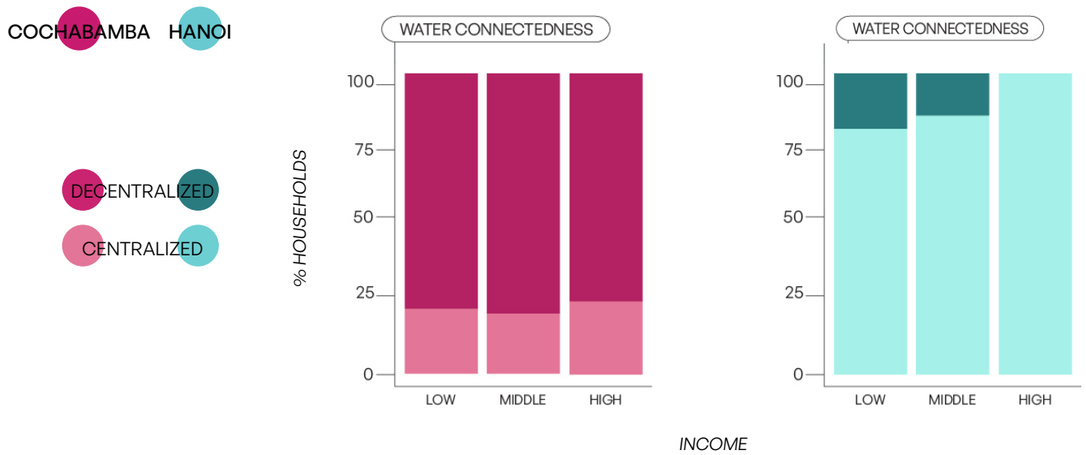


Figure 76.
Share of household connected to centralized/ decentralized water system

vices and therefore to have a better service quality compared to other households (*Figures 78 - 79*).

In Cochabamba, the percentage of households with complementary storing technology, self-built pipes and pumps increases with higher incomes. The same tendency can be detected in the case of the dotation of underground tanks, which remain mainly accessible to higher income groups. The share of households with no additional device, no individual storage, is quite low, even in low- income groups. Households tend to invest in complementary technologies, whatever may be their income.

In Hanoi, the percentage of households with both delivery and storage technologies is both very high when compared with Cochabamba and quite constant according to income group. This testifies that in Hanoi the access to complementary technologies is not very selective.

In general, in the cases of hybrid co-production (connected to the municipal network), namely in the neighbourhoods with full networked centralized system in Hanoi and in the areas of Cochabamba connected to the municipal system, a higher income may imply the chance to access the centralized system individually in a more secure way, through a higher capacity to afford complementary storage technologies.

In the cases of decentralized co-production, namely the majority of the areas considered in Cochabamba, a higher income implies the possibility to access a decentralized system in a more secure way, af-

fording both complementary delivery and storage technologies. Indeed, accessing the decentralized network is not sufficient without individual compensatory strategies. Most households, including low-income households, have to invest in complementary systems if they want to get a reliable water service.

In Hanoi and Cochabamba, networked sanitation serves around 50% of the surveyed inhabitants, with some 25% increase for higher income groups in Cochabamba, and a 15% decrease in Hanoi's higher income groups. This is related with the growing use of decentralized wastewater treatments systems in New Urban Areas.

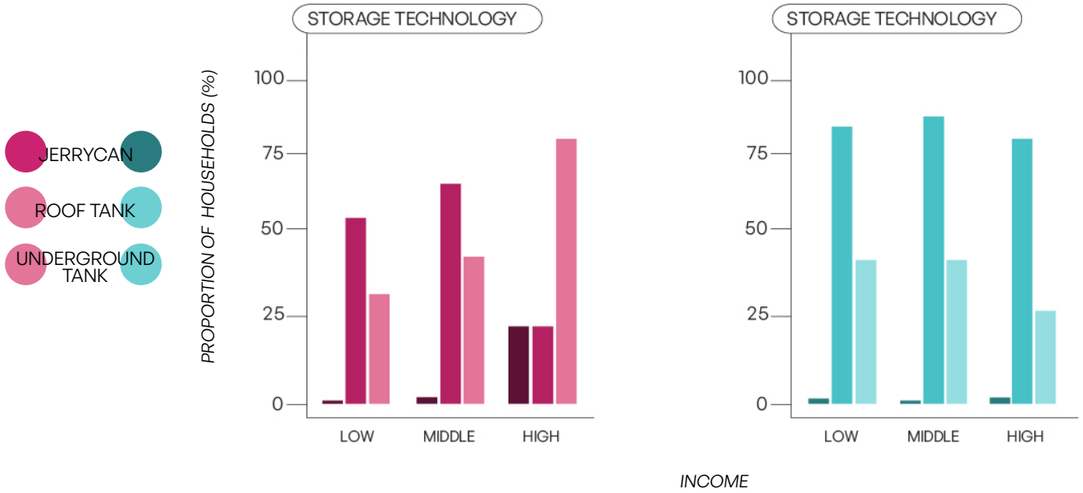


Figure 77.
Proportion of households with different storage technology by income groups

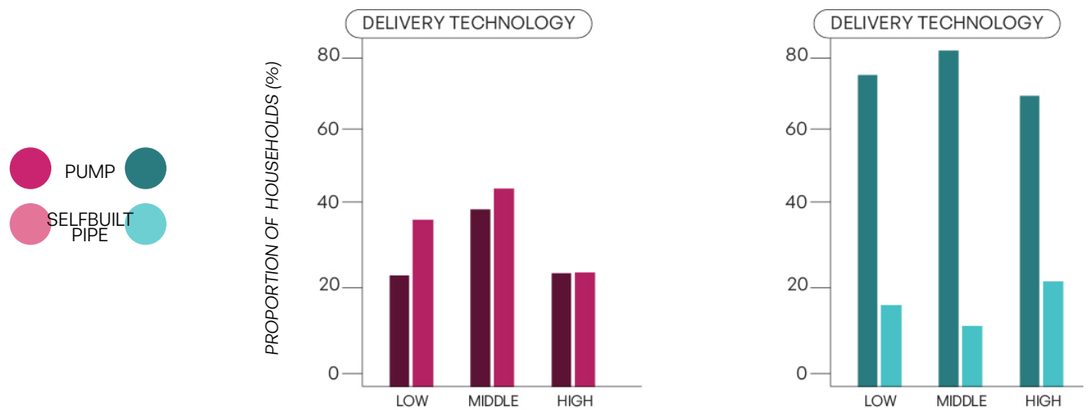


Figure 78.
Proportion of households with different delivery technology by income groups

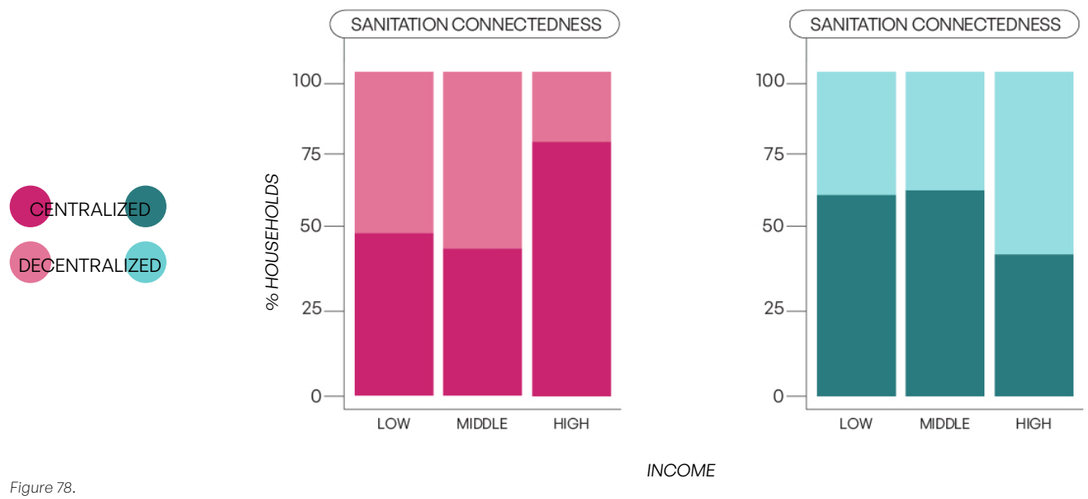


Figure 79.
Share of household connected to centralized/ decentralized sanitation system

4.3.6 HOUSEHOLD SATISFACTION WITH WATER AND SANITATION SERVICES

In this last section, I describe the household satisfaction of the water and sanitation facilities, considering their perception of the regularity, quality and price of the service. This level of satisfaction over water and sanitation services conveys an opinion about the adequacy of the co-production practices that households are developing in their settlements. It should be stressed that responses are personal and subjective. Satisfaction with water quality may be largely independent from the measurable quality of piped water. Satisfaction was evaluated by interviewees along a five points scale, ranging from 0 (very bad) to 5 (very good).

Despite huge differences in infrastructure, management and degree of decentralisation, it should be noted that water quality and frequency are not perceived so differently in the two cities (*Figure 80*).

There are still notable exceptions to this general statement. In Hanoi, respondents particularly appreciate the regularity of the service.

Quite interestingly, households are not open to increased costs for the water service in Hanoi, and even more so in Cochabamba where inhabitants consider they pay already too much for water. In Cochabamba, the water cost is perceived to be too high and respondents' willingness to pay more for improving the services they receive is much lower than in Hanoi. This may be related to our previous comments on the need to combine collective and individual co-production in most peripheral cases in Cochabamba. Another explanation may be related to some lack of trust as regard with local water operators, their retribution and the distribution of costs amongst households after the institutionalisation of these organisations following the Water War. These factors will be further discussed in the case studies.

In Hanoi, with the best access to centralized municipal water network, networked solutions are much preferred by respondents, in terms of water frequency and quality, and the cost of the service (*Figure 81*).

When the network is not widely available, as in the case of Cochabamba, decentralized co-production based on shared wells and mini-networks provides a more regular and less costly solution, when compared to the municipal network. For this reason, one may observe

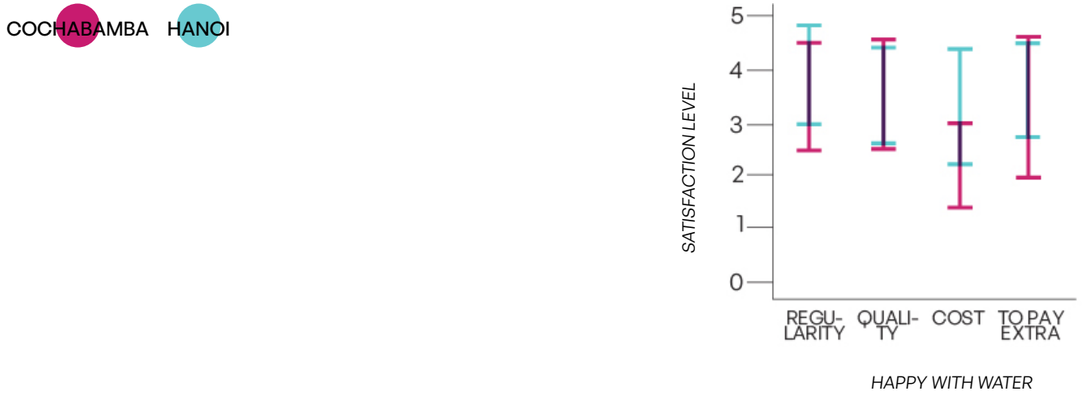


Figure 80. Satisfaction level with water service

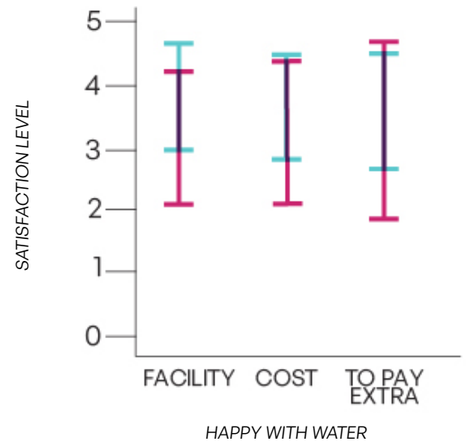
Figure 81. Satisfaction level with water service as a function of access to centralized/ decentralized network

some form of resistance against a further deployment of the centralized network in the Bolivian city.

In both cases, respondents' willingness to pay extra to improve water service is generally higher in settlements with decentralised water provision.

It may be argued that once the centralized network reaches a sufficient number of urban areas and households, the cost of being off grid and having to coproduce water tends to increase. This may be related

COCHABAMBA HANOI



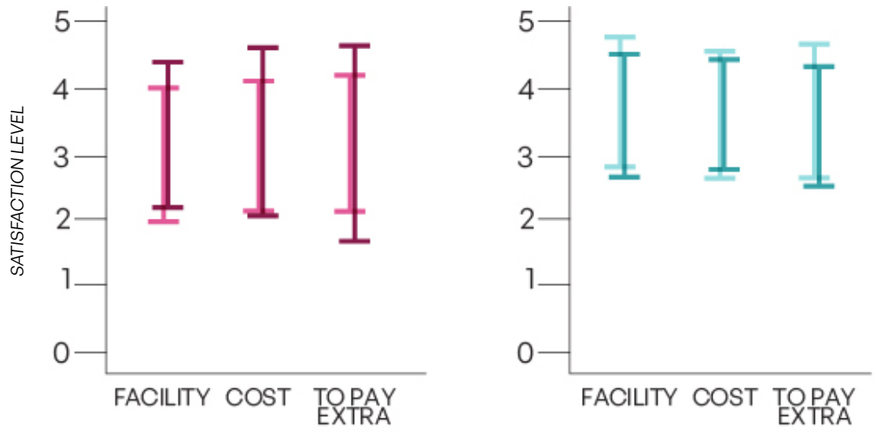


Figure 82. Satisfaction level with water service as a function of access to centralized/decentralized network.

Figure 83. Satisfaction level with sanitation service as a function of access to access to network

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to the lack of public support and incentives in such cases, where policies and funding is mainly oriented towards completing the network. By contrast, where the centralized network is not available, there may be more institutional support for local solutions. Furthermore, preference for decentralized solutions may be related to some form of coping strategy. As there is no available alternative, preference to decentralized solutions may still appear as the best option in the short term.

In Hanoi, the satisfaction over the cost and quality of sanitation is higher than in Cochabamba. As been said above, flush toilets and shared septic tanks are widespread for almost all inhabitants. Although the cost of desludging is not high, this cleaning practices is not performed on a regular basis.

In Cochabamba, perception of sanitation costs and facilities is largely varying in the different urban typologies. In general, satisfaction is quite low, both with the quality and the cost of the service. This may be related to cost of desludging and the lack of access to individual toilets for some inhabitants in the city.

4.3.7 CONCLUSIONS

As can be seen from the previous analysis, coproduction is a multi-faceted phenomenon, highly dependent on the service considered, i.e. water versus sanitation, the type of urban settlement and, more generally, the access to networked services in the area. Quite importantly a majority of the cases can be considered as historical, which may be explained by the fact that coproduction is inherently an incremental practice that tends to develop over time. The survey reveals that coproduction should not be considered as a temporary fix between a fast urban development and the subsequent deployment of a centralised network. In a number of cases, it rather appears as a long-term solution, that may be perceived as a positive or by default choice by inhabitants.

When centralized water networks are available, water coproduction tends to develop at the individual level, in order to improve the quality of the service, and extend the availability of water over the day and the week. Such practices can be observed in a number of different urban configurations, i.e. apartments towers, collective blocks, peripheral settlements. As a stop-gap solution, co-production tends to develop incrementally over time with few if any intervention of intermediaries to regulate the use of punctual delivery and storage technologies complementing the piped service. The presence of water associations at the settlement level does not always translate through an active involvement of the associations in the daily management of the network and its extension.

As a general tendency in the two cases, group or collective coproduction tends to be substituted over time by individual coproduction in areas connected to the centralized network. It is somehow related to the desire of inhabitants to improve their “status” and hence control their access to water at the household level with no intermediaries. Obviously, group coproduction of water is much more developed and resilient in areas disconnected to the centralised network. It may somehow appear as the only strategy to temporarily “fill the gap” between uneven urban development and infrastructure provision. Still, it appears as a much more durable solution in a number of cases, especially in those peripheral settlements that densified over time.

In some places, the presence of an alternative solution somehow appears as a deterrent for a further extension of the network that may not appear as a priority to public providers. It can be observed at this

regard that when access to centralized services is widespread at the city level, households tend to prefer to get connected to the network (Hanoi case). When group or collective coproduction largely prevails at the city level, it does not appear to be the case and it may turn into a form of resistance against the deployment of the centralised network (Cochabamba case).

Water associations are much more active in those areas that are not connected to the networked system. In these cases, group or collective coproduction is usually doubled with individual systems to complement and increase the regularity of the decentralised service. The service usually relies on a much more diversified technological portfolio, involving punctual delivery and storage technologies (pump, water tank and/or barrels), but also diffuse technology as self-built pipes through a more direct operation in the delivery process. As a trend, the hybridisation of collective, group and individual practices of coproduction raises a question of equity in access to services, especially between those who can and those who cannot afford complementary technologies, i.e. rooftop or underground tanks with the required pumps and piping systems.

In the case of sanitation, coproduction mainly occurs in areas lacking centralised networks, with the exception of some New Urban Areas in Hanoi where it is legally required to process wastewater at the settlement level, before recombining these in the centralized network. Such public-private partnerships are highly debatable from a sustainability point of view as they imply to mix treated and untreated waters and process them jointly at a later stage. They further tend to increase the costs of housing without a clear environmental benefit.

In the poorest areas (slums, peripheral, villages), sanitation co-production involves very basic technologies (shared pit-latrine and holes for the disposal). They are often the cheapest and only infrastructures for ensuring basic sanitary services. In fact, sanitation co-production at the level of shared toilets emerges in lower income groups. In slums, co-production remains in the primary “survival” phase, with significant health issues. The difficulty (and probably the unwillingness of authorities) to build or upgrade the sewerage infrastructure in poor areas implies the development of individual or collective forms of co-production for sanitation.

In affluent areas and in neighbourhoods of recent development (apartment towers and collective blocks), sanitation development im-

plies the presence of more water-demanding infrastructures (individual flush toilet). Sanitation co-production appears mostly at the level of effluent disposal: shared secondary sewer lines and treatment facilities, large septic tanks. Group co-production at the level of disposal is somehow diffuse in middle to high income classes. For higher-income residents, decentralized co-production mainly involves individual flush toilet, with shared disposal infrastructures, i.e. collective organisation for cleaning shared septic tanks or DEWATS. Generally, the maintenance of sanitation systems falls well below common environmental expectations, which may lead to further problems in terms of clogging and flood management.

Compared with water distribution, the coproduction of sanitation appears much less incremental and rather organized “by design”, may it be because the sewerage network does not cover the area in question, or because sanitation has been organized through collective infrastructures like common septic tanks which require some group coordination for the maintenance.

Finally, it appears that co-production of water and sanitation does not usually match in the observed case studies. In a number of cases, coproduction is organized at the group level for sanitation and at the individual level for water services. When group coproduction is observed both for water and sanitation in a given area, it is usually not the same local intermediary that handle both services and the related infrastructures. Such a disjoint configuration does not invite to address water availability along a circular approach, which is one of the most relevant problems in terms of co-production sustainability, along with that of spatial justice.

84.
Underground water storage tanks. Above, a public fountain in the slum area of Phuc Xa in Hanoi. Below, a collective tank in Villa Moscu, Cochabamba.


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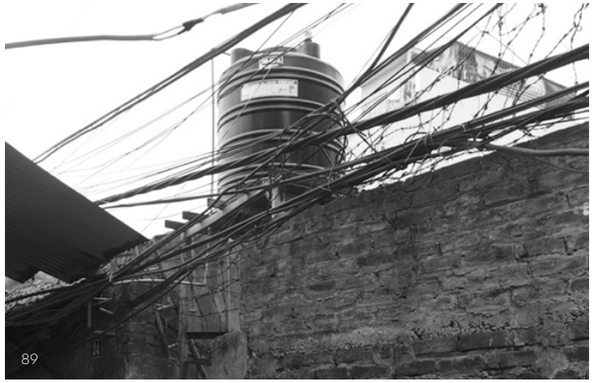
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85.
Underground water storage tanks. Above, a public fountain in the slum area of Phuc Xa in Hanoi. Below, a collective tank in Villa Moscu, Cochabamba.

86. 87 88. 89.
Different size and material of households roof water tanks in Hanoi

90. 91 92.
Collective water tanks pictured across the city of Cochabamba

93
Pump installed along a main canal in Hanoi

94.
Shared well financed by UNICEF in Phuc Xa floating settlement in Hanoi

95.
Filter column for water purification in Hanoi KTT

96.
Simplified water storage technologies in Hanoi

97. 98. 99.
Simplified water storage technologies in Hanoi

5 Tales of co-production in Hanoi and Cochabamba

5.1 Tales of water in Hanoi and Cochabamba

This chapter offers a reading on the incremental nature of wss co-production, bringing together six cases.

From struggles with lack of or poor access to water services in the South of Cochabamba, the daily uncertainty of flood risk or water pollution in Hanoi villages, dwellers are engaged in the production of water services and they play an active role in the re-configuration of their built environment and related water infrastructures. Although practices of co-production may often appear as ad-hoc and improvised solutions to bridge the gap left by unfinished infrastructure networks, they are telling the widespread capacity of ordinary citizens to learn, adapt and to cope with uncertainty.

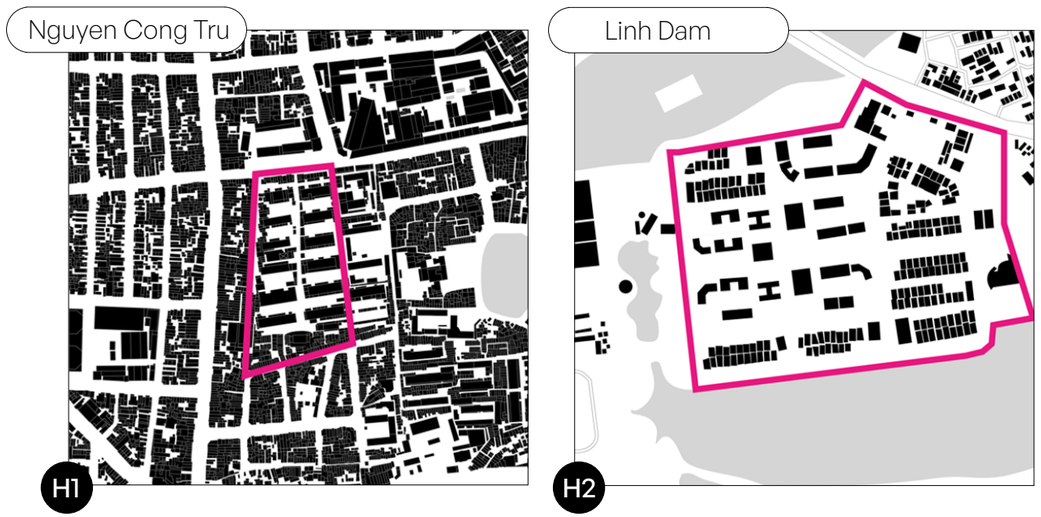
Over time, this form of adaptation contributes to shape a new rational, albeit spontaneous, urban order as inhabitants frequently need to re-organise themselves and to mobilise new resources to manage complexity in a transforming environment. As a trend, we see how this capacity to organise, whether as families, groups or collectives is becoming increasingly sophisticated (Hamdi 2004 p.14). Mixing an ethnographic approach with a morpho-typological one to the reading of the transformative processes of water infrastructure and the built environment, these tales of the "ordinary" tell us a lively and fluid constellations of inhabiting practices, where contingent actions and long-term processes of growth and decay, shape the socio-material and socio-political relations in the city.

The six stories of co-production of water services gathered in this chapter, surface a more participatory attitude and form of governance than that usually envisioned when thinking a city as the result of top-down planning and they allow us to surface invisible values and relations among communities hidden behind the pipes that run through them.

	HANOI			COCHABAMBA		
name of the case study	**Nguyen Cong Tru (H1)**	**Linh Dam (H2)**	**Lang To (H3)**	**Villa Moscu (C1)**	**San Jorge (C2)**	**Serena Calicanto (C3)**
type of location	urban	peri-urban	rural	urban	rural	peri-urban
housing typology	Housing blocks (5 storey) Row and detached houses	Housing blocks (11 storeys) Apartment towers (32 storeys)	Row and detached houses	Row and semi-- detached houses	Row houses	Row and semi-detached houses
type of developement	Planned Public housing	Planned Private housing	Unplanned Historical rural village	Unplanned Historical urban village	Unplanned Historical rural village	Planned Public subsidized housing
water and sanitation networks	Centralized water and sanitation networks	Combined centralized and decentralized water and sanitation network	Decentralized water and sanitation network	Combined centralized and decentralized water and sanitation network	Decentralized water and sanitation network	Decentralized water and sanitation network
information about co-production	Water co-production at the household level, sanitation co-production at the group level	Water co-production at the group and household level, sanitation co-production at the group level	Water and sanitation co-production at both household and collective level, irrigation at the collective level	Water co-production at the household and collective level	Water co-production at the household and collective level, sanitation co-production at the household level, irrigation at the collective level	Water and sanitation co-production at both household and collective level

Figure 100.
Table of the selected case studies and main features

HANOI



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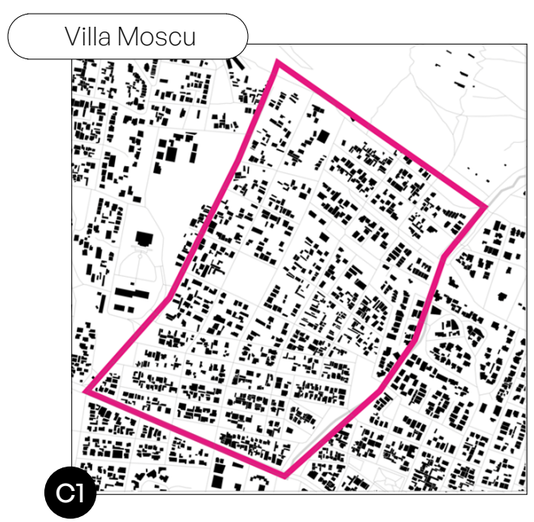
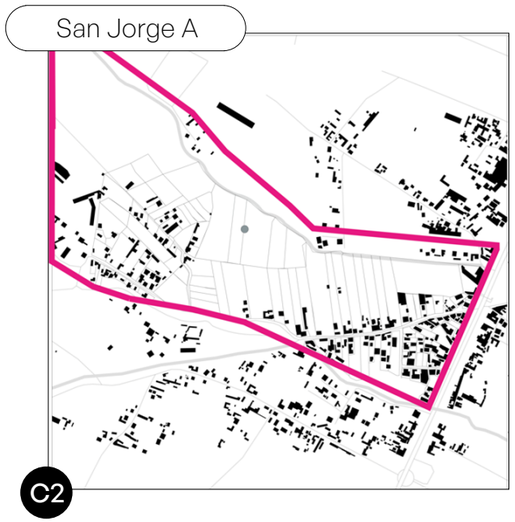




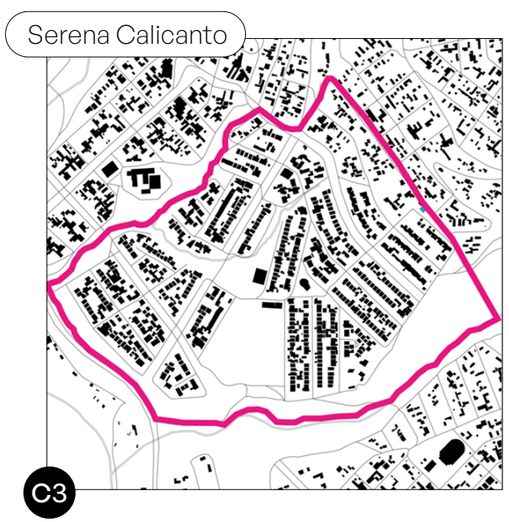


Figure 101.
Site plan of the selected case studies (0.8 km)

5.2 H1 Reconfiguring condominium dwellings: the privatization of the housing systems and the dismantling of collective facilities in Soviet Living Districts (KTTs)

5.2.1 SOVIET RATIONALISM IN HANOI KTTS

After the defeat of the French colonial administration, in 1954 the Democratic Republic of Vietnam was proclaimed in Hanoi, soon followed by the framework of economic aid from the Soviet Union, which started with the Economic and Technical Cooperation Agreement of May 1955 (Cerise 2009). This agreement marked an era of urbanization where large developments, following a centralised masterplan, characterised the re-configuration of Hanoi peri-urban fringe. Between 1954 and 1975 the Vietnamese government, with technical and economic support from the Soviet Union, played a relevant role in the provision of housing and basic services, by delivering collective flats, called Khu Tap The (KTTs). These dwelling-units were meant at sustaining rural-urban migrations and the reconstruction of the country's economy. They were mainly located in the outskirt of the city[4] on former rural land and paddy fields, along the first city ring. Built under the motto "socialist housing for the modern, socialist person", the soviet living neighbourhoods (KTTs) were used as propaganda tools supporting the idea of modernity, and are today the most relevant physical legacy of the socialist housing regime (Fanchette 2006).

Conceived as a dormitory belt around the historic centre, KTTs are examples of a centrally-planned approach to urban planning which dominated the period of collectivism in Vietnam. Their spatial organisation found their roots, on one hand, in the modernist ideas of the American "neighbourhood unit" model, and, on the other, on Soviet constructivist experiences and, in particular, in the *mikrorayon* housing system, the primary structural element in the urban planning found in the Soviet Union and former communist countries (Dolly et al. 2015).

They were designed to meet specific characteristics which rendered them autonomous functional islands[5]. The size of the population should not exceed 20,000 inhabitants and be less than 4000 inhabitants, a number considered sufficient for hosting at least a primary school.

4. While at the time these neighbourhoods were considered suburban, with the expansion of the city, they have now become central. Precisely because of their location, they are currently a contested ground for investors in the real-estate sector.

5. The construction standards of these "dwelling units" are framed within the Decision No. 04/2008/QD-BXD dated April 03, 2008 issued by the Ministry of Construction.

The borders of the neighbourhoods had to be clearly recognized, often thanks to the presence of commercial activities and they had to be well connected to the main road network. The open spaces between the buildings were mandatory and public functions were to be installed at the core of the settlement. In KTTs, rows of monotonous apartment blocks are organized around public facilities and basic services, such as medical centres, schools and kindergartens. Managed by administrative services for the neighbourhoods, they accounted a state-owned general store for food supply and they were connected to centralised power and water supply.

Between 1958 and 1990, about 30 KTTs were constructed in Hanoi, occupying a total area of about 450ha, namely the 50% of the urban dwellings produced at the time (Bùi Ngoc Phuong, 2018). The dormitories were built in three different phases[6]. Most of the KTTs built during the socialist period housed between 7000–15,000 people and were settled on a land area of 15–25 ha (Hong and Kim, 2020).

Architecturally, they were radically opposed to the Vietnamese housing systems (Fanchette 2016). They were produced through mass production techniques, following principles of standardization and economy, with concrete bricks replacing traditional wood framed constructions. These multi storeys (2-5) homogenous blocks (the maximum height considered acceptable without elevator) were in a first phase

6. As Bui (2017) describes, the first generation KTTs (1954-1960) were mostly one or two floors height, while the second generation KTTs, built between 1960 and 1974, accounted four or five storeys, with families sharing facilities (kitchen and toilets). It is with t he third generation (1975-1986) that the KTTs acquire higher standards, with private facilities, better construction materials and more surface accounted for each household.

102. The construction of the highway and a Soviet Living Neighbourhood (KTT) on the right.

provided with collective facilities (kitchen and toilets). Referring to the spatial organization and distribution principles of the Narkomfin building in Russia (Bui, 2017), one of the first examples of collective building in the Soviet Union, the small sleeping cells in the second generation of KTTs settlements were organized along large common areas. Like in other Soviet experiences, the spatial organisation of the building blocks turned out to reshape the notion of family around that of society (Cerise 2009). Emphasis was in fact given to the shared spatial and infrastructural elements, rather than the private ones. As Shannon and Cerise (2010) point out, the main problems of these neighbourhoods were of three kinds. First the construction by the government of these neighbourhoods did not sustain Hanoi rapid urbanization and the housing demand. Consequently, these typologies of settlement were finally abandoned by the government which turned towards a liberalized housing regime. Second, the living conditions in the blocks were unbearable: the small size of the apartment units (30sqm) could not meet the needs of Vietnamese extended families, given the small size of the living space, which was often only 2 m2 per person (Cerise 2009); and the materials used in construction (concrete and bricks) were not proper for the local climate conditions. Moreover, the apartments were owned and maintained by the State as households' contributions with "token rents" did not meet the costs of maintenance. Indeed, the low rental rates (set below the level of real housing costs) prevented the state housing agencies from collecting sufficient funds for repair and maintenance of the existing housing stock (Nguyen Quang and Kammeir 2002). Residents regularly faced inadequate water pressure, a choked drainage system and poor septic tank maintenance. As a result, the living conditions in the KTTs buildings soon turned extremely poor, exacerbated by growing population pressure on neighbourhoods. Currently, Hanoi has 24 KTTs providing a total living area of one million m2 for a population of 140,000, which is almost the double of the initial one for which these settlements have been planned (Hong and Kim, 2020).

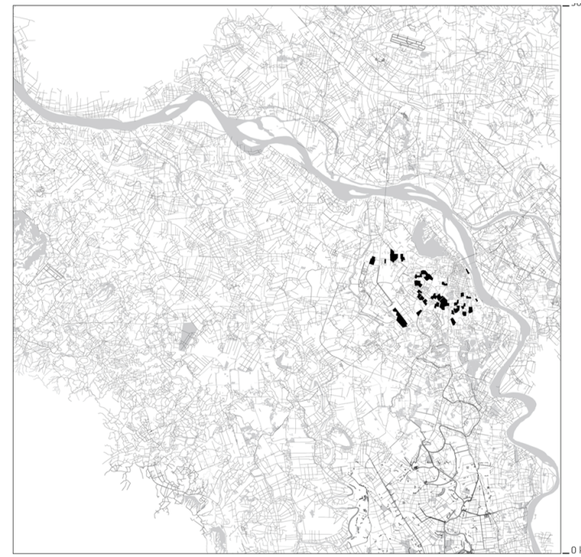


Figure 103.
The distribution of KTTs (Soviet Living Neighbourhoods) in Hanoi

5.2.2 NGUYEN CONG TRU

The case of Nguyen Cong Tru represents the second generation of living quarters produced by the Ministry of Construction, with funding taken from government budget in order to provide higher living conditions to government employees. The neighbourhood is located in Hai Ba Trung district, south of Hanoi's Ancient Quarter and occupies an area of 6 ha. Originally a village settlement, during the colonial period, the French planners redeveloped the area which was turned into a cemetery in 1885 (Bui 2017). The location was strategic as Nguyen Cong Tru street was leading to important military poles in the city centre. In the late 1950s, after the end of the colonial domination and during the soviet period, the French cemetery was removed to build social housing.

The spatial organization of the neighbourhood reflects the socialist way of producing residential areas where notion of habitat is associated with collectivism, while housing is considered as a social asset rather than private property (Cerise 2009). According to the original design, KTT Nguyen Cong Tru consisted of 14 housing blocks, of 4 or 5 floors each, arranged on three allotments divided by the main roads. The

apartment blocks occupy the central and western allotments, while public buildings, as a general market, a primary school and a kindergarden, are located in the eastern part.

The original apartment units were 30 sqm, including a shared kitchen and toilet space (about 6 sqm for each household), accessible through a common distribution corridor which recalled the shared role of small alleys in traditional rural villages. While apartment units were oriented toward south, the common areas destined to kitchen and toilets were oriented toward north. Each floor of the block accounted for eight apartment units and two shared spaces.

The area was connected to the centralized water, sanitation and power networks and the technical infrastructures were provided and maintained by the government. The water and sanitation infrastructures in each block were shared among a number of residents also sharing the common service areas. From the road, a pipe came to serve the kitchen and toilets of each residential block, after being stored in two collective tanks located on the rooftop. As for sanitation, the shared bathrooms were connected to the septic tanks, two for each stairwell.

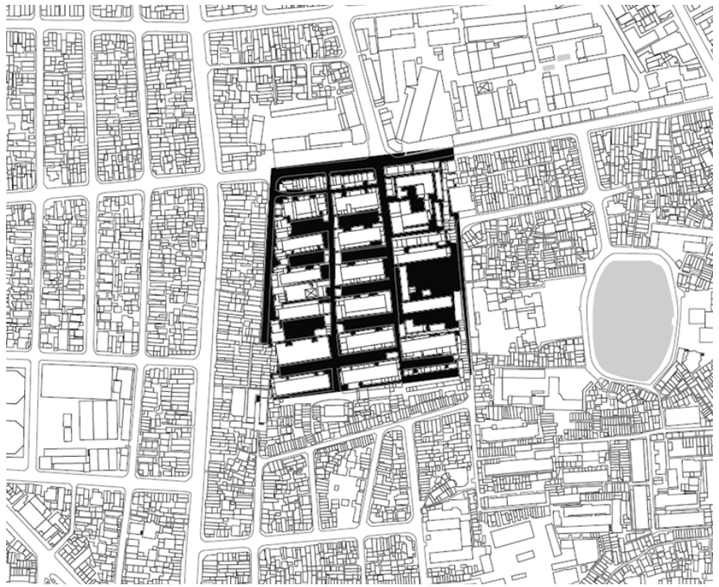


Figure 104.
Nguyen Cong Tru site plan

Figure 105.
Picture of densification in Nguyen Cong Tru

5.2.3 THE HOUSING REGIME TRANSITION AS A LEVER FOR A GRADUAL INSTITUTION CHANGE AND THE EMERGENCE OF INTERMEDIARY ORGANIZATIONS

During the socialist housing regime (1954-1990) the stringent legislations and the government ownership of the KTTs buildings, made the construction and renovation of the apartment units very difficult (Dolly et al. 2015). Under this regime, private constructions were forbidden but, at the same time, public housing was insufficient to respond to the increasing housing demand and the need for renovation of the existing building stock in the city (Koh 2006). In the KTTs, licenses for constructions or renovation works took months or even years to be issued by local authorities. They were required not only for construction works but also for minor works, as maintenance and renovation, like re-painting a building façade (Dolly et al. 2015).

At the same time, the state could not provide maintenance, given the fact that rents were set very low. Even if adjustments of rents have occurred several times between 1960s and 1980s, some problems prevented a constant maintenance of the housing stock, as explained by Koh (2006).

First, no regulation nor legislation was dealing with the maintenance, and the lack of maintenance was the major problem and source of conflicts between authorities and tenants. At the same time, there wasn't any organization of tenants to report in case of issues, controversies or breakages. Therefore, dwellers had to directly refer to the housing authorities, the state-owned enterprise that owned the building, and to the Ward. Given the long red tape, the payment of fines has been often preferred by inhabitants than the legal license route (Koh 2006). Fines were often delivered to those who built illegally, but generally these practices were tolerated especially if the constructions secured the approval of the community, did not offend public works and guaranteed a pay-off to ward officials. As a consequence, illegal constructions in KTTs multiplied in both private space, through additions and extensions of the apartment units, and in public space, as any open space in-between buildings started to be occupied by new dwellings.

To address the shortcomings described above (scarce funds, maintenance problems, unbearable apartment size) in the attempt to institutionalise and formalise the previous informal constructions, Hanoi

city administration developed a model of state-private cooperation for the upgrade of these collective areas in the 1980s. This model, known as *House Repair Cooperative Scheme,* accommodated changes in the building blocks, ultimately providing private ownership of the apartments. Moreover, it transferred the responsibility of building maintenance to groups of households, which emerged as intermediate organisation between state organizations (ward level) and local communities (Koh 2006). Within the framework of this co-production scheme, the government was responsible for selling material and contributing economic support, while residents contributed money and labour. Works included repainting the facades, upgrades of the pipes and building individual kitchen and toilets. Collective spaces were subdivided to install private facilities. However, the fact that not all households were granted building permits triggered what Dolly et al. (2015) define a double process of unbounding and bounding: on one hand, the unbounding of the formal and planned boundaries of the built space which increased outside regulations and, on the other, a bounding (recreation of new boundaries) of the collective areas, which were progressively subdivided and privatized by inhabitants. Such spatial variability, whose re-configuration processes will be described in the following chapter, occurred with the agreement and coordination of households, local authorities and heads of the resident groups, named as *to dan pho* (TDP). TDP is a community organisation that plays a relevant role in co-producing urban services in Hanoi dense areas, acting as link (intermediary body) between the inhabitants and the local authorities.

The size of these organizations is generally between 25 and 30 households, while their number is established by the Ward. Generally, in the dense areas of the inner Hanoi, 50 to 100 TDPs are found in each Ward. They play a double role, as both state and community organizations. On one hand, they perform tasks on behalf of the ward from which they receive some funds, as for promoting the party ideology and registering new residents. On the other hand, as representatives of the communities, they play an important social function and mediation role, as for facilitating connections with Ward officials and eventually mediating quarrels among neighbours (Koh 2006). TDPs are represented by appointed leaders, to *truong to dan pho*, periodically elected by the residents, who are also responsible for collecting funds from the community they represent. These funds are used for the organisation of common activities, and maintenance works of the shared sanitary infrastructure,

drainage system and public space.

Spatially, a TDP is defined by formal groupings of continuous rows of houses, generally sharing common spaces. In KTTs, as in Nguyen Cong Tru, TDPs are generally formed by residents of two facing blocks. Their role in mediating with local authorities became more and more relevant with the sale of the state-owned housing stock, in particular, they played an active role of negotiation and bargaining with local authorities for issuing construction permits on behalf of the community.

5.2.4 THE GRADUAL PRIVATIZATION POLICY AND THE RISE OF INEQUALITIES

The reconfiguration of the building blocks followed the privatization policy, which underwent a gradual implementation.

If until 1990s the KTTs were controlled and owned by different state institutions, afterwards they were reallocated and directly controlled by the city housing authority. From 1970s-1980s, the use-right sale was not accepted, so households were afraid of eviction and continuously facing insecurity. From the 1980s until the privatization policy in 1994, selling the use-right was the only possible transaction which incentivized the social mix in the area. Indeed, the neighbourhoods were planned for hosting state employees, who benefitted from their position by having access to subsidized housing. With the sale of the right to use, a mix of people started to live in the KTTs: state employees; people who bought the use right from the original state employees; second hand tenants. This policy immediately revealed discrepancies in terms of access to housing in the neighbourhoods: while those state employees who had been allocated the housing and those who bought the use right from the original inhabitants had the right to purchase ownership, second hand tenants did not have this possibility.

1994 Decree n. 61/CP finally introduced the sale of the state-owned housing stock (Tran and Dalhom 2005). This policy was planned by the government to encouraged people to invest and engage in renovation of the existing housing stock. At the same time, the funds obtained from the sale of state-owned housing was to be reinvested by the

government for producing new dwellings and for renovating existing ones. Once the buildings were privatized and the apartment units sold to the inhabitants, or demolished (in a later moment) to make room for new denser constructions, these planned neighbourhoods rapidly increased in density. However, this policy shift did not occur at once, but gradually, at different stages. At the beginning, only few buildings were experimentally privatized and later privatization was applied on a larger scale, especially thank to a subsidy policy. The subsidy policy, as Tran and Dalhom (2005) show, mainly benefitted government officials and veterans, or those who already were part of higher classes, finally contributing to strengthen inequalities among dwellers, especially between house owners and tenants [7].

As follows, if for the majority of households, privatization allowed an improvement of the living conditions in the area, in term of access to water and sanitation services, the application of the privation policy contributed to feed a process of spatial differentiation which produced socially and spatially a very unequal urban space.

7. Currently, it is accounted that almost the 60% of inhabitants in all KTTs in Hanoi are apartment owners.

5.2.5 SPATIAL RE-CONFIGURATIONS INSIDE AND IN-BETWEEN THE BUILDING BLOCKS

Multiple forms of gradual spatial reorganization can be found in the neighbourhood.

The original settlement units (the multifamily blocks) underwent a progressive, horizontal extension of the housing units by means of parasitic structures which allowed the inhabitants to increase the living surface, adapting the building to the needs of their extended family.

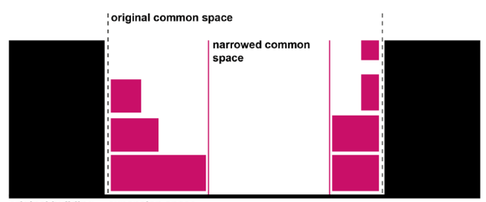


Figure 106.
Nguyen Cong Tru elevation before and after extensions

The extension of the housing units has occurred over time, by means of semi-permanent structures of varying sizes and different uses. These structures called tiger cages range from simple projecting surfaces, used as balconies to grow plants or to dry clothes, to real rooms hosting a bedroom or a living room. They are generally built with the same technique: anchored to the original facade through cantilevered iron beams or, in the case of extensions involving multiple floors, i.e., multiple dwelling units, they are supported by a concrete structure that is cast into the ground. As Koh (2006) points out, these two types of tiger cages are the outcome of an incremental evolution. In the 1970s only the first type was found in the area. Tiger cages were built without support or foundation, but simply added to the building. The multiplication of these units in addition of weight to the building did not meet a reinforcement of the foundations, thus causing various building stability problems. In the 1980s the second type started to develop. They were outlasting structures, built with stronger material and, if an agreement among dwellers was found, they were often co-constructed and co-funded among groups of residents. For example, those living in the same building block on different floors often organized to share infrastructure costs and structural interventions. In some cases, they have agreed to jointly build the bearing structures to support additional spaces such as foundation and column frames by co-funding the works.

As a consequence of these two processes (attaching and extending), most of the house units have doubled their surface (Hong and Kim 2020). The original facades of the houses have been completely altered and today some parts of the original building emerge timidly, behind an organic articulation of additions which appear the snapshot of this organic process of transformation over time.

This densification process also allowed for a progressive conversion of parts of the buildings. Change through conversion can also be applied to the case of housing, as when material changes are undertaken in order to change the use of existing housing structures. Rapid material conversions in Nguyen Cong Tru have corresponded, on one hand, to the abovementioned layering process due to housing shortage, on the other, to respond to the need of technological change (Bengtsson and Kohl 2020). Three conversion phenomena can be identified in Nguyen Cong Tru. First, the redistribution of common spaces (kitchens and bathrooms) divided between the various families and made for private use. Since the service core is separated from the house units by a

common corridor, access to toilet and kitchen units is now regulated by the presence of padlocked doors and gates. The switch from collective to individual facilities is evident by the presence of a multitude of water tanks anchored to the north facades of the buildings. The technical changes due to the installation of individual facilities has also impacted on water and sanitation services, as residents describe below.

> We are five members of the family, three generations, living in this apartment since 2000. Look, we just made some renovation works and painted the walls. The former apartment owner had already changed the organization of internal space by adding the toilet and bathroom into the house. The kitchen which used to be shared with other families, has been moved to the balcony, so the house is prevented from the smell of cooking. Me, my wife and my son sleep in the living room, our bed is separated from the living space by a wardrobe, while my parent took the other room. Basically, the most concern of our situation is the lack of privacy in the house.

Another form of encroachment observed in Nguyen Cong Tru is the conversion and extension of the ground floor surface of the housing units to accommodate commercial activities (workshops, cafes, restaurants...), that make the neighbourhood extremely vibrant and full of daily activities and services for residents.

Finally, the public space in-between the building blocks has been progressively occupied with the construction of new permanent house units, called "squeezed-in construction" and more ephemeral and temporary constructions. The squeezed-in constructions are the output of an illegal construction process that took place from 1975 to 1985, leading to progressive changes of the built environment especially of the public space (Koh 2006). This process allowed a progressive upgrade of the materials used in construction which ultimately consolidated the built environment. Fanchette (2016) has described the step-by-step development of these new constructions in public space, initially marked by the rise of vegetable gardens, a space-source that allowed households reducing costs of food supply. In a second moment, straw and bamboo constructions were built to host various functions: raising chickens, cooking, parking vehicles or farming. Gradually, and often in the night so

to avoid the eyes of the authorities, these semi-permanent structures were replaced by durable material, such as bricks. The multiple awareness campaigns launched at the time by the Communist Party did not succeed limiting the rise of these illegal structures in the neighbourhood, as Koh points out (2006). Indeed, dwellers ignored the rules imposed by the authorities or co-opted the authorities, proceeding undisturbed with the construction activities.

Today, although most of commercial activities are carried out within permanent spaces, an equally number take place in public space, through the use of small temporary structures, as tents, and umbrellas that host small restaurants, cafes, or vending activities. This form of instant urbanism is largely widespread in Hanoi and despite an apparent ephemeral nature, cannot be considered informal and unplanned. It is in fact regulated by the community, through those social structures already mentioned above (TDPs) and approved by local authorities, benefitting from a percentage of the rent of the public space. The multiple forms of spatial reconfiguration described, are normally been undertaken with the agreement of the resident groups' heads who, being themselves residents, are sympathetic to the need of households to increase the house surface and to raise their living standards.

All these forms of gradual spatial reconfigurations were sufficiently numerous and significant to provoke a broader impact on the nearby urban environment. Radical changes now appear in the relationship between the buildings and the street while at the same time, the appearance of new functions as shop, bars made the areas more attractive. Moreover, if according to the original plan, KTTs building blocks and house units had to be radically opposed to the cultural and traditional architectural form, over the time, the modifications altered the original plans and proposed a new layout of the neighbourhoods and the distribution of houses which by adjoining rows of rooms, now recall the spatial organization of the traditional shop houses largely widespread in Hanoi.

In Nguyen Cong Tru this densification process, through the progressive addition of infrastructural and spatial elements to the existing building blocks and to the public space, has ultimately triggered a conversion of residential space into commercial one (ground floors), shared space into private one (the subdivision of shared facilities and their privatization in the building blocks), public space into private one (the emergence of squeezed-in constructions and temporary support infrastructures in-between the blocks).

107.
House interiors in NCT

108.
Small street cafe in NCT public space

109.
Electric supply in NCT

109A.
Different tiger cages in NCT

5.2.6 MULTIPLICATION OF PIPES AND TECHNICAL DEVICES FOR WATER SUPPLY

The transformations of Nguyen Cong Tru built environment have shown that this urban model has been able to adapt to meet increasing population and dwellings' living surface, while creating a strong sense of place and community among the households inhabiting the area. The gradual transformations described above illustrate the strategies of adaptation emerging at a local level over a planned and centralized urban and infrastructure system that became obsolete with the settlement growth. The multiple activities for expanding the spaces of living have also triggered an upgrade and re-configuration of the water and sanitation systems, which ultimately reworked the boundaries of infrastructure networks, opening a space for service co-production.

From the neighbourhood inception until the housing-repair-cooperative policy was implemented, water and sanitation services were subsidized by the government. The area was connected to centralized water supply and sanitation. Each household had to contribute to water supply with 3000 VND (0,13 $) per month, regardless the consumption. From two main water reservoirs located in the neighbourhood, water was pumped to each block, and there, it was stored in two large tanks placed on the rooftop.

The water was afterwards distributed by gravity through two main pipes to the shared facilities (common kitchen and toilets) located in each floor. Moreover, one public stand-pipe was also built in the neighbourhood to supply water during shortages. When the water was not supplied to the tanks above the buildings (because of lack of pressure or breakages), people had to fill baskets at the standpipe.

> At the time water was generally available and some redistribution practices were observed, especially when residents of other neighbourhoods, suffering from water shortages, were also accessing this source. This was sometimes a source of conflict among residents.

If in the first years after the birth of the neighbourhood water resources were easily accessible, over time the infrastructure began to undergo a process of deterioration that was not faced by the government, which was the owner of both the buildings and water infrastructures. As

the residents pointed out during the mapping activities, the processes of spatial reconfiguration through densification described above, have triggered an upgrade and incremental development of the water infrastructures, as the spearhead of the wider program of privatization of the public housing stock. Indeed, dwellers evoked the transformation of the neighbourhood and the installation of individual facilities (kitchen and toilet) and the consequent adaptation of water infrastructures. As one workshop participant explains, the process of division of the collective spaces has contributed to an overall redesign of the water infrastructure system, which has partially switched from collective to individual, as water meters were installed in each apartment.

> The houses have progressively expanded.
> In the past, we used to have shared facilities with 4-5 households sharing 1 toilet, but now almost each house has its private toilet. So, we had to build a new system which connects directly to the main pipe.

The incremental evolution of the urban fabric has resulted in an extension of the water network, with two configurations found in the neighbourhood depending on the type of transformation of the built environment. On the upper floors, the water is distributed to each toilet/kitchen space through tertiary pipes (built by households) connected to the original secondary pipe. As for the connection to the “squeezed-in units” built in the public, individual connections are made directly starting from the primary pipe, placed under the road fabric. The reallocation of the housing stock and the installation of individual facilities turned dwellers into consumers, since the different house units became equipped with private meters and storage tanks. Since then, the water cost depends on the consumption. The shift from a collective to a hybrid system of water supply is here described by an interviewee.

> In the past, the management board provided each building block with two collective water storage tanks, later taken down. In this block, one of the tanks has been converted into a chicken coop. Until a few years ago a neighbour kept the chickens there. However, most of the tanks have been destroyed since every apartment has been equipped with private storage tanks.

In this process of hybridization of water infrastructures, co-production is mainly found in distribution (tertiary pipes) and collection through water tanks anchored to the block facades, and managed by the households. The case illustrates how through co-production households expanded their technical portfolio, by adding a series of technical devices in order to guarantee better water quality (i.e. filters) and regularity (i.e. storage tanks). Although these incremental and ordinary shifts in circulation of water and wastewater are an attempt to improve service quality, in terms of equitability some concerns arise. Indeed, environmental issues and the pollution of water does not equally affect the inhabitants, as one resident reports.

> In the area people believe that water is highly polluted. Most of the people use filter for the cleaning the sediments, but my family does not, since the cost of a filter column is too high (3-5 million vnd depending on the type) and we cannot afford it. So, we simply boil the water before drinking.

Similarly, the regularity of the service depends on the capacity (and the number) of the water storage tanks and their location in the building blocks. This leads to a differentiation in the quality of the service provided which depends on the economic resources of the households, i.e.. their willingness to invest in the maintenance of the infrastructure and technical devices.

> There is a shortage of water at the upper floors.
> They usually have to pump water in some specific time only. Moreover, depending on the size of the family, a number of households have more than one tank. This is a problem, because when there are water shortages, residents on the upper floor have no water since it is stored by those living on the lower floors.

The dialectics of spatial reconfiguration and mutual adjustments occurring in Nguyen Cong Tru produce an unmappable infrastructure of water flows, in constant becoming. Residents continuously generate and experiment with a number of ways of intervening in the water networks as older systems become obsolete as new spatial reconfigurations take place. As for the built environment, densification and redeployment of

certain technical solutions can be seen in water infrastructures. Indeed, the fact that despite the individual devices (tanks, pipes, meters), the main distribution network has remained the same, suggests a layering process. However, access to private facilities connected to individual water supply, has reconfigured the entire network and led to the dismantling of some of its parts. It is the case of the collective water tanks, that have been appropriated for new uses (i.e. growing chickens) or demolished.

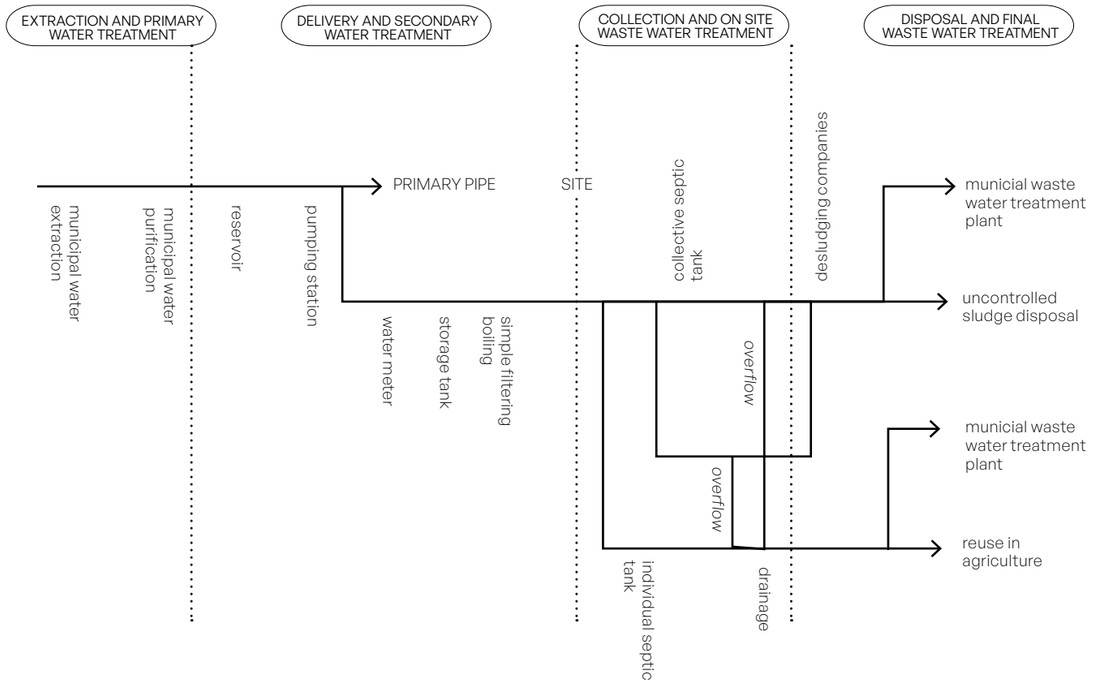


Figure 110.
Technical devices employed in the flow of the co-produced wss services

5.2.7 GROUP CO-PRODUCTION OF THE SANITARY NETWORK AND PUBLIC SPACE IN-BETWEEN THE BUILDING BLOCKS

If the water supply is mainly implemented at an individual level, through small scale technical devices adopted to ensure regular supply, collective action for the management of the sanitation infrastructure is occurring at group level. In the past, the government provided for the maintenance of the septic tanks, as well as for the periodic cleaning of the drainage systems especially in the monsoon season, when they easily clogged.Now, after the allocation of the building stock to private apartment owners, the maintenance of the sanitation network has become shared between the municipal company and residents. While the main drainage pipes are managed by the municipal Hanoi Sewerage and Drainage Company Limited (HSDC), those running in-between the blocks until the main roads and collecting storm water and the overflow from the septic tanks are under the responsibility of resident's groups (TDPs). The heads of the TDP, elected every 4 years, collect yearly fees in a common fund, used for promoting common activities and social solidarity events, i.e. funds for the poor and the disabled. Moreover, this fund is also mobilised for the periodic desludging of the shared septic tanks and the drainage system when it clogs, for maintaining public space and collecting waste. The cost of desludging of each septic tank is about 10.000.000 VND (435,10 $), normally payed every 5 years with contributions of 500.000-1.000.000 VND (21,8-43,5 $) by each family. The co-production of public space finds a profound link, although not easily visible, with the co-production of the sanitary networks (drainage and sewerage) from the moment in which the public space hosts such infrastructures. Indeed, in many cases it has been reported that the management of the infrastructure network (i.e drainage works) was financed with part of a common fund built through the rent of the public space.

> Since few years we do not pay for maintenance of septic tanks, nor for the drainage system. These costs have been sustained through a sum generated by shops and parking spaces rented out between the blocks. This is for us a way to generate funding through the management of public space. This is also convenient for the Ward, since we give them a 5% of the rent.

However, the current drainage and sanitation systems present some weaknesses and this co-production model is subjected to limitations. In particular, the lack of proper maintenance of the septic tanks, which are often not regularly cleaned and the fact that due to extensions of the building, many of them are not easy to access. Moreover, most of the tanks leak and wastewater drops out, causing bad smell around and contamination of the water pipes.

> The water is not clean. Sometimes you might find worms in it and the pipes leak. For this reason, when it floods the storm water from the drainage goes into the water pipes and the quality of water further decreases. In these cases, we need to buy bottled water.

The neighbourhood has problems of regular localised flooding, especially in the rainy season, due to the clogging of the drainage system. In fact, most of dwellers, by creating private bathrooms, connected the sewer lines from their toilets directly into the drainage system, whose capacity is undersized and therefore not sufficient for collecting the sludge of an increased population.

> Today, 60 years after Nguyen Cong Tru was built, the neighbourhood looks totally different. The building blocks have expanded and I think they also have lowered. In the past, we did not have flooding problems. Now, each time it rains, the water rises very high, flooding the stairs and the ground floors of the buildings. Even the access to the roads is sometimes not guaranteed.

The incremental adjustment of the sanitary networks in more complex than that of water systems. Indeed, the neighborhood's incremental development was not supported by an upgrade of the sanitation infrastructure and overpopulation has generated various problems related to the management of the wastewater and drainage systems. Both the collective septic tanks and the drainage system are severely damaged by the overcrowding of the houses. Issues of maintenance and management are perceived by the residents, who complain of a progressive deterioration of the buildings and the infrastructures connected to them.

111.
Individual water tanks installed in NCT north building facades

Today the neighbourhood is much more crowded than before. When Nguyen Cong Tru was built, a family unit had about two people, now extended families have up to ten members. Planners did not foresee such population pressure.
Therefore, the septic tanks are not working properly anymore, being often blocked. In 60 years there has been no improvement or upgrade of the infrastructures. Indeed, to date, I can say that maintenance problems have worsened.

5.2.8 HOUSING AND INFRASTRUCTURE OBSOLESCENCE: A NEW ENGINE FOR RADICAL TRANSFORMATION

In Hanoi 1516 KTTs (mostly 2-5 floors) have been built between 1960s and 1990s and most of them are overpopulated and dilapidated due to lack of maintenance. On the one hand, the modernization of Hanoi city and the proximity of the KTTs to the city core and main urban services due to the expansion of the urban agglomeration have increased the land value in these areas. On the other, the incremental spatial practices highlighted above, criticized as illegal and unsafe, together with the increasing decay of the buildings conditions, are used to justify a government plan meant at “cleaning” these neighbourhoods and redevelop them, through private sector investments. This process fits with what Bengtsson and Kohl (2020) point out in their study on incremental change of housing institutions and housing structures: the obsolescence of the built environment and related infrastructures can be exacerbated through deliberate neglect, which is at the core of the incremental mode of change called drift. The case of the soviet living neighbourhoods is a clear example of drift. From the moment in which the housing stock and infrastructures are not maintained, the government, by making a matter of public safety, is legitimised to declare the neighbourhoods unhealthy, dangerous and to be demolished. As a consequence, they are becoming very attractive for private investments aimed at maximizing the use of the land through a replacement process.

The progressive deterioration of the buildings and related infrastructures is correlated to a legislative gap that was formed when the privatization of the housing units took place. The privatization policy introduced by the 1994 Decree n. 61/CP, allowed the sale of the state-owned housing stock without providing any regulation or legislation dealing with the maintenance. Moreover, at the legislative level it was not clearly expressed what the territorial boundaries of private and public spaces were, as also inhabitants pointed out during our workshop.

Indeed, while individual housing units in Nguyen Cong Tru were privatised in 1994, the common areas remained under government ownership, resulting in an unclear division of responsibility between households, resident groups and the government.

The government is officially responsible for maintaining common areas, the buildings’ main structure and shared facilities, such as sewerage pipes and septic tanks.
In practice, the resident groups’ head, through our annual contributions, is mainly responsible for the maintenance of the drainage system, the periodic cleaning of septic tanks, the management of solid waste and all the common areas in the building blocks and in-between them.

It is easy to imagine how much this cumbersome and complex process with much of ambiguity was not efficient in the management and maintenance of the buildings and soon accelerated the inevitable decay that, unless a constant process of repair and maintenance, mercilessly affects the built environment. So, in 2002 Hanoi People Committee has targeted the KTT neighbourhoods for renovation and approved the reconstruction plan. Nevertheless, only the 1% of building blocks has been replaced so far, since the process of redevelopment has encountered various resistance to its implementation (Dinh Quoc Phuong 2019). The constant threat and opposition to demolition for some residents (those living in the squeezed-in constructions) is summed to the widespread mistrust in the compensation mechanisms for the redevelopment of the area. In particular, various interviews showed a relationship between those who had had the financial resources to improve the conditions of housing and infrastructure, and the resistance to the urban redevelopment program promoted at the municipal level. An interviewed woman who has recently renewed her apartment expresses opposition to the

plan envisaged by the government.

> There is a new plan for the redevelopment of the neighbourhood, but I am against it. The government wants to build high rise buildings, with not much sun light and with private space and gated areas in place of public space. I recently upgraded my house, and therefore my living conditions have definitely improved since I moved here 20 years ago. Investors only care about their profit and I am afraid this might result in a bad quality design.

On the contrary, other inhabitants interviewed hope that the redevelopment program will lead to a better condition of housing, and, in general, of life in the neighbourhood. A man, owner of a fish noodles shop welcomes the transformation in the area.

> There is a plan to transform the whole area, but no public consultation was set up nor a detailed planning has been shown to the inhabitants so far. However, I expect the government will compensate me with 2 apartments (for a total surface of 100 m2) and also one shop, located at the ground floor of the new apartment tower. I am willing to move, since I will maintain my commercial activity but at the same time gain 30 m2 extra for the apartment.

As for the privatization policy, this process of superimposition of a new rational order on top of the existing built environment is gradually implemented and tested. In 2011, the first two residential blocks were demolished and replaced with an apartment tower. While those who have been relocated have obtained enough surface as compensation, the costs related to infrastructure management has increased. For example, residents of the new building pay for water 22000 VND/month (0,96$), a rate almost three times higher than that paid in the original blocks. The fear that the costs of managing services (water, common expenses, electricity) might become unsustainable, as well as the high value of land

in central districts, is becoming a barrier to the redevelopment of these areas and makes it difficult for the government to impose a new rational masterplan over this co-produced space.

112.
Common staircase in NCT building

5.2.9 CONCLUSIVE REMARKS

State and society are not entirely separated, but interrelated and inter influential. The relevance of Geertman and Kim (2019) studies is to highlight the impact of everyday activities on government decision making system in the Vietnamese arena, thus, to frame the role played by ordinary citizens in the bargaining process, which through mainly non-confrontation techniques, have contributed to define the actual legislation system. Citing the work of two authors (Kerkvliet 2005, Bayat 2010), it is shown that political shifts in Vietnam haven't been the result of organized mass movements (rapid changes), but the result of the action of small-scale political activities over the time, conducted by informal groups (incremental changes). This suggests that an incremental, step-by-step work of "atomized ordinary citizens", can lead to the construction of a robust and enlarged network. In this sense, small and incremental adjustments in KTTs have contributed to drive to broader changes in the housing regime. I have tried to retrace the stages that marked a transition between a state system of provision of housing and services and a liberalized and decentralized system, which has instead opened spaces for institutionalised "co-production", thus legitimizing all previous informal practices. Some conclusions can be drawn:

First, the case of the KTTs and Nguyen Cong Tru shows the limitation of imposing a centrally-planned and foreign model of urban design which did not dialogue with local customs and needs. At the same time, its incremental development testifies the capacity of communities to appropriate existing spaces and infrastructures and, through constant re-configurations and dwellers' activities, to better suit the increases in size of their households, living standards while improving access to service. Incrementalism of the technical infrastructures in NCT is linked with access to private property and lack of state investment in maintenance: the transition from state property to private housing gave the inhabitants a sense of security which allowed an immediate, though incremental response to the precarious conditions in which the Soviet neighbourhoods were found. Indeed, the lack of state investment in maintenance and upgrade of the housing stock, has meant for households to resort to their own interventions. Dwellers started to be involved in a step-by-step spatial transformation process and a series of actions to build new infrastructure networks along with spatial reconfigurations beyond the codes and rules set by the system of law but at the same time in compliance with its officials at a local level. This process allowed a gradual densification of both the existing built-environment and related water infrastructures. Third, this process of re-design took place through negotiation and bargaining among dwellers and local authorities through which house owners sought to increase territorial control and to improve access to water and sanitation services.

In this process, through which the inhabitants expressed their autonomy and role as players in the built environment, service co-production can be interpreted as a strategy to fill the void left by the state in the management of water services and in the maintenance of the housing stock and, on the other hand, as a step of a wider transition process aimed at "de—collectivising" the urban fabric, by encouraging the transition to individual, private systems not only in the management of buildings but also of related supply services. The introduction of a private property regime, indeed triggered the abandonment of all collective spaces and infrastructures which guided the idea of a soviet way of inhabiting. At the same time, the recognition and institutionalization of residents' associations (TDPs) as control and management bodies of the built environment and related infrastructures in Vietnam urban areas, allowed the government to maintain a certain degree of control over communities. However, if co-production de facto complements state responsibilities by guaranteeing a regular water supply and sanitation in the difficult transition from a government infrastructure management to a co-produced one, the consequences of privatization of services and of community management leads to an unequal distribution of benefits and services and, as well to a general state of obsolescence of the building systems and water infrastructures. Moreover, it should be stressed that although co-production (of both drainage networks and public space) allows the generation of additional economic resources from a community fund, this is not reinvested in upgrading the sanitary network, which generates the environmental problems described above.

CO-PRODUCTION FLOWS

→ **Water supply**
household connection
to the centralized water system
household storage
and treatment (water tanks,
pumps, filter columns, boiling)

→ **Sanitation**
collective drainage system
connected to shared
on-site treatment facilities
(4 septic tanks in each block).
Some house units are directly
connected to the drainage
system.

CO-PRODUCTION ACTORS

→ **Water supply**
municipal water company
(HAWACO) + local water
treatment plan and pumping
station (Nguyen Cong Tru
Water Department)

→ **Sanitation**
municipal company, Hanoi
Sewerage and Drainage
Company Limited, primary
drainage system + resident
groups (co-funding;
co-managing) septic tanks
and secondary drainage lines
+ household private septic
tanks and tertiary sewerage
lines

CO-PRODUCTION AREA

→ **Water supply**
from block unit (original shared
infrastructure, government
subsidized) to plot unit
(household co-production)

→ **Sanitation**
two facing blocks share
responsibility for repair
and maintenance
of the technical portfolio,
i.e. drainage lines, septic tanks
(group co-production)

MAIN CHALLENGES FOR CO-PRODUCTION

→ Spatial conditions influence
water quantity and reliability
and do not guarantee
an equal service (residents
at upper floors often face water
shortages, while residents
at ground floors are subjected
to periodic floods and septic
tanks overflows)

→ Increased density
has driven spatial and technical
reconfigurations resulting
in a complex and deteriorated
infrastructure system.
Frequent clogs, leakages
require constant maintenance
and upgrading of the technical
portfolio lines

→ A municipal redevelopment
plan for these areas will
impact on the community
dimension of these
neighbourhoods, ultimately
increasing maintenance costs
(in apartment towers water
related costs are higher)

TRANSFORMATIVE/ADAPTIVE NATURE OF CO-PRODUCTION

→ From government to
citizens' control over water
and sanitation infrastructures
(transformation related
to wider political changes
and reforms, leading
a progressive retirement
of the government as main
services and housing provider)

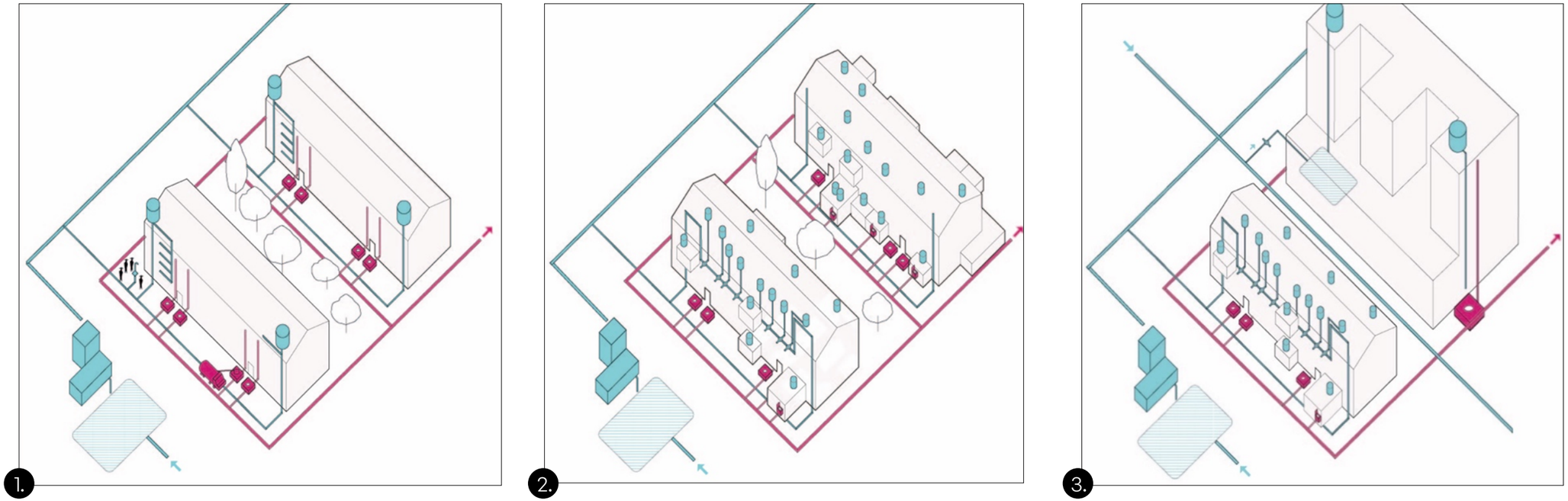
→ Transition from collective/
public infrastructures
to individual/private ones
(transformation related
to households increased living
surface and privatization)

→ Demolition of old blocks
and resettlement schemes
are promoted by the
government to increase
density while favouring private
sector speculation in real
estate development in KTTs.

1. *The infrastructure system right after construction. Connection to centralised network with pumping station to distribute water in the neighbourhood. Each collective block is provided with collective storage tanks connected to shared service units (toilet and kitchen). Sludge is collected in shared septic tanks after that wastewater is mixed with rain water in the drainage system.*

2. *The infrastructure system after liberalisation of the housing market. Connection to centralised network with pumping station to distribute water in the neighbourhood. Each collective block is provided with individual storage tanks connected to new privatised service units (toilet and kitchen). Sludge is collected in shared septic tanks after that wastewater is mixed with rain water in the drainage system. Some new buildings settled in the open space have their own septic tanks while others connect directly to the main drainage system.*

3. *The infrastructure system after the construction of a new tower. Connection of the new tower to centralised network with own pumping system and storage tanks to distribute water in the apartments block. The building has a own septic tank after that wastewater is mixed with rain water in the drainage system.*



113.
Evolution of Nguyen Cong Tru technical infrastructures and built space

5.3 H2 Planning the neoliberal city: land-for-infrastructure mechanisms in New Urban Areas (NUAs) and emerging forms of co-production

5.3.1 THE LIBERALIZATION OF THE REAL ESTATE MARKET AND THE IMPOSITION OF A NEW SPATIAL ORDER

In the early 2000s, new urban policies marked the return of the state to the centre, as the driving force behind the country's housing development (Quertamp 2010). New programmes are designed to encourage the rapid production of housing, capable of supporting the economic development of Vietnamese cities. New urban areas, Ku Do Thi Moi (KDTM)[8] start being built in the peri-urban fringe of large cities through land use conversion mechanisms. Agricultural land is subtracted to farmers mainly for new residential developments. The organisational model underpinning these new policies is mixed: public administrative structures having their own managerial autonomy are supported by mixed public-private capitals (Fanchette 2016).

There is an upscaling of the urban typologies (high-rise buildings) and an overturning of the social and spatial logics that these new neighbourhoods envision, compared to the previous planned urban policies that characterised the spatial organisation of the KTTs. First, the social class for which these new dwellings are designed is not purely that of state workers (as had been the case with the KTTs)[9] , but a mixed class eager for modernity. If the soviet living quarters represented a model of collective and autonomous dwelling grounded on the socialist idea of relational space, these new settlements are witnesses to a society oriented towards individualism that assimilates commodity relations to social ideals and whose aim is the acquisition of private ownership of housing. Given an increasing demand for housing in Hanoi, land prices are rocketing, responding to the logic of the market and allowing building speculation. Theoretically, housing in NUAs is allocated through a list, where state workers and city residents are being given a preferential role. Although the construction of housing is under the responsibility of a semi-public authority (the state oversees the planning and construction process), housing enters the circuit of private speculation as soon as it is sold (Fanchette 2016).

The morphological pattern of the residential complexes sees the use of mixed building types combining tower blocks, single family houses, semi-detached houses, commercial and public buildings built almost entirely on agricultural land or ponds.

The development of these areas, decreed by the 1992 Housing Policy, is subsequently implemented and approved by Hanoi Masterplan. Researchers have highlighted the segregationist effect of these residential models: the socio-spatial fragmentation created by their discontinuity with the urban fabric of the surrounding areas (often villages), by the non-native modernism of the architectural style promoted by the typologies adopted, wipe out all traces of the city's agricultural past (Schramm, 2017; Fanchette, 2016; Moretto et al., 2019). Partly as with the KTTs, these areas are conceived as self-sufficient units and this is also because the areas are built in a synchronised way, i.e. residential and commercial buildings are built simultaneously. Whereas for KTTs the idea of self-sufficiency was linked to state subsidy and collectivisation of services, KDTM represent settlement models of the market and building speculation.

The mechanism of production of such housing is as follows. The authorities transfer the right to use land at low cost to developers who,

Figure 114.
The distribution of NUAs in Hanoi

8. Decree n.52/1999/ND-CP dated 8 July 1999 defines a new urban area as "a project-based new living quarter constructed and planned with a complete infrastructure system and connected with an existing city or town".

9. This policy envisaged at an early stage that 30-50% of housing would be allocated to low-income households

in return, are required to provide urban infrastructures (water, sewage, electricity) and public buildings, which are then entrusted to state or municipal companies. The construction of the housing is financed by the buyer, who pays for the land use right and the purchase of the housing through various steps of payments, usually in instalments, and concluded before or during construction. The municipality sets the initial prices when the project is approved, but usually the houses are sold several times before construction and each time the house is resold, the price is set by the market and goes up.

This is compounded by the state's inability to control housing speculation which is considered to be the engine of the country's economic development. Indeed, speculation mechanisms also explain why some of these housings are left empty for a long time, especially in new urban areas located far from the city centre: they do not serve for dwelling but as a form of capital. As Fanchette (2016) points out, a disparity is thus created between the market value of new housing and the compensation mechanisms, which to date are almost derisory, to those who are expropriated of agricultural land.

"This financial model favours insider dealing and confers market values onto dwellings that are several times greater than the compensation received by neighbouring villagers for the loss of the agricultural land upon which are built these new urban areas"

(Fanchette 2016, pp. 99)

The modernisation of the capital city takes place through various processes of fabrication of the built environment, associated with internationalisation, which imply the abolition of all those spontaneous and informal forms of territorial management that characterise the dense and lively fabric of the villages and central areas of the city. These islands, often in the suburbs, are connected by large road networks that incentivise private car traffic.

The question many researchers ask is whether this top-down model can really work without any control and efforts of institutions to enforce the rules of these large-scale planned area. Leaf (1999) reveals the deeply contradictory mechanism in urban planning in the city. As I have previously pointed out, starting with Koh's studies, Vietnamese urban planning is centrally planned and state-led, with the government showing control over urban development through laws and norms, regulating the

construction industry and access to land. At the same time, it transfers urban development in the hands of national and foreign mega projects. While at the global level, all reforms are therefore aimed at integrating Vietnam into market economies, at the local level the authorities seek to control the in-situ development as explained in the next chapter, and to counter or, conversely, to encourage rapid and informal development.

The problems of this development model, as pointed out by a number of authors investigating the relationship between new urban areas and the modernisation of the country, are multiple. First, the abandonment of one of the founding values of previous socialist policies, the right to housing, is part of the broader process of de-collectivisation of the country economy and rise of market logic. Secondly, the lack of an adequate transport system (both public transport and an adequate road network) in a densely built-up area causes various mobility and pollution problems.

Third, the lack of investment in integrated infrastructures and the inability of the state to guarantee funds for development are manifested in a lack of infrastructures and environmental services that should accompany building activities that systematically impact on the environmental degradation of surrounding villages. As an example, the great amount of wastewater discharged from these new settlements often generates localized floodings and reduce surface water quality in the neighbouring villages (Labbè and Boudreau 2011, Schramm 2016).

Figure 115.
View over Linh Dam from above

5.3.2 LINH DAM

Prior to 1998, NUAs were built as pilot projects to explore demand in the market. Initially built on a small scale in terms of both space and financial investment, they are characterised by a mix of building types. Enterprises are responsible for housing production and related investments, while city authorities are responsible for the implementation of technical infrastructure (Minh et al. 2017). Located in the south of Hanoi, Linh Dam is one of the first pilot projects implemented in the Vietnamese capital, an urban model that marks the country's urban development following the land reforms that followed the Doi Moi approved in 1986. The Linh Dam project was conceived in 1997 and involved the construction of about 990,000m^2 of land classified as rural and the construction of housing for 20,400 inhabitants.

Strategically located near downtown Hanoi and connected to major transport axes, Linh Đàm was built on former paddy fields. The Urban and Housing Development Investment Corporation (HUD) developed the area after the masterplan was approved in 1999. HUD is a state-owned enterprise operating under the Ministry of Construction. While the planning of the area was centralised, the flats' design and construction were delegated to several subcontractors, who completed the project in 2002. In terms of built environment, Linh Dam appears as a patchwork

FIgure 116.
Linh Dam plan site plan

of standardised high-rise buildings, villas, housing blocks, and facilities planned for the upper-middle-class residents, surrounded by large green spaces and roads.

What is different from the planned models of the previous period, namely the KTTs of the socialist collectivist period, is the private philosophy of housing and public spaces and services in the neighbourhood. While the State intention in producing the KTTs was to increase housing density while maintaining a strong collective dimension, both in the organisation of housing and in the organisation of open spaces, in Linh Dam, the need to increase housing density (increasing the blocks up to 30 floors) is confronted with the entry of private capital and a private regime in the use of land. There is thus a differentiation in land management, with portions of land allocated to private development that differ from the standardised blocks as they are divided into narrow and long plots, similar to those in the city centre and villages. At the same time, the functional mix is ensured by the use of the ground floors of the building blocks for commercial functions and services for residents.

Figure 117.
Linh Dam earliest condominium buildings

118.
Linh Dam older buildings with the recently built up towers

5.3.3 URBAN DENSIFICATION AND THE DUPLICATION OF WATER NETWORKS

According to the initial planning, Linh Dam water infrastructures had to be decentralized. Equipped with own water network (a mini-network connected to wells) and treatment plant (for pre-consumption), the neighbourhood water supply system was conceived as autonomous. Likely, wastewater and drainage in the area flow into separate pipes in the perimeter of the neighbourhood, before being discharged in the city's combined sewerage system.

However, today the overlap of two alternative systems of water supply reflects the increased density in the area. The first system is an independent water network that supplies the neighbourhood by making use of groundwater captured by ten wells. This water network, funded by the real estate investor is controlled by the Linh Dam Water Company, a subsidiary company of HUD. When the system was put in place, it was designed to supply the decentralized water network from underground water, captured by eight wells.

While the Water Company is responsible for water distribution in the perimeter of the compound, the maintenance of the water infrastructure at the building level is under the responsibility of residents. In each block, the water flows continuously in two connected tanks each with capacity of 45m^3, located at the ground floor level. An automatic valve pumps the water and shuts-off once the tanks are filled. Afterwards the water is pumped to two water tanks on the upper floor and by gravity it is then distributed to each flat.

The increase in population in the area, particularly following the densification of the urban fabric due to the construction of 4 new tower buildings, has impacted the initial water system, which became insufficient to respond to a growth in water demand, as inhabitants pointed out.

> The amount of people was increasing and so was the water demand. Once the new high-rise buildings were built, the water quantity turned poor. At the beginning, we had 8 wells, whose depth spanned from 80 to 120m based on their location. Two more wells have been built to increase access to the resource, but we still did not have enough water. In the last 7 years, we have faced a rapid

decline in groundwater resources. Now, only the 25% of water is taken from the wells, while the remaining 75% is taken from the Da river.

While the first decentralized network was installed in parallel with the built environment, the construction of secondary pipelines, connected to the centralized network, was implemented in 2017 in response to the constant shortages due to the construction of new tower blocks in the area. This was possible since the investor, to increase profits, took advantage of the presence of a nearby city park. Instead of providing facilities and open areas for the residents (parks and playgrounds), it changed the land use of open areas to building land. In 2015, four more 29-32 storey buildings (VP2-VP3-VP4-VP5) were built in this neighbourhood. This process of densification was not foreseen in the original HUD plan. Consequently, the existing water network turned not to have enough capacity, in terms of either quantity of resources or water pipe sizing, to supply the whole neighbourhood. This situation created huge problems with water shortages, as the underground water tanks in the older blocks were no longer receiving sufficient water at adequate pressure. As a result of two years of organised waves of protests and claims with the local People's Committee, new pipelines were built to serve the new buildings and to increase water quantity in the neighbourhood decentralized network. By then, the area started to receive surface water from the Da River Company No. 4 and two independent systems now run in parallel in the neighbourhood.

The protest started because people living in the older blocks lacked water, so we asked the company to provide enough water. Now, these new buildings are connected to the centralized water supply network that takes water directly from the Da River.

The duplication of the two water distribution systems has improved the amount of water available for the residents of the older blocks by solving the supply problem. However, it has not led to the desired spatial equity, since the two systems draw from different sources, with different qualities. While the inhabitants of the newly built blocks draw from the centralised system, with a good quality water, the others use a mix of two different sources which are combined. Indeed, in older

blocks part of the water comes from the centralized network, while the rest is drawn from groundwater. The inhabitants report that this source is contaminated with arsenic. As the two sources are mixed, the quality is therefore not as reliable as the one from the centralized network. Dwellers from the older building blocks have therefore to integrate with other resources, as they explained us.

We do not believe that the water we get at home is safe. Therefore, we buy about 40 l of water per month that we use for drinking and cooking.

In our house we have purchased a filter that we use to treat the water that comes to us from the mains both before drinking it and for washing vegetables. We have to replace it every three months

Residents in Linh Dam, as in other NUAs, organize both collectively (at the building scale) and individually (at the household scale) to produce their own water services from the moment the network (whether this is centralized or decentralized) runs off public land and into the built fabric. The same form of self-management is found when looking at sanitary and drainage networks. While the main pipelines are managed by Linh Dam Company, the periodic cleaning and repairing of technical devices in the apartment towers, i.e. desludging costs, are shared by residents. This form of co-production, which is widespread in the NUAs, is the result of a public-private agreement that offloads infrastructure management and related costs onto the community sector.

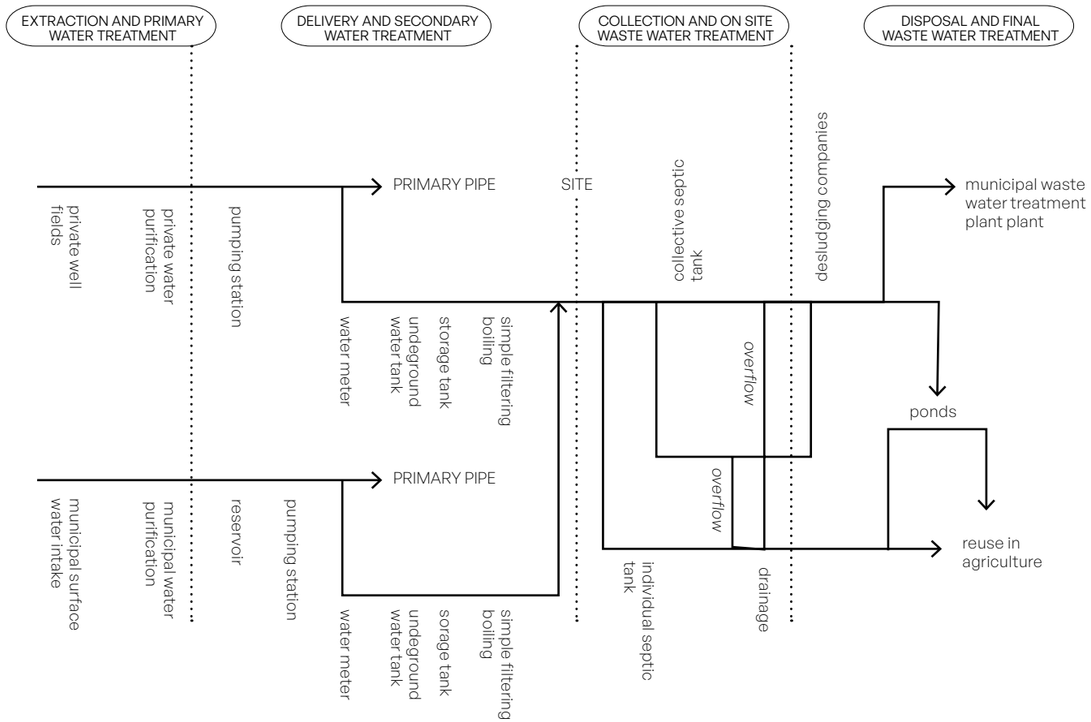


Figure 119.
Technical devices employed in the flow of the co-produced WSS services

5.3.4 AN EMERGING SPACE OF CO-PRODUCTION

As Sofoulis (2005: 448) explains, the sociotechnics associated to this 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." Through the implementation of standardized infrastructure, the water system becomes strongly compartmentalized in both physical terms—the infrastructures—and institutional terms—responsibility for service provision, operation and maintenance. Its control is trusted to experts who have access to networks, valves, logarithms, and its complex extended hidden geography. Whereas, the user just turns the tap, flushes the toilet, and pays the bills (Moretto et al. 2019).

The construction of technical infrastructures in NUAs is delegated from the State to the private sector through a public-private framework called "land-for-infrastructure". It is a land-based financing mechanism through which planning authorities use land as in-kind payment for the construction of technical infrastructure and the delivery of public services. (Labbè and Musil, 2014). The management and maintenance of the technical infrastructure in these urban islands is then transferred to management boards whose duties, organisation and responsibilities are defined by the 2014 Housing Law. Accordingly, during the construction phase and the first years of the life of the buildings, the investor nominates a management board to develop and manage the infrastructure in the whole area (Moretto et al., 2019). These initial infrastructure production and management costs are roughly estimated to be 2% of the purchase value of the property. When all the flats are sold, which in Hanoi central areas generally occur after 1-2 years from the end of the construction, the investor is no longer responsible for the maintenance of the technical infrastructure. Maintenance responsibility is indeed handed over user groups, the residents' management boards, represented by the dwellers in each tower. Unlike resident groups (TDPs), which are an extended arm of the government, management boards only have a technical responsibility. However, similar to TDPs, they have a hierarchical structure that allows them to coordinate easily and they have elected representatives at different scales. For example, each floor of a tower has a leader. The leaders of the different floors form a management board of the building whose top management is elected by the residents.

Heads of management boards are voted every 3-5 years, and they play a relevant role in representing the users, negotiating with the property developer and the local authorities, and managing the fees for the maintenance of the buildings and related infrastructure. As Hien (2005) pointed out, the investors often delay the establishment of residents' management boards to maintain control over public space and to increase their profits through its privatization (i.e. property densification, rent). In Linh Đàm, after waves of complaints, these residents' organisations not only succeeded in reconfiguring the water infrastructures, but also in taking control over public space. Indeed, through political pressures and bargaining, they forced private investors to build green areas and playgrounds as opposed to a private gym and a tennis court (Tran 2015).

The co-production between service users and regular providers in NUAs is substitutive, since it is the output of a synergic relationship between planning authorities and the private sector to accelerate the process of urbanisation and service delivery. On one hand, residents of NUAs are expected to bear more responsibility and risks related to the high costs of maintaining such large-scale infrastructures. In return, co-production guarantees them greater decision-making capacity in the allocation of resources, lower costs of repair and maintenance and, at the same time, a certain degree of territorial control. Linh Dam is an interesting arena where to observe the tensions and conflicting interests between the private and community sector versus land and infrastructure management. On one hand, the private sector tries to exercise and extend control over the use of space outside the planned and approved masterplan, in order to increase profit margins as for the densification of the area through the construction of the four new apartment towers. On the other hand, the community sector, through the mediating role of the management boards which are coordinating and scaling up, is becoming a cohesive subject, claiming autonomous action and control over land and infrastructures and the possibility of adapting them to the community needs.

120.
The TDP meeting room inside the new apartment tower

121.
Butcher's shop in the market on the ground floor of the apartment tower

5.3.5 CONCLUSIVE REMARKS

The mechanisms of land reconversion occurring within the wide arena that Vietnam has opened to private investments are mainly organized around alliances between the real estate sector, local governments and domestic businesses, in a mix between market-oriented politics and socialist principles that Labbè and Musil define a hybrid market-socialist regime (2014). The water sector has been impacted by these mechanisms. According to Hanoi Masterplan[10] , connection to water pipe lines in both urban and rural areas is expected to reach the 100% mainly due to extensions of the centralized networks in new urban areas, funded by private capitals. Hanoi urban development is thus being shaped by the synchronic construction of large-scale infrastructures and mechanisms of land dispossession and redevelopment through high-rise building complexes. The philosophy of such large-scale development is based on the myth of the sanitary and modern city. Nevertheless, as the case of Linh Dam and other NUAs investigated in the course of this research shows, as well as in the wake of research conducted by Schramm and Wright-Contreras (2017), this vision has remained "uneven and unstable" and, de facto, dwellers engage actively with the various complex water and sanitation networks. Some conclusions can be drawn:

First, the case confirms how NUAs, conceived as independently administered entities, are producing large-scale fragmentation and exacerbating inequalities, including access to water and sanitation services. While research generally associates fragmentation to the spatial effects on neighbouring districts, especially villages, this case shows how fragmentation can also occur within the same perimeter of the area. The two networks now supplying Linh Dam are indeed revealing discrepancies in access to water, in term of quality and costs. Despite the success of their collective action, residents of the old housing blocks have lower quality water that they have to make up through individual co-production practices which raise costs. The splitting of the system revealed the impossibility of an incremental adaptation of the existing networks.

Moreover, it has emerged how the idea of modernity and consumption underlying this model of urban planning is nothing more than a smokescreen. While the large technical infrastructures serving Linh Dam, as well as other NUAs, are designed, financed and built by the private sector and planning is controlled by the public sector, their management/maintenance costs are then handed over to the users, when all

10. “Water supply masterplan of Hanoi Capital through 2030, with a vision until 2050” approved in 2014, through resolution No. 499/QD-TTg

the flats are sold. The emergence of co-production is therefore revealing the partiality of the consumerist and modern model that these neighbourhoods want to represent, since the high costs of running the service fall on the shoulders of the residents, although they are connected to centralised services provided by the State.

Lastly, residents of NUAs are generally described as passive consumers, with a consumeristic attitude toward the supply and management of water and sanitation services. This consideration respects the expectation that living in modern high-rise buildings goes along with the status of consumers of externally provided services (Schramm and Contreras, 2017). However, Linh Dam residents, through coordination and bargaining mediated by the presence of the co-production organizations, played a relevant role in the reconfiguration of water infrastructures and public space. Resident management boards are often led by technicians and engineers, elected among the residents for their technical skills and high knowledge of the infrastructural systems they administer. This highlights the strong social and cognitive capital underlying their everyday action.

CO-PRODUCTION FLOWS

→ **Water**
older blocks connected to the company de-centralized water system
+ centralized system
+ group storage (water tanks, pumps)
+ individual water purchase

→ **Water**
recent apartment towers connected to centralized water system
+ group storage (water tanks+ pumps)

→ **Sanitation**
decentralized drainage and sewer systems connected to on-site shared treatment facility at the block level (septic tank)

CO-PRODUCTION ACTORS

→ **Water**
investor (co-funding + co-planning)
+ private water company (co-management): decentralized network for drinking water until the block level
+ management boards (co-design + co-management) at the block level

→ **Water**
recent apartment towers Water Authority
(Duong River Company)
+ management boards (co-design + co-management) at the block level.

→ **Sanitation**
HUD decentralized separated drainage and sewerage systems
+ management boards (co-design + co-management) at the block level (drainage system + septic tanks)

CO-PRODUCTION AREA

→ **Water**
block unit (group co-production)

→ **Sanitation**
group unit (group co-production)

MAIN CHALLENGES FOR CO-PRODUCTION

→ While legislation imposes infrastructure management standards, state controls on implementation are problematic and investors often limit operating costs and increase profit margins through densification

→ Inequality mechanisms are highlighted in the neighbourhood where the two networks present different qualities

→ Wastewater are recombined without treatment as they flow out of the area

→ The ability of management boards to influence investors' choices in land and infrastructure management clashes with the high costs that are charged to users

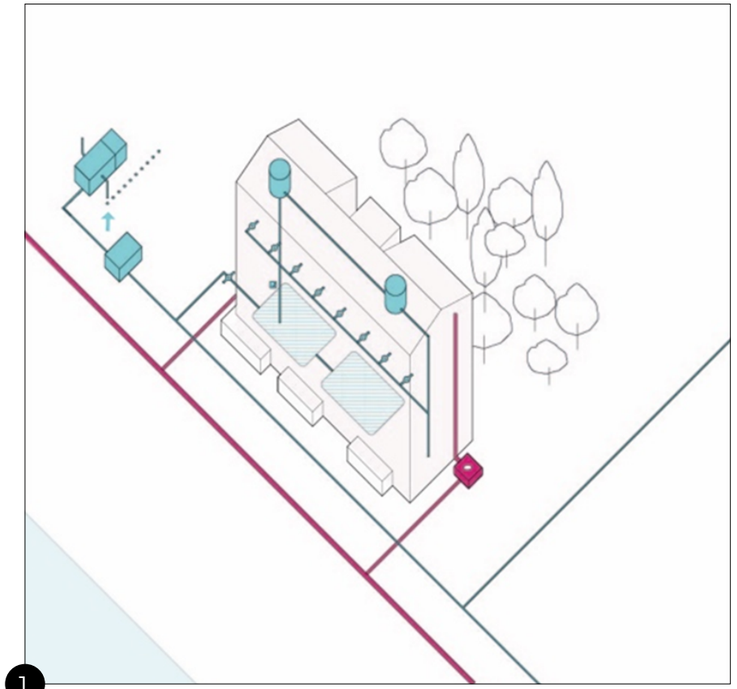
TRANSFORMATIVE/ADAPTIVE NATURE OF CO-PRODUCTION

→ The production and management of water and sanitation infrastructures is progressively transferred from the state to the real estate investor and ultimately to the residents

→ Transition from a decentralised system to a hybridisation of networks as a result of densification

1. *Condominium typology in Linh Dam with drinking water network managed at the neighbourhood scale relying on groundwater. In each block one underground water storage tank and two collective tanks on the rooftop allow water to be distributed to each apartment. Septic tanks are connected to the sewerage system, separated from the drainage.*

2. *Condominium in Linh Dam with new apartment tower. Two water networks are overlapping in the area: the decentralised one relying on groundwater is serving the older blocks, while the new ones are connected to the city centralised network.*



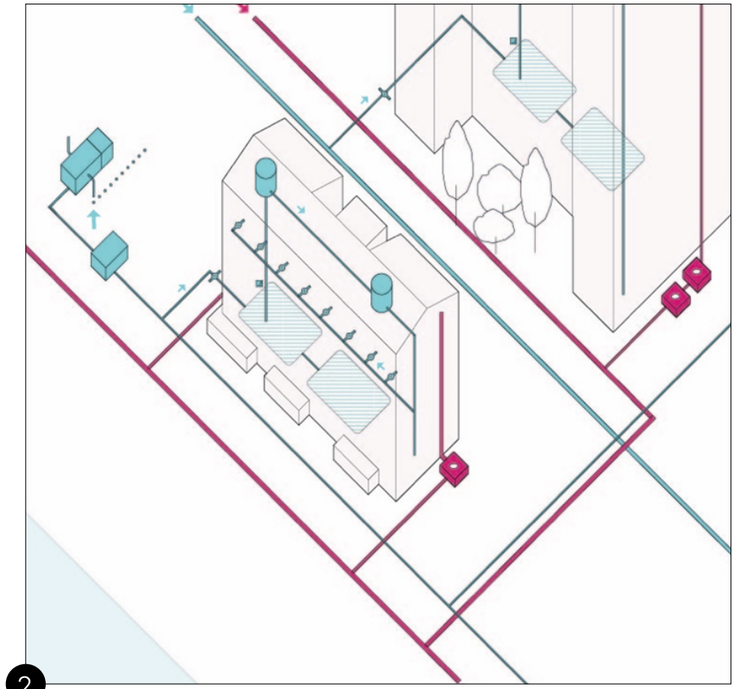


Figure 122.
Evolution of Linh Dam technical infrastructures and built space

5.4 H3 Archipelagos of networks in peri-urban areas: toward a decline of community action?

5.4.1 URBANIZATION IN HANOI AND THE INTEGRATION OF TRADITIONAL VILLAGES

One of the most peculiar features of the process of urbanization in the Red River Delta is the interpenetration between the city and the rural world, that recalls the concept of *ruraropolis* a socio-spatial configuration in which the traditional rural socio-economic system merges with a typically metropolitan territorial organization (Qadeer 1999). The Red River Delta is today considered the densest rural area of the world, with an average of 1,200 inhabitants per km2 which corresponds to a space of 830m2 per inhabitant (Montresor 2016). Urban activities proliferate in a dense fabric of villages, now hosting a diversification of commercial, industrial and craft activities alongside the traditional fish and rice cultivation.

Hanoi, located in the high plane of the Red River Delta, since the 1960s is characterized by rapid growth at the periphery of the city due to migrations from rural areas, large changes in settlement patterns and the progressive inclusion of ancient rural villages within the urban grid (Labbè 2010).

During the Imperial era (1010-1872) in the wake of a millennium of Chinese colonization, villages have been integrated into the urban grid to form a first green belt of food supply and handicraft activities functional to the economic development of the capital. In colonial times (1873-1945) and in the collectivist era (1954-1986), urban development in reference to villages, veered towards opposite policies. Instead of integration, a clear separation between rural and urban environments was promoted, with villages excluded from development plans which were limited to the city core.

In these periods, despite urban changes taking place, the villages did not undergo major transformations especially given the fact that until 1990s, the Ho Khan national policy limited population growth in urban areas.

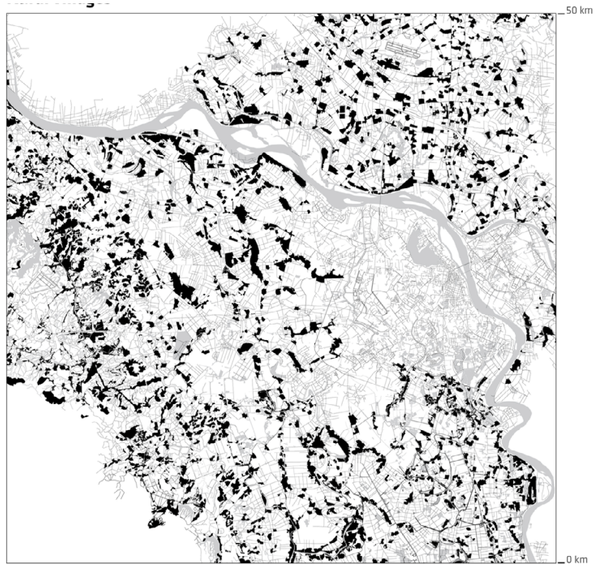


Figure 123.
The distribution of rural villages in Hanoi

Rapid transformations in the villages started with the Doi Moi reforms and their integration into the urban agglomeration acquired massive dimensions since 2008, when the administrative boundaries of Hanoi have been enlarged. By including the former Ha Tay Province Hanoi reached 3.6 times the size of the previous area, including 6.4 million inhabitants (Labbè 2010).

The impacts of urbanization on rural villages outside Hanoi, progressively annexed to the urban districts are multiple. Massive reconversion of agricultural land into urban land to host new residential development (which is expected to cover about 36% of Hanoi's suburban agricultural land for urban development), is leading a forced career change to farmers who are progressively losing sources of livelihood (Labbè 2010). At the same time, the creation of industrial parks is contributing to the process of formation of non-agricultural occupations while attracting new dwellers (Fanchette 2015). Consequently peri-urban villages have become denser, urbanized -in situ- (Friedmann, 1979) and spread out with economic development and liberalization of land use.

Yet, they present weaknesses in terms of social equipment, infrastructures (roads, sewers and water network), and are at most suffering the consequences of uncontrolled urban development.

124.
a farmer working the land and, in the background, new urban areas under construction in Hanoi outskirt

5.4.2 LANG TO

Figure 125.
Lang To plan

Lang To is a peri-urban village belonging to the Ta Thanh Oai Commune, in Than Tri district, located approximately 12 km south of Hanoi central area. Its population was estimated around 9,000 inhabitants in 2009. The village stretches for about two kilometres along the Nhue River, which has become nothing less than an open sewage canal now that the city has expanded without simultaneously managing and treating the wastewater. The intense smell of the canal permeates the streets facing it. Settled along the riverbanks the village occupies 84 hectars and is characterised by a linear morphology. Topographic conditions determine two types of village settlements found in Hanoi city: the first of "village-island" and the second of "village-road" (Montresor 2016,; Nguyen 2003) [11]. Village-road types are distributed directly along a main dike road and present a linear structure.

Indeed, Lang To linear shape and extension is defined by the Co Nhue River on the western part, with the main street along the dyke overlooked by commercial activities and the main cultural and religious buildings, and by wet-rice farmland on the eastern part.

The village has one main characteristic for which it was selected as a case study: it is a rural village in transition which well represents Hanoi

11. The first refers to villages mainly located in upland areas, less threatened by floods, established on a levy of artificial earth and find themselves isolated in the water during the monsoon season. The second type of villages are found in lower areas, subjected to more regular floods. The villages are settled on natural mounds and form contrails along the ancient secondary banks of the rivers.

process of urban growth through the progressive inclusion of the rural fabric within the urban agglomeration. Lang To transition takes place simultaneously on different levels. First, it is experiencing changes in the built environment both within and outside the village perimeter. Indeed, it is part of the administrative district undergoing a process of reconversion from rural to urban which has accounted the largest decrease of farm land (about 27%) in Hanoi between 1991 and 1999 (van den Berg et al. 2003).

In addition to the transformations of the built environment, other dynamics occurring in the village allude to an ongoing transition from rural to urban. The progressive reduction of agriculture activities as opposed to the increasing intensification of commercial activities and services, go hand in hand with an increase in both surface and groundwater pollution due to the upstream densification of the city. This poses a series of challenges related to environmental preservation and infrastructure development in light of a process of demographic, urban and economic growth that sustains Hanoi's rapid integration of rural villages into the urban fabric.

126.
Lang To distribution along the polluted Nhue canal

5.4.3 DE-COLLECTIVIZATION AND THE GRADUAL TRANSITION OF AGRICULTURE COOPERATIVES

Agriculture cooperatives are a key player in the co-production of water services in rural Vietnam. In the peri-urban areas of Hanoi, which are still disconnected from centralised water supply networks, they are responsible for managing the complex irrigation networks that feed agricultural fields and the drinking water networks. The current model of agricultural cooperatives operating in the country is the outcome of a long drawn-out process of development, where the function of these actors has been regulated and redefined in the light of wider political and economic transitions in the country[12].

The origin of agriculture cooperative is in the 1950s, when, adhering to Marxist philosophy and on the model of China and the USSR, the leaders of the Vietnamese Communist Party assumed that socialism required the founding of large agricultural cooperatives to collectivize the means of production, especially the land, and ensure its efficient use, through the construction of irrigation canals and their collective management. The State not only considered cooperatives the most efficient forms of organizations related to agricultural production, but was also convinced that through their control and taxation it could dispose the economic means necessary to finance the industrial development of the country (Kerkvliet 1995). Thus, starting with the agrarian reforms of the mid-1950s, continuing with various steps up to the 1970s, the land, until then distributed equally among the various households, began to be collectivized and the agricultural cooperatives started their process of formation. An interesting aspect that emerges in Kerkvliet's analysis work is the incremental spatial extension of cooperatives over time[13] . Kerkvliet (1995) describes how this process of formation and consolidation of the cooperative model took place by a joining process and how the scaling-up of these organisations turned out to be problematic over time, leading to the progressive exhaustion of the main agricultural functions assigned to them. This process, further favoured by post-Doi Moi agrarian reforms, stood as a response aimed at countering the errors accumulated with the collectivization period. The "household contract" (khoam muoi) of 1988 decreed profound transformations in the cooperative system and incentivised the process of re-distribution and re-subdivision of the means of production and of the land to individual families. Moreover, with the Doi Moi reforms, farmers started to receive incenti-

12. Cox and Le (2014) summarize cooperative development into four main phases: the voluntary collectivisation period of 1954-1975; the compulsory collectivisation period of 1975-1981; the de-collectivisation period of 1981 – 1997; and the neo-collectivisation period since 1997.

13.The establishment of cooperatives took place at first on the basis of existing forms of solidarity and exchange between neighbours who then joined in cooperatives at village level (thon). Subsequently, through the joining of more villages, cooperatives were extended up to a point where various cooperatives have absorbed all those of the villages within the Commune (xa), the smallest administrative cell.

ves to invest their labour and capital to increase the production, through mechanisms aimed at strengthening the individual property.

The agriculture cooperatives in peri-urban Hanoi play a relevant role in providing basic services, as they are often responsible for the production, treatment and delivery of drinking water to the villagers. This renovated role should be framed within the wider process of reforms that affected the country economic and political systems at large, under the phase of de-collectivization [14] .

The establishment of the Lang To agriculture cooperative occurred in 1958. The adoption of the Cooperative Law, effective on January 1 1997, encouraged the transformation of the former collectives and the set-up of new cooperatives. In this transition process, the Agricultural Cooperative in Lang To, has been transformed into a private organisation that manages a range of agricultural services (loan of machinery and sale of seeds), territorial services (management of canalisation networks) and basic services (management of the mini-drinking water network). It is indeed in 1997 that UNICEF funded in Lang To the first pumping station to supply drinking water and handed it over the agriculture cooperative, which, in 2009 was transformed in a joint-stock company. The cooperative now counts 25 members and generates profits from agriculture activities like hiring machines, selling water and fresh products. It plays also a relevant role in term of water supply and management of related infrastructure, providing water for more than 2.500 households living in the village. As a stock company, it is independent from the People Committee, and therefore it directly operates with households as an intermediary private service provider.

14. Wolz and Duong (2010) highlight three main changes related to the effects of the de-collectivization on the agriculture cooperatives: the redistribution of farm land to families (Resolution No. 10, 1988) that recognised farm households as basic unit of agricultural production; the assurance of long-term land-use rights to farmers (Land Law 1993); the obligation of collective farms to be dissolved either to be transformed into market-oriented cooperatives, promoting incomes of their members (Law on Cooperatives, 1996). This law, approved by the National Assembly of the Socialist Republic of Vietnam, defined a renovated cooperatives' role as service providers within a multi-sectoral commercial economy. Consequently, the purpose of cooperative activities was diversified, and included integrated trade and service supply, as well as sector-focused and professional services (Kirk and Tuan 2009).

5.4.4 "IN-SITU URBANIZATION" AND THE RURAL-URBAN TRANSITION

Urban villages in Hanoi are the product of a transition process that contributed to a progressive conversion of rural areas into urban ones and diversification of livelihood activities.

Originally forms of "clan dominated" islands, villages were relatively autonomous structures, with little connection with people outside

the community. They were often organised into different clusters, and spatially they were conceived around common areas with historical and symbolic value as pagodas, temples, common wells. The boundaries of the villages were generally marked by the presence of a dense fence of bamboo trees, serving as protective elements which disappeared in the process of including the villages in the urban fabric of the rapidly expanding city.

The integration of villages in the urban fabric occurred incrementally, influenced by State policies and economic reforms that characterized the transition from a collectivist socialist economy to a market economy. From 1956 to 1986 the Ho Khan policy system was strictly controlling population moving to the cities: rural-urban migrations were to be approved and permits were hardly issued. Therefore, in this period, not much was transformed in the villages structure, that remained almost unchanged until the liberalization period (Fanchette 2016). Once migrants could be registered as temporary residents in Hanoi , a process of massive densification occurred, informed by the necessity to provide housing to an increasing migrant population moving from the the neighbouring provinces. In the wake of the liberalization of the housing market, the villages' built environment underwent gradual changes that altered almost entirely the urban fabric in order to allow an increase in density, which is now comparable with that the one found in neighbourhoods in central Hanoi. Pandolfi (2001) asserts that the villages' positioning in the interface between the urban and rural milieu has allowed them to adapt to the dynamics underlying the urbanization process, while preserving their main spatial organization. So that the prevailing form of integration of villages into the urban fabric is defined by various authors as "urbanization in situ", suggesting a process of endogenous transformation within the socio-spatial fabric of the villages (Papin 1997).

Those changes are defined by many authors as "informal" or "self-organised", given that Vietnamese Government could not respond to the housing demand and therefore, after a period dominated by restriction and severe control over private construction, supported or even sustained several reconfiguration processes in Lang To. First, an expansion toward the east has contributed to the conversion of that 5% of land that was, by law, under the ownership of the agriculture cooperative and allocated to its members in order to produce vegetables for their households. This area has been progressively occupied with new constructions, thus contributing to a progressive decrease in agri-

cultural land and fish ponds. However, this expansion did not meet the demand for housing. Therefore, a process of densification within the existing built environment took place which caused the proliferation of tiny plots of land through plot subdivision and densification at the parcel level, with the progressive addition of floors and the rise of new constructions (Fanchette 2016). The subdivision of existing plots and subsequent densification allowed additional sources of income, through the rent or selling of portions of land. Although no historical cartographic data of the neighbourhood was available to confront with the current plan, on-site observation and satellite images suggest that the size of the plots was variable and generally between 300 and 700 m2, with the different buildings facing around a courtyard and the main house placed transversely on the opposite side of the entrance to the plot. Currently the plots' size has scaled down, reduced to almost 1/3 of the initial surface. While dwellings have been extended and most of the plots have been sub-divided, the traditional rural houses with tiled roofs (*nhà ngói*) surrounded by gardens and enclosed by stone walls have been replaced by urban looking multi-storey buildings (*nhà xây*), built with reinforced concrete and bricks (Labbè 2011).

Meanwhile the village has seen a diversification of livelihood activities, from agro-fishing activities to a diversified landscape of trade and small industrial developments. It is accounted that while around 70% of residents are originally from the village, the rest is composed by migrant workers mostly from the Nam Dinh and Ninh Binh provinces.

5.4.5 MULTIPLE FORMS OF CO-PRODUCTION AND TRACES OF PRE-EXISTING WATER SYSTEMS

Lang To waterscape is characterised by the coexistence of multiple systems, based on different sources and technical infrastructures, which tell the story of the evolution of the neighbourhood and its transition from rural to urban. Most of these systems are operated by households, individually or collectively and therefore multiple forms of co-production are found in this case study.

The village is connected to a decentralized drinking water distribution network, which provides water for more than 2,.500 households. The network is managed by the agricultural cooperative, which also plays relevant role in the management of irrigation canals. The cooperative was funded on April 5 in 1958 and in 1999, following the "Law on Cooperatives" it has been institutionally re-arranged. It is now a joint stock company, where 25 members (farmers shareholders living in the village) have shared capital and generate profits from water selling and agriculture activities, like hiring machines and fresh products. The water network was built in 1999, with funding from UNICEF and been transferred to the cooperative. The water infrastructure that it manages consists of a small-scale water network that relies on underground water extracted by a well at a depth of 120 meters and pumped throughout the village by two stations. The inhabitants described to us the incremental evolution of the system which, following the densification of the neighbourhood and the increase in demand for water, was built in two phases. The first pumping station was funded by UNICEF and built in 1999, with an overall capacity of 0.6m^3 water/h. The network was extended in 2012, when the pumping station was upgraded by the Cooperative. In the same year, a second station has been built, funded by the Cooperative, with a capacity 1.5m^3/h. Before the construction of the network, households relied on multiple resources, as it was described during the workshop.

> About 20 years ago or longer we took water mostly from ponds, rivers, and one common well facing the canal in the southern part of the village. Later, surface water became polluted. We started to drill wells and we could find water 10 meters depth. At the time, we had manual well, which were not connected to any storage tank. We had no idea about the quality, but the water looked clean. Moreover, each house had a small rainwater tank connected to sedimentation tank, to take the cleaner water. After some years we could not find groundwater anymore, so we had to pump deeper. At that moment (1997) UNICEF started a project for a decentralized water supply system. The project was implemented for two reasons. First, to respond to increasing groundwater pollution. There is a city cemetery 3 km away, which increased in size over time, lowering groundwater and surface water quality. Second, because the old agriculture cooperatives almost a decade before 1997

started to be transformed into stock companies providing services for the villagers. So, we gradually switched to the water supply new system. Each village has similar system run by the cooperative.

From these words of an interviewee during the workshop with the Lang To community, in May 2019, we read how access to water in the village has been marked by the multiplication of technical infrastructures and the progressive diversification of the resources used. It also emerges that this development took place in a responsive and adaptive way with respect to two major dynamics. On one hand, in response to a progressive deterioration of the environmental conditions of the village, attributable to the rapid urban growth that has not been able to guarantee environmental protection and water resources preservation. On the other hand, in continuity with the social and political transition described above, marked by a repositioning of agricultural cooperatives as intermediate organizations, providing services to the local population.

Given the village disconnection to centralized networks, different forms of self-provision have for long time represented the only means to access water. Historically, water was extracted from collective wells, generally located in front of the main religious and institutional buildings, bearers of symbolic and cultural value, from which the inhabitants drew the water and carried it to the houses through buckets. Moreover, surface water was also taken from the nearby canals and used for domestic consumption. Over time, water supply became largely individual and wells started to be drilled by each household. Not only I would say, the shift to individual wells was driven by environmental issues, i.e. surface water became highly polluted with increasing urbanization, but also by technological innovations. Given the low water table, digging a well at 10 meters was economically advantageous and technologically feasible, as the water was directly accessible in the plots. Rainwater harvesting was also a common practice in traditional villages.

To sum up what said so far, before the network was put in place, dwellers mainly relied on underground water captured by wells, generally drilled in the households' gardens and rainwater, collected by gutters in underground tanks.

With the institutionalization of the cooperative as service provider and the construction of the mini-network, individual self-help practices have been progressively replaced by collective co-production. However, in recent years, the contamination of underground water supplied by the cooperative, is challenging the sustainability of the current supply system.

We do not trust the quality of tap water we purchase from the cooperative, which we only use for washing, bathing and toilet flushing. We collect the rainwater that hits the roofs of our house through the system of gutters, connected to an underground concrete tank. We also have a water purifier in the house which allow us to use this water to eat, cook and drink. However, I would say that this is not the most common practice. 70% of households in the village have 2 water tanks. 30% have 4 tanks.

Since the cooperative has not made any investment in technologies aimed at cleaning the water, affiliations to the current decentralized network are decreasing. Households have to cope with environmental decay at the plot level, with the available means, resorting to individual self-help practices, as in the past. In Lang To, resources and technologies are highly differentiated and often used in a complementary manner, depending on the use. Quite surprisingly, when dwellers have available land and financial means, they rely on rainwater harvesting which is now being used again for drinking, as it is widely considered a safer source than underground water.

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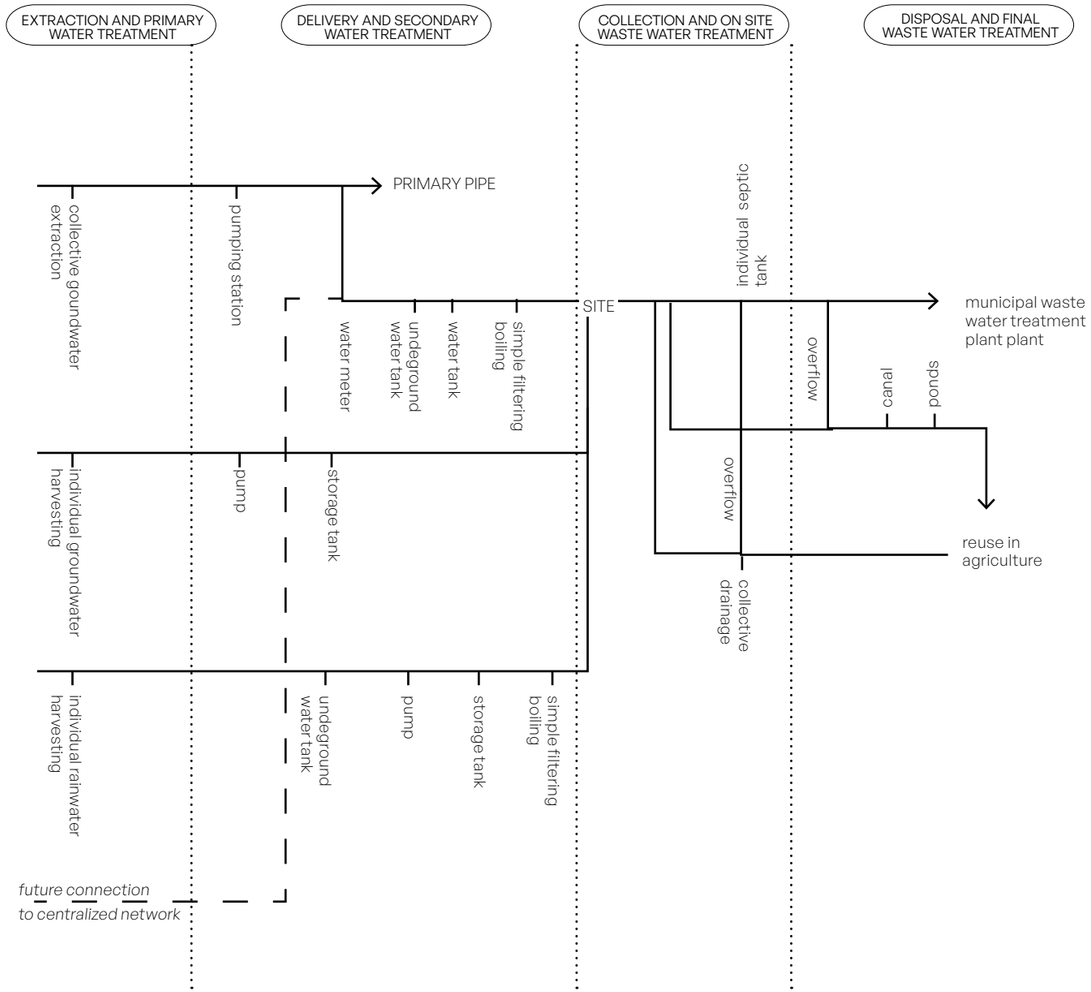


Figure 127
Technical devices employed in the flow of the co-produced WSS services

5.4.6 ADAPTING TO URBANIZATION: REGULATING FLOODS AND MITIGATING THE IMPACT OF WATER POLLUTION

Citizens and communes in rural villages are traditionally co-managing water systems, especially the drainage and irrigation networks.

The Labour Fund for Public Interest is an example of co-funding scheme operating at the Commune level. Built upon annual contributions of resident's, this fund is mobilized to conduct maintenance and repair works, like for the road, sewerage or drainage infrastructures in traditional villages (Viet Anh Nguyen 2005). In Lang To, it has been reported that households generally contribute to the To Thanh Oai Commune with 200.000 VNĐ in a year (less than 10$) for the maintenance of the infrastructure networks. In addition to this, as also reported by Schramm and Contreras (2017) citizens are called to contribute with 10 days of labour for public works.

In recent years, the management of water infrastructures has required some adjustments to counteract the effects of water contamination and flooding, which has been increasing in the district. Indeed, Lang To is under strong pressure of urbanization and densification of central areas and has also encountered major environmental transformations due to its geographical location, in the downstream of Co Nhue River and To Lich River. Those two drainage river basins where huge amount of wastewater and storm water collected in Hanoi flow, are fed by a complex network of sewers, open channels and ditches. Due to its position, the village receives increasing amounts of wastewater which, being not treated upstream, is rising major concerns in terms of pollution as well as consistent waterborne diseases, ie. a wide number of cases of poisonings due to consumption of wastewater-fed fishes (Viet-Anh 2005). With increasing urbanization, the amount of wastewater flowing in the area and high level of underground water contamination (mainly arsenic and iron), have threatened the sustainability of current co-produced practices for irrigation and water supply, requiring a progressive adaptation in the management of the technical infrastructures.

In particular, contamination from urban wastewater and industrial effluents has created problems for the traditional practice of wastewater reuse, creating an overall loss in agriculture and aquaculture, and impacting the health of farmers and consumers (Nguyen and Eiji 2011). Since 1960s, the irrigation system in Lang To was designed to uptake water from the Nhue river which has been in use to irrigate hundreds of hecta-

res of agricultural land. The agriculture cooperative was diverting surface water directly from the canal to feed the farmers' rice fields surrounding the village. The growth of the city which did not occur with proper wastewater treatment, has made dangerous to use this source for drinking and irrigation. Nowadays, the Nhue river and the secondary canals are not naturally connected anymore. The cooperative has installed a pumping station which regulates the water flow from the river to the canals: surface water is now diverted to irrigate the fields just in case of draught, while in the event of flooding of agricultural land, water from the canals is pumped out into the river. The management of this infrastructures is shared between the Ministry of Agriculture, which is responsible for the river banks, the Agriculture Department of the District (DARD), in charge of controlling and maintain the infrastructures once villagers report breakages, and the Agriculture Cooperative who is responsible for the maintenance and regulation of the water flows.

128.
Irrigation canal in Lang To

129.
Elevated irrigation canal in Lang To

5.4.7 THE TRANSITION TOWARD CENTRALIZATION OF WATER SUPPLY

Especially when it comes to peri-urban areas, dwellers rely on multiple resources, often multiplying or complementing access to the centralized water. Hanoi peri-urban dwellers still disconnected to the centralized network, access water in a number of ways, relying on community-based piped water systems, households' tube wells and rainwater harvesting. Increasing contamination with arsenic, ammonium, pesticides and industrial chemicals threatens the cleaning capacity of traditional technologies while the overexploitation of the aquifer has led to severe land subsidence. To address the shortcomings in the existing infrastructure system and increase coverage as needed to meet the World Bank targets, the country aims at increasing investment in water infrastructures, implementing a regulated tariff calculation based on water meters and reducing leakages and illegal connections (Contreras et al. 2017, Interview Senior Officer JICA, Interview Private Investor in the Water Sector).

The process of extension of the centralized network results from a joint negotiation between urban and rural ministries responsible for water provision. Urban planning authorities contribute to the design and construction of water treatment plants, while operation and maintenance costs are largely dependent on state programs and local efforts aimed at encouraging rural households to connect to the piped distribution network (Contreras et al. 2017).

In the framework of this vision endorsed by the state, localized and co-produced practices for water management largely found in Hanoi peri-urban villages are progressively replaced by centralized infrastructure networks, which develop and extend parallel to urbanization dynamics.

Although community labour is still practiced in Lang To, as in other rural administrative villages, co-production is oriented towards maintenance of rainwater collectors and irrigation canals with almost no interest towards the water system, presenting multiple problems related to water pollution.

Rather than investing in the upgrade of the current water supply network, Lang To dwellers have agreed in connecting to the centralized water network. The main pipelines have been installed in the village main road along the canal, while the secondary system has not been yet put into place. This new system is expected to distribute water within the next six months.

> We are happy to connect because we expect the water quality will improve. However, we are also aware of the fact costs will increase. Hanoi Water Utility Company operating at the municipal level will then distribute the water.
> A totally new piped network will be built, but we don't know if we will still keep the old one. In 6 months, hopefully, we'll get connected.

A rising central question addresses the debates between "coexistence and displacement" of socio-technical infrastructure in transition (Furluong 2014). Will the two systems coexist after the village will be collected to the centralized water network? Or will the centralized network replace the local schemes? What will happen with the local practices which are still widely spread in the village, as for rainwater harvesting? The importance of retaining free water sources, as rainwater harvesting in combination with piped water is promoted in many parts of the world as a transition toward more sustainable water management. In Lang To, dwellers have traditionally relied on rainwater, given the lack of piped water schemes and the high level of rainfall during the monsoon period. The possibility of using multiple resources allows them a certain flexibility in diversifying sources according to uses, as well as the economic advantage of minimizing costs. The extension of the centralized water network will probably be successful in wiping out patterns of co-produced water supply, by imposing large schemes to existing micro schemes that characterize the current community water network and the other practices which engage citizens as service co-providers. With the connection to the centralized water network, Lang To dwellers are expecting the water quality will increase. However, given a legal requirement for metered billing in Hanoi and the increase in water tariffs due to the privatization of water companies following the full-cost recovery principle [15], the attempt to displace rainwater and restrict users to local piped water schemes could significantly raise household costs, presenting new barriers for low-income groups.

15. The water tariff increase is currently under discussion between the Private Investors, the Water Company and Hanoi People Committee.

5.4.8 CONCLUSIVE REMARKS

The densification of the city occurring both formally (through the construction of NUAs) and informally (in existing built environments) is contributing to an increase in the water demand, which represents a profitable arena for the water companies to extend their networks in villages still disconnected. At the same time, proper sanitation and wastewater treatment are still largely ineffective in Hanoi city, where most of urban wastewater is discharged in rivers and canals, with a tremendous impact on environmental resources. As a result, peri-urban villages in the rural-urban transition are getting connected to centralized water networks but they continuously cope with water pollution, floodings and environmental degradation. This is especially the case for those villages located downstream, as Lang To. Local resources, as groundwater extracted from individual or community wells, and surface water from rivers and streams are being replaced by a distant resource (surface water from the Duong River) thanks to the construction of new water treatment plants and extended pipelines.

Co-production of water and sanitation services in Hanoi villages still disconnected from centralized networks takes different configurations. Indeed, multiple organisations are found to be in charge of the different infrastructure networks. In Lang To, the agriculture cooperative manages the drinking water and the irrigation network. In the framework of the economic de-collectivisation process that occurred in the country, this organisation has been progressively transformed into a private service provider. The drainage system is managed at the village level with contributions from dwellers in terms of money and labour. Finally, most of dwellers produce their own services at the scale of the plots. The daily struggle for a regular, high-quality supply in face of increasing water pollution means that dwellers have resorted a series of individual and collective strategies to counteract the effects of urbanisation. The diversification of the resources used and the technical portfolio needed to process these resources, the regulation and control of irrigation canals, are compensatory strategies that have led to the adaptation of existing water practices or the development of new ones. When financial and land resources are available, several systems co-exist in the same housing system. This shows dwellers ability to find alternatives to improve access to water other than that provided through central networks.

Two self-reinforcing processes are highlighted in the observation of this case study.

Rapid urbanisation is contributing to ecological degradation in the peri-urban interface (Fanchette et al. 2011, Labbé and Boudreau 2011, Schramm 2016). The increasing amount of untreated wastewater discharged into downstream areas, such as in Lang To, goes hand in hand with decreasing groundwater and surface water quality. This threatens the sustainability of existing systems that rely on these resources (Viet Anh 2004). At the same time, given their densification and integration in the urban agglomeration, peri-urban villages represent a profitable arena for water utilities to extend centralized networks and to meet full-cost recovery.

This move from a cooperative to a centralised management of the water infrastructure network is supported by the government. This transition also entails a move from an artisanal to an industrial way of infrastructure production (Bakker 2003). As in other cases emerged in the literature of the topic, this transition is accompanied with regulations prohibiting self-provision through the use of local resources (Bakker 2003, Furluong 2014). Hanoi Masterplan for water supply goes in this direction, limiting the use of underground water and progressively dismantling decentralized water treatment plants managed by local communities.

Even though these water practices in peri-urban villages have proved to be extremely resilient, one can expect, by observing the trend at the city level, that the collective dimension that for a long time has characterized service provision in these areas will be progressively replaced by more individual actions, once the centralized network will start operating. This goes in line with a more consumeristic approach toward water provision, but does not necessarily mean that technical hybridisation won't continue to exist.

130.
Bricks at Lang To suggest ongoing densification of the village

131.
A farmer looking at rice fields flooded with untreated wastewater

CO-PRODUCTION FLOWS

→ **Water**
house individual connections to the collective de-centralized water system
+ individual storage (water tanks, pumps)
+ household rainwater harvesting system
+ household wells

→ **Irrigation**
collective irrigation system and pumping stations

→ **Sanitation**
collective drainage and sewer systems connected to on-site shared treatment facility (septic tank) or no treatment

CO-PRODUCTION ACTORS

→ **Water**
UNICEF (co-funding + co-planning)
+ Agriculture Cooperative (co-planning + co-management) mini network for drinking water
+ irrigation system
+ Households (co-management + co-planning): of alternative systems, i.e. rainwater harvesting, individual storage…

→ **Water**
Municipal water company Viwasupco (future connection to centralized network)

→ **Sanitation**
Ta Thanh Oai Commune and Village inhabitants (drainage system + septic tanks)

CO-PRODUCTION AREA

→ **Water**
plot unit (household co-production) and village unit (collective co-production)

→ **Sanitation**
village unit for drainage system + plot unit (septic tank, if present)

MAIN CHALLENGES FOR CO-PRODUCTION

→ Socio-economic conditions influence household's investment capacity in technology and consequently water quality and reliability

→ Increasing water pollution has threatened both irrigation system and the decentralized water network

→ Urbanization is absorbing villages progressively connected to centralized networks

TRANSFORMATIVE/ADAPTIVE NATURE OF CO-PRODUCTION

→ In-between community managed piped water scheme to centralized municipal network, a number of incremental and coping co-production practices.

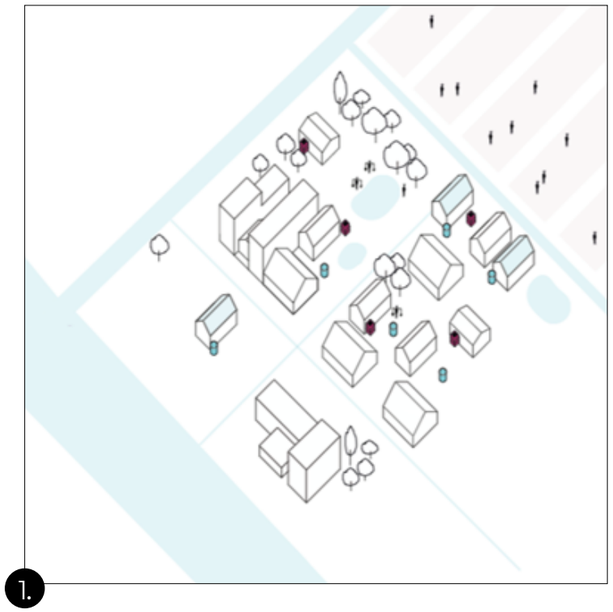
→ Transition from decentralized water network relying on groundwater to municipal centralized sewerage system

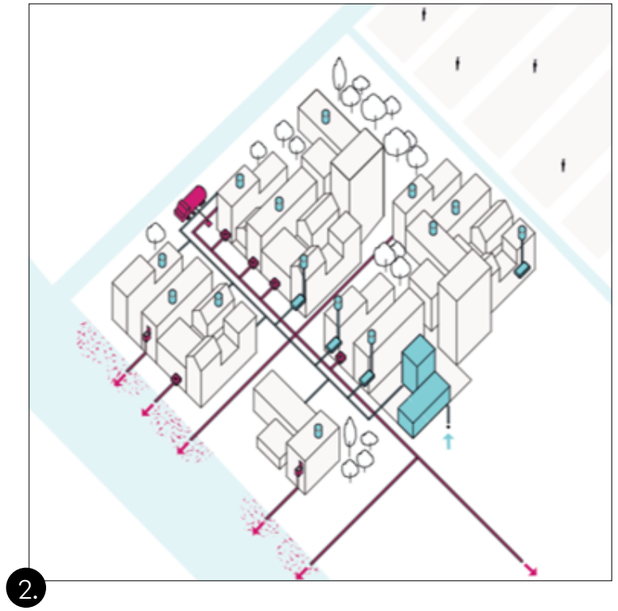
→ Transition in co-production organizations (the changing role of agriculture cooperative in the decollectivization process)

1. *Lang To earliest settlement. Drinking water was collected from rivers and ponds and rainwater was also collected in the courtyards. The water from the Nhue Canal was pumped to irrigate the agricultural fields.*

2. *Lang To settlement development after Doi Moi Reforms with incremental housing construction. The settlement was provided with a decentralized water network drawing on groundwater. In each house households would co-produce with water tanks and secondary pipes for in-house distribution. Most of the houses installed septic tanks with overflow combined with drainage in a collectively managed network.*

3. *Lang To current settlement. Two drinking water systems supply the neighbourhood. The decentralized network relying on groundwater and rainwater harvesting. Complementary strategies and devices are employed at the household level. Future connection to the centralized water network with the primary water pipe already installed in the main road.*





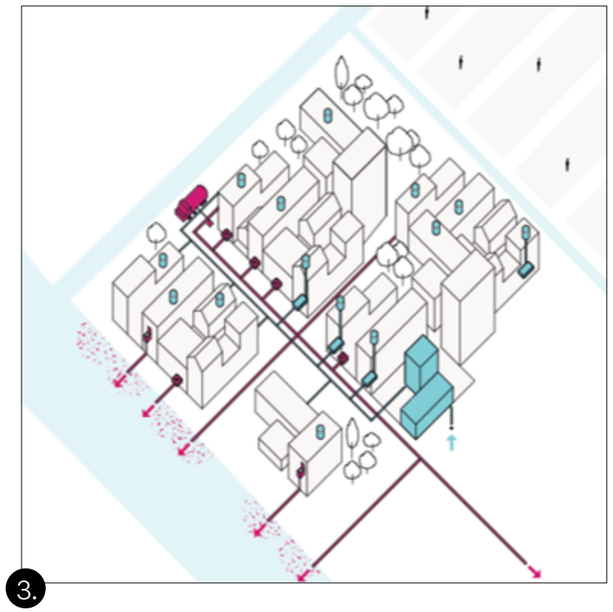


Figure 132.
Evolution of Lang To technical infrastructures and built space

5.5 C1 Multiple networks: the co-existence of centralized and decentralized water networks in Cochabamba Northern area

133.
Avenida America in the north of Cochabamba

5.5.1 VILLA MOSCU: BIRTH OF A NETWORK AND FIRST DEVELOPMENT

Located in the northern area of Cochabamba Villa Moscu is a consolidated urban settlement, accounting for about 3000 plots hosting 7000 inhabitants, most of whom are considered upper-middle income. It exhibits a compact rectangular structure with a regular, grid-like urban mesh whose northern boundaries are defined by the Tunari Park, the southern by the ring road and the eastern and western by the presence of other neighbourhoods with similar morphology and density. Dwellings of 2-3 stories set back a couple of meters from the street front, generally bordered by walls, with the exception of tiendas, commercial units that blur the boundaries between private and public space. These extensions of the dwellings are accessible from the street, although by night it is not allowed to enter it and the shopping of a limited number of primary goods is done through windows.

From North to South, the neighbourhood presents a hilly topography which follows the slopes of the Tunari mountain and is located in an area historically rich in groundwater on the aquifer recharge zone.

The origins of the neighbourhood date back to the late 1950s, specifically to 1959, the year the Junta Vecinale Villa Moscu was formed. At this time there was no plan for the urbanisation of the area, which was mainly agricultural. The development of the neighbourhood was not conceived as part of a planned urbanization project, but took place spontaneously through the allotment of the agricultural land of a former hacienda[16] that was sold to different owners. After a first division into nine plots, initially covering more than 1,000 m^2, land was progressively subdivided and sold to new dwellers, as pressures on the city increased.

The densification of the settlement occurred through a refined, albeit spontaneous, coordination process which was well described by inhabitants during the mapping workshop. Indeed, the various infrastructure networks, such as roads, electricity and water infrastructures were built by the inhabitants in parallel with the construction of the dwellings. To respond to the first challenge of making the neighbourhood accessible, as there were no means of transport, roads or paths connecting the area with the city centre, the earliest occupants self-organized and by borrowing a tractor, they started digging land in order to open the first roads.

16. Haciendas were landed agrarian estates mostly found in the colonies of the Spanish Empire, owned by Spanish-descended elites and supported by the unpaid work of indigenous tenant farmers, seasonal workers, and domestic servants. While originally consolidated by the titling of colonial land grants in 1645, unpaid hacienda labour persisted in Bolivia until the agrarian reforms in 1953.

In 1966 we organised ourselves to start community work. We were a small group living here, with no basic services, not even a latrine. There was no drinking water in the area nor a distribution network, only a stream from which people fetched water. In that year, the president started to ask for the participation of the inhabitants in the community work. Every Sunday we would all meet together, working on various projects: bringing stones, cement and other materials we could find or borrow. Thanks to some neighbours who were carpenters, we built the first water tank. While men and young boys helped to transport the material, women were preparing lunch.

Likely, the construction of the water network also came about thanks to collective action. The settlement location, on the slopes of the mountain, made it possible to access water from a spring located in the Tunari Park, shared with the inhabitants of the upstream community of Andrada. Through communal labour the two communities built the first water infrastructures which allowed to connect their settlements to the spring and to access water. They contributed both materially and financially to the construction of the network, its planning and reorganization over time. In particular, while the community of Andrada mainly contributed with labour, that of Villa Moscu covered the cost of the materials used for construction and offered periodic refreshments for those working on the construction and maintenance of the common infrastructures over time.

Regarding infrastructure ownership, the agreements stipulated that the entire water infrastructure (the pipes and cisterns connected to the spring) located upstream and before the perimeter of Villa Moscu neighbourhood is property of Andrada, while the spring sources are co-owned by both communities[17] .

These forms of customary exchange among different communities around water resources management, translated in urban settlements are hardly explored by scholars, although they have a very ancient tradition among rural communities in the Bolivian Andes.

It can be said that the collective efforts made by the first settlers in providing basic services in Villa Moscu and their joint action with Andrada community represent the culmination of the common good. They indeed led to a remarkable social capital, resulting not only in the shared

17. The issue of ownership of the infrastructure network is central as it relates to the control and management of water. It has now become the source of conflict over time among these two communities.

infrastructure they still manage but in the emergence of a set of principles of social coexistence and forms of exchange - self-organization, voluntary association, mutual aid - that recall the underlying values of what scholars have defined the “moral economy of waters” (Trawick 2001, Wutich 2011).

The embryonic form of neighbourhood organization that contributed to the emergence of the first infrastructure networks emulated the structure of a family, a small group of neighbours sharing, out of necessity, time, means and resources to improve the living conditions in the area and to bring basic services. Despite the limited means available (economic and material resources and workforce), the operating mechanism of this 'clan' structure was extremely well designed.

The extension and densification of the built environment in the area occurred in parallel with the progressive parcelling of the land, road construction and implementation of community infrastructures, sustained by increasing affiliations to the water network. These processes happened synchronously: when new inhabitants settled and asked to join the water service, the Junta would also bring the main infrastructures. This was made possible by a mechanism for reversing the membership fees for the neighbourhood council (initially 150B) which would go into a community fund. Funds recovered from affiliation fees were indeed used to finance consolidation works in the neighbourhood (i.e. to extend water networks and to open roads) as well as to organise celebrations and activities meant at consolidating community ties.

Before the water network was installed, roads did not exist. We built them, working together. We did this because we never received help from the mayor's office, the government or any other institution. With the few resources we had, we rented machines so that we could profile the roads. We collected a lot of construction material which we used for subsequent works. The roads were opened according to population growth. New inhabitants came to live in the neighbourhood, asked for water, registered as members, payed an affiliation fee and that's how the roads were opened.

Through this self-feeding process, the council has progressively extended its boundaries while increasing control over land, allowing the

consolidation and improvement of the built environment as well as of the water network, whose morphology was reconfigured over time.

5.5.2 THE GRADUAL TRANSFORMATION OF THE COMMUNITY NETWORK AND DECLINE

The rationality shown by the network evolution through incremental extensions, did not necessarily imply a technical rationality that took into account possible future uncertainties of the system, but rather a contingent rationality to address the problems that gradually arose in the process of urbanization. We have seen how the network has developed in a process of mutual adaptation with the demands driven by land occupation, following a simple and rational logic: the network settles and consolidates. When new inhabitants settle, the network extends. This is the incremental logic of water infrastructure development in Vila Moscu. However, if this logic was possible and economically sustainable with plenty of resources, it became problematic over time, as the resources became scarce and the demand increased. This explains the emergence of a number of conflicts in relation with water distribution as well as the coexistence of different networks in the neighbourhood.

Figure 134.
Villa Moscu site plan

Villa Moscu today is covered by two different water supply systems: the centralised one managed by SEMAPA and the decentralised one, itself composed of two separate networks, managed by the neighbourhood council.

The first drinking water network had a linear structure and ran along the Eudoro Galindo road. From the spring located in the community of Andrada, a pipe fed a water collection tank of 600,000lt located in the upper part of the neighbourhood. From the tank through a secondary pipe, the water was delivered by gravity down to the first dwellings of the neighbourhood, in that earliest urban sector called Morro.

The agreements with the community of Andrada stipulated that they would receive water during the day from six in the morning to six in the evening, while in Villa Moscu water would be distributed daily from six in the evening to six in the morning. In this first phase of network development, water was available 24 hours a day in the neighbourhood.

As the area was further developed, secondary connections were progressively added to the first linear trunk and secondary streets were opened at the same time. At this stage of development, the infrastructural net has progressively acquired secondary branches transforming itself from a linear structure to a comb structure. Between 1968 and 1970, Villa Moscu saw the occupation of two new sectors, Quechisla and Petroleros, which led to the creation of a second water network. Although morphologically independent, the second network continued to draw on the same spring resource shared with Andrada community. It is from the 1980s onwards that the district began to expand in an increasingly rapid and improvised manner and the mature community network evolved from a comb-like to a mesh-like structure. This development phase was immediately followed by a crisis phase that led to a gradual decline of the community system in the face of water-related challenges.

First, the community of Andrada experienced a similar increase in population, which created instability in the management of the network and led to the emergence of a first conflict among the two communities that so far had jointly shared their resource systems:

> The community of Andrada started to cut off our water. We did not sue them just to avoid further troubles with those in power. They wanted to ignore us and neglect how much we had invested over the years to build the water network. We are both co-owners of the water sources and we also

pay taxes on them. These types of conflicts are particularly frequent when new generations take over the community. They forget their history.

These words uttered by one of the earliest inhabitants of Villa Moscu show a central issue: that is the dissolution of community ties over time, partly due to the progressive demand for water at the same time as the resource dwindled, and partly due to the growth of the neighbourhood, which made inhabitants unaware or insensitive to those initial collective efforts made by the first residents. Since these tensions have surfaced, the two communities redefined their agreements and operational rules. Villa Moscu thus progressively rationed the water distribution from the shared spring. If this water was initially constantly delivered to households 24 hours a day, today is only distributed 2 hours per week.

According to the initial agreements, the community of Andrada was to receive water during the day from six in the morning to six in the evening, while in Villa Moscu water was distributed daily from six in the evening to six in the morning. This has been the case for a long time, but today these agreements are no longer being respected, because the demand for water in Andrada has grown and they have decided to cut us off three days a week. Now the water from Andrada only comes from Monday to Thursday from six in the evening to six in the morning.

Moreover, the uncertainty given by the dependence of an increasingly scarce and distant resource, made it necessary to diversify water resources by drawing on an independent resource. After surveys were carried out at various points in the neighbourhood, a well was drilled at a depth of 120 m deep well. In order to increase water storage capacity a new tank was connected to the existing networks drawing from the well.

Not only a gradual rationing of surface water following conflicts with Andrada and the settling of a new groundwater system to meet the growing demand for water in the neighbourhood, but an important change in the community took place since the implementation of Popular Participation Act in 1994.

Indeed, this recognition which saw the institutionalisation of the Junta Vecinale, later to become the Territorial Base Organisation (OTB),

meant that community organisations could draw on municipal resources through POAs to carry out a range of activities in neighbourhoods, mainly conducting works in public space, for example building sport facilities, schools, health centers.

There is thus an important transition: from a phase of informal neighbourhood development (in which citizens were co-founders of all activities in the neighbourhood as well as in the construction and management of the built environment and the water networks) to a phase in which support from the public sector makes collective work less indispensable. There is a strong increase in the cost of affiliation to the water service (from 150B to 4000B) and while new households do not connect to the decentralised network because considered too expensive, even a number of households already connected start to complain about a worse quality of service and disaffiliation begins. We have seen how the community network emerged through the efforts of the first inhabitants in a co-evolving relationship with the gradual urbanisation of the neighbourhood. Households were not considered simple service users, or customers, since they were required to contribute, either with work or money, to community works. This collaborative attitude in the neighbourhood has changed with its growth and the institutionalisation of the Junta Vecinale: the more people inhabited the areas and the more services increased, the less was the need for association and contribution to community works. Citizens turned progressively into passive customers and the neighbourhood council to a private service provider.

I would dare to speculate that the formation of social capital linked to land management which was initially expressed through forms of social and spatial solidarity, was threatened by an interplay between urbanization process, decrease in water resources and the institutionalisation of the community organisation. Thus, began internal conflicts within the neighbourhood that emerged mainly from the individual interviews. On one hand, as we read below from the words of the OTB president, the old inhabitants have a suspicious look at the new ones. The latter, on the other hand, have the same mistrust of the junta's actions, which many consider corrupt and opaque.

In fact, we all knew each other (...) Before, thieves didn't even come here, but now that more people have arrived, thieves have also arrived.

The first inhabitants of the neighbourhood held plots of a thousand metres. This preserved the family unity in the land occupation. There was more organisation and willingness to cooperate among the first inhabitants in the maintenance and cleaning of the neighbourhood. While the new ones say that since they pay taxes they are not required to clean. They are only willing to do things when their interests are directly affected.

This conflict, both with the community of Andrada and with the new inhabitants of the neighbourhood, illustrates the total dissolution of those foundational ties constituted by the collective work of the first inhabitants. This loss of solidarity is evidenced by a series of 'feedback' actions, taken by the OTB to block its borders, not only preventing the extension of the network, but encouraging disconnection of current affiliated members. For example, the fact that with the sale of the plot or the house, the new owner does not receive the title of member, i.e. he does not have the possibility to have his membership transferred to the network for which he has to pay 4000 B for a new affiliation, is a clear example of a strategy to decrease the number of connections.

5.5.3 THE EMERGENCE OF THE CENTRALIZED NETWORK AND HYBRIDISATION

The growth of the district and the conflicts briefly described so far produced instability in the community network management system. In order to respond to this crisis, the neighbourhood council decided to "freeze" its boundaries, by refusing new affiliations to the water network. When the more recently occupied sector of Confopromin began to be occupied, the inhabitants demanded a quantity of water that the council decided not to provide. This mechanism of exclusion from the network generated a micro fragmentation within the neighbourhood. From the moment they are excluded from the drinking water service, the new inhabitants decided not to maintain their membership of the council, thus contributing to urban development in the area. This conflict preceded the extension of the municipal centralized network. At the beginning of the 2000s, it was already clear that the council would not extend its networks anylonger, so SEMAPA entered in the neighbourhood.

The extension of the centralized network took place in different stages from 2000 onwards, since there was no plan to extend the network to the entire district. The initial cost for installing SEMAPA in the neighbourhood and joining the network was 2000 Bs, but has now fallen to 78 Bs, since the first dwellers connecting to the network had to contribute to funding and works to bring the main pipelines in the area[18].

In Villa Moscu there is currently an overlap between these two networks, the centralised network operated by SEMAPA and the decentralized network operated by the OTB[19] . It is estimated that about 80% of the neighbours are connected to both systems, because even though the resource is scarce and the monthly volume of water has been reduced, the community service is still functioning and economically advantageous compared to that offered by SEMAPA. Most households use both systems. In order to reduce the expenses related to water consumption, households prefer to consume water from the OTB and complement it, where necessary, with more expensive water distributed by SEMAPA. In fact, the OTB is paid a flat rate of 31 Bs/month, which includes 20 Bs to cover water-related expenses, a mortuary fee of 10 Bs and a contribution for the police module of 1B. The cost of water purchase from SEMAPA varies according to consumption and the level of consolidation and finishing of the buildings, which are divided into categories. In general, the cost of those using the centralized network is around 200 B per month, a much higher figure than the community one.

The survival of the community network is threatened on the one hand by the extension of the centralized network and the decreasing contributions to the OTB funds, and on the other by the progressive decrease in local resources. Even the water currently extracted from the well, which covers about 20% of the district's water needs, is destined to disappear within five years, according to the OTB's leader forecasts.

The flow rate of the well was 3l/s and is now down to 1,2. We try to keep it down, with constant cleaning and maintenance. We would like to drill a new well to be able to be relieved, but even the resources we have are insufficient. What we are seeing is that there is a Misicuni network, which will have a 900,000 cubic tank

18. I think it is interesting to point out to the reader that the trend in SEMAPA's centralised system membership costs is opposite to that of OTB, i.e. it decreases over time once the neighbourhood is reached by the main water trunks.

19.Former neighbourhood councils (Junta Vecinales) were institutionalized in 1994, with the Ley de Participacion Popular (LLP). As the legal personality of these organizations was recognized, they are granted funds from the Municipality to invest in urban development. In the case of Villa Moscu, the same OTB who manages neighbourhood development also has control over the water network. This type of community organisation that fulfils this dual role is often the one most susceptible to elite captures and forms of patronage, as found in interviews conducted in Villa Moscu and in other neighbourhoods.

almost on the border of our OTB. We have contacted them to see if they can supply us with water, but we have found out that we will have to help and co-fund the works to carry the pipes from the network to our reservoir..

We have observed different forms of spatial and infrastructure re-configurations in the neighborhood, suggesting a process of adjustment and bounded rationality. As long as the resource was constant and water was distributed regularly, the community organization opted for an extension of the neighbourhood jurisdiction, in parallel with the extension of the drinking water network. As the water resource dwindled, the organization responded with stop-gap solutions and allowed the extension of the centralized network in the area so as to guarantee a better water supply to those who were already affiliated. The construction of the Misicuni Dam and the assurance of a possible safe water resource poses new challenges to the OTB, which will need to re-organise itself and redefine a new role in light of changed urban and environmental conditions.

The survivability of the council, now considered by many inhabitants to be opaque and corrupt, especially since it has not called new elections for years to change its leadership, will be tested in the coming years. As the resources on which the network is based are depleted and the connection to the centralized network increases, the community organisation will be forced to redefine its role and adapt. The hope, in the words of the leaders, is that the OTB will maintain control over the distribution network, but receiving water from SEMAPA, through the Misicuni dam.

If we have the possibility of buying water from SEMAPA or from the Misicuni dam in bloc, I think we would be in a better position to distribute water and even to receive new affiliations. We already have a good water distribution management; our system works well. But for that we need to improve our water distribution networks, the pipelines and the tanks, and to look for some funding to bring water from those big tanks of Semapa to our tanks. I imagine that if this happens, we will be able to meet the needs of all the neighbours in the OTB, which is quite large.

Since about 2017 Misicuni has been a reality in Cochabamba, however at the moment it has not yet been able to provide the resource and distribute it to the various neighborhoods.

If this were to be possible, we have seen how it is also the most desirable solution for these community networks, the boundaries of the network and OTB control, could find themselves changing again, re-expanding and then, probably, freezing again. Clearly this scenario is sweetened by the leaders, who are not, however, seen in a positive light by the community. This poses a further challenge to the organization, whose survival is based not only on the network it manages but on the social role it represents that has been lost over time.

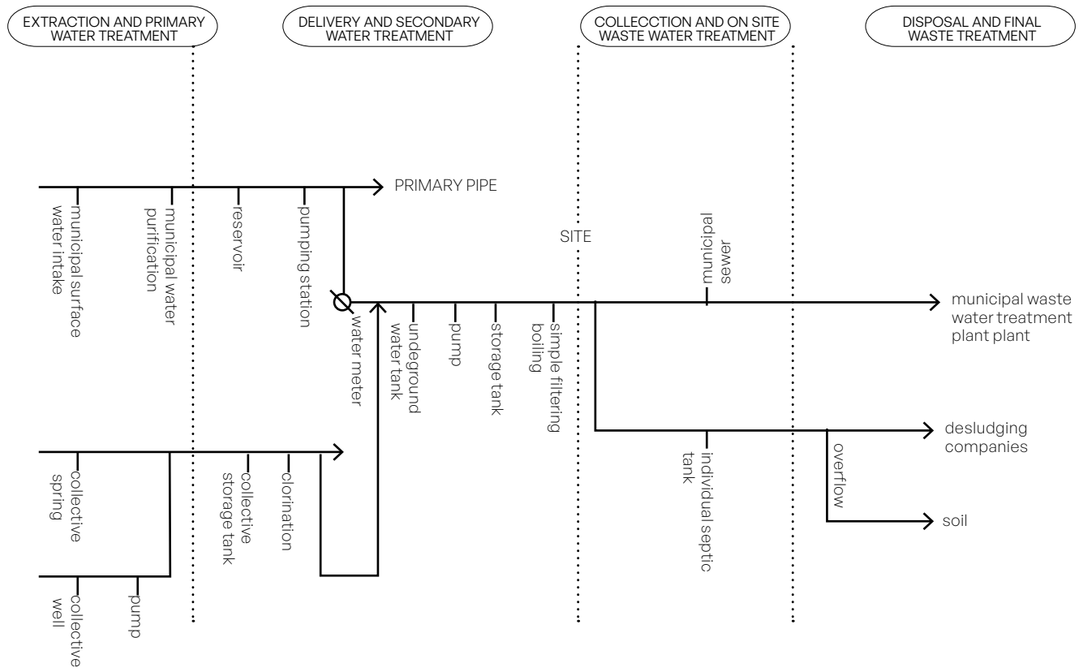


Figure 135.
Technical devices employed in the flow of the co-produced WSS services

5.5.4 CONCLUSIVE REMARKS

With its overlapping networks, the water landscape of Villa Moscu shows a dynamic and multifaceted character. I sought to look at the infrastructuring processes of the different water networks serving the neighbourhood and to reflect on the role of co-production in ensuring that this process would be able to respond to the continuous challenges dictated by urbanisation.

There are currently two main actors producing water services in the area: SEMAPA, the municipal water utility that is progressively extending the grid in the north of Cochabamba, and organised citizens through. In the case of Villa Moscu, the organisation in charge of water services is the same OTB that manages the development of the neighbourhood.

The hybridisation between technological systems found in the neighbourhood does not only concern the combination of the centralised and decentralised network, which in some portions of the neighbourhood overlap, but above all the incremental evolution of the community network which I tried to trace with the inhabitants during the participatory mapping workshop. As we have seen, this development been structured over time through processes of extension (from an initially linear structure, it has been consolidated as a mesh structure), duplication (with the urbanisation of two new areas, a second network has been established), the insertion of new infrastructural systems (with the reduction of surface water, a well has been opened that has required new technologies) and the progressive replacement of technologies that have become obsolete over time.

We also observed the relationships between this material process of infrastructuring and the reconfiguration of the community organisation, in particular the shift from a 'clan' form of organisation to a more bureaucratic organisation. After the institutionalisation of the Junta Vecinales (1994 Public Participation Law), the district experienced a growth in the number of inhabitants, and the OTB encouraged expansion of its boundaries and to have access to a higher amount of municipal funds through the POA and to those coming from the community through water affiliations.

While the process of boundary expansion was initially cost-effective and ensure the consolidation of the neighbourhood and its services for some time, with the decrease of available resources, the OTB adopted a series of incremental strategies designed to cope with increasing

uncertainties. Upgrading strategies (increasing water storage capacity), rationing strategies (decreasing water use), the search for an independent resource (well), all compensatory strategies implemented by the community organisation before opting for "freezing its boundaries" and allowing the centralised network in the area to reach those it excluded.

The fact that the two networks coexist in the neighbourhood creates several problems, especially given the fact that there is no adherence between the territorial boundaries of OTB and those of the water network. About 20% of the inhabitants belonging to Villa Moscu are not connected to the community network and, consequently, do not contribute to the community fund. On the contrary, a portion of the neighbouring district Faros de Aranjuez receives water from the board and, it is said, public works in the settlement come from the POA of Villa Moscu. Faros de Aranjuez was in fact part of the initial territory of the Junta Vecinale, but broke away with the transition from Junta Vecinale to OTB. The institutional status of the organization in charge of the water network is not clear and is likely not to operate in a transparent way.

There is a widespread opinion in the neighbourhood that the current leadership (which has not called the assembly to elections for years) wants to maintain its power in the face of elitist and inequitable water management, and in the face of increasing complaints especially from those excluded from the system and from those who, because of progressive rationing, have been forced to compensate for the lack of water by connecting to the most expensive service provided by SEMAPA.

CO-PRODUCTION FLOWS

→ **Water**
in-house individual connections to the municipal centralized water system
+ households' storage devices (water tanks, barrels, jarrycans)

→ **Water**
in-house individual connections to decentralized water system (private borehole)
+ households storage devices (water tanks, jerrycans, barrels)

→ **Sanitation**
municipal sewerage connected to centralized wastewater treatment plant+ on-site shared treatment facilities (i.e. holes, septic tanks)

CO-PRODUCTION ACTORS

→ **Water**
Municipal Water Authority SEMAPA + households

→ **Water**
Villa Moscu neighbourhood council (OTB)
+ Andrada neighbourhood council (OTB)
+ individual storage (water tanks, jerrycans, barrels)

→ **Sanitation**
SEMAPA + households

CO-PRODUCTION AREA

→ **Water**
Individual house space for households'

→ **Sanitation**
Common compound drainage system + common block spaces for sewer and septic tanks

MAIN CHALLENGES FOR CO-PRODUCTION

→ Reduction of both surface and underground water resources is leading to water rationing measures, impeding new affiliation to the co-produced network

→ The sharing of the resource with the upstream community is revealing itself a source of conflict, undermining the survival of the co-produced practices relying on it

→ The co-production organization is not anymore perceived as a community actor, but rather as a private provider whose management is deemed to be opaque and corrupt

→ Decreasing affiliations means less funds for neighbourhood improvements

→ The municipal network now connected to the Misicuni Dam might guarantee a more safe and regular resource than that provided through co-production

TRANSFORMATIVE/ADAPTIVE NATURE OF CO-PRODUCTION

→ The extension of the co-produced water service went along with increasing urbanization and densification of the built environment, with the opening of the road network contributed by the affiliation to the water network.

→ Transition of the former Neighbourhood Councils (Junta Vecinales) from informal collective organisations to institutionalised service providers.

→ Progressive adaptation strategies adopted by the council to respond to higher water demand in a context of decreasing resources

→ Increasing connections to the centralized network and disconnections from the community network

1.
Villa Moscu earliest settlement with water network relying on spring water from Andrada community in the north of the area.

2.
Villa Moscu settlement growth and upgrade of the storage system with a new tank introduced and connections added.

3.
Villa Moscu third phase of settlement growth and upgrade of the water distribution network with groundwater extracted from a local well. In-house connection to the sewerage network.

4.
Villa Moscu current development with two overlapping networks. The old decentralised one drawing on the two water sources and the centralised one connecting the most recent part of the settlement.

Figure 136.
Villa Moscu evolution

137. 138. 139.
The semi-detached housing systems in Villa Moscu

140.
House construction in Villa Moscu

141. 142.
Public spaces in Villa Moscu

5.6 C2 Politics of water intersecting politics of land in rural villages

5.6.1 AN AGRICULTURAL MUNICIPALITY IN TRANSITION

143A.
the rural municipality affected by urbanization

Since the 1960s, Cochabamba's urban growth has followed a new conurbation axis marked by the construction of a road linking the city of Santa Cruz with that of Oruro. This linear-like conurbation crosses several municipalities in the metropolitan region of Cochabamba, including Vinto, located in the North-West side of the region.

In the 70's and 80's, particularly with the boom in the production and export of cocaine in parallel with to the relocation of workers in the mining sector in the Andean area, the city experienced various forms of expansion caused by the strong migration pressures. This rural municipality, located about 17 km from the city centre of Cochabamba started to be affected by land redevelopment and urbanization.

The total surface area of the municipality of Vinto is 235.7 Km2 and develops over three ecological regions: the Valley, an area of foothills and on of highlands that corresponds to the Tunari mountain range.

Vinto has a variety of water sources: rivers, springs, lagoons, and groundwater. In its jurisdiction there are three main river basins: i) Pairumani, ii) La Llave, and iii) Huallaquea. The hydrographic formation of Vinto is mainly made up of the Rio Grande. The water that flows down from the mountain range through the rivers serves to recharge the aquifers, as part of it infiltrates into the foothills. Because of its location on the area of aquifer recharge, this area accounts for abundant water resources, which allowed the organization of the main economic activities around rainfed and irrigated agriculture, especially in the area of influence of the La Llave watershed. In intensively irrigated areas, vegetables are produced, while in rainfed areas, agricultural activity is complemented by dairy cattle breeding.

According to INE's Poverty Measurement Methodology on Unsatisfied Basic Needs, 49.1% of Vinto's population was poor in 2001. Compared to 1992, there was a considerable reduction in poverty, but in relation to other urban centres close to the city of Cochabamba, the municipality of Vinto reports the highest poverty rate (Quiroz et al., 2007).

Access to piped water for domestic consumption is still limited. According to the 2001 INE Census, 47.26% of Vinto's population is supplied by piped water, the rest access water from the river or from neighbours. It is also evident that the levels of housing equipment are lower than in other population centres, for example in Vinto only 4% of the population has sewerage.

Despite the area's predominantly agricultural vocation, non-agricultural activities are developing around the main settlements, in parallel with a process of rural-urban conversion. The growth of the tertiary sector, mainly in the valley area of the basin, is partly due to the increase in smallholdings, water scarcity and the increase in family obligations (e.g. higher education for children) that lead to the need to find alternative sources of income, thus diversifying economic activities in the area.

143B.
Breeders resting in the shade during the heat hours

5.6.2 SAN JORGE A

Located in the municipality of Vinto, San Jorge A was established as an agricultural district in the 1970s when the first inhabitants settled. Today, the neighbourhood is connected to a water distribution network that supplies water both for domestic use and for irrigation of the cultivated land that now occupies the largest area of the neighbourhood.

Prior to the installation of the recently built water network, there were many ways of accessing water, which varied over time, depending on the possibilities of the inhabitants. Initially, surface water, collected from the streams and irrigation canals, and rainwater were used as a drinking source.

> At the end of the 1970s, when we settled in, we were living a cruel reality. We had no drinking water, which we took from the river and rainwater collected from the roof. Another way of accessing water was through irrigation canals that were piped to small self-made depressions in the ground that we commonly call ulajocha. From there it was filtered, boiled and consumed.

The first form of organization of the social fabric of San Jorge took shape in 1985, when the inhabitants formed a Water Cooperative, which included the two neighbouring OTBs now known as San Jorge and San

Jorge A. The cooperative had the role of intermediary for the purchase and distribution of water in the area. It used to buy about 40,000 l of water daily from the neighbouring community of Crucero, which at that time had its own well. The cost of water purchased from the neighbourhood soon began to rise as the neighbourhood became denser and demand for the resource increased: initially the households paid a fee of 7 Bs, which later increased to 8 Bs (around 1 $) per cubic meter of water purchased from the cooperative. Although the resource was not extracted locally, the cooperative had built a distribution network that initially covered a small part of the village. This network, of linear form, ran along the main village road and was connected to an elevated storage tank, daily filled from the cooperative. While the 2% of the water was for water consumption, the rest served for agricultural purposes.

After 5 years of buying water in tanks, which covered only 10% of the demand in the area, the cooperative tried to raise funds to drill a well. The need to increase the quantity of water raised the question of resource independence from the external organization on which they depended.

However, the choice of the location of the well generated the first form of conflict among the inhabitants, which started in 1996 and ended with the dissolution of the cooperative and the administrative fragmentation of the OTB in 1999.

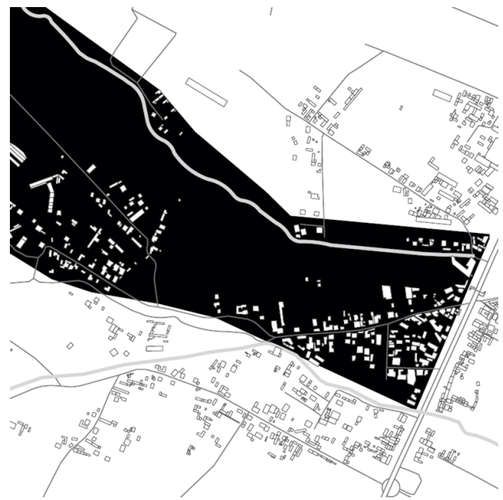


Figure 144.
San Jorge A plan

5.6.3 THE COLLAPSE OF THE COOPERATIVE SYSTEM

It can be said that the installation of the well, marked the transition of the neighbourhood from rural to urban, leading to the emergence of internal conflicts within the same community that had initially united for the formation of the cooperative. These conflicts are still perpetuated today.

This transition was dictated by the changing needs of farmers who until then had access to water from the La Llave River, and managed it according to customs and traditions, through *mitas de agua*, customary forms of collective management that provided a system of irrigation in rotation.

> From 1985 until the year 1990, we believed that the cooperative system was that organization that would provide greater benefits to the members. But in our case, essentially, the cooperative became an intermediary simply in charge of selling water. At first, the cooperative was generating but not distributing dividends among members. Then came its bankruptcy. Initially, when the cooperative had about 120 members, the system worked quite well. Unfortunately, population growth increased the demand for water, which began to become scarce. The neighbouring community no longer wanted to sell us water as its population had also increased. It was therefore necessary for the cooperative to have its own resources. By then we decided to drill a well. Unfortunately, this situation did not occur, because the cooperative - I repeat -, became only an intermediary, and this led to its failure.

The exhaustion of the cooperative occurred for several reasons. On the one hand because this intermediary organization was not able to guarantee a distribution of profits to its members, nor it could continue operating its network relying on a resource that had been denied by the neighbouring community. On the other hand, because the community of San Jorge was extremely un-cohesive, presenting different needs in its population. In fact, while the part of the neighbourhood north of the ring road had a strong agricultural vocation, the part to the south was mainly residential. The decrease in surface resources that until that

moment had guaranteed the survival of the archaic system of *mitas de agua*, caused an increase in water demand for irrigation, which would have been met only with the use of new independent source of water. However, the decision to locate the well in the northern part of the neighborhood, triggered a series of violent protests in the southern part, which accounted a higher number of inhabitants. The conflict is described in this way by the inhabitants:

> We told ourselves that the well would be drilled in the northern part, because if we drilled it in the southern part it would certainly not benefit those of us who irrigate. And we succeeded. All 150 members of the cooperative put up $100 for the drilling works. We negotiated for a long time with Juan Miranda Quilla (the president of the NGO that had come in as a facilitator of the construction process) from August to September 1999 so that the well could be drilled in our area. We withstood various sabotage attacks during the construction phases of the well, which began in October and ended in December. When the well was drilled, the people in the southern area told us to give them their money back or give them the well. We wanted to keep the well, so we preferred to give them back all their shares on the condition that they quit. There were about 30 of us. We were so strong and determined that we fought to defend the well. We watched over it for months, in shifts, day and night. Finally, we got it..

This conflict, narrated by the voice of those who 'won the battle', is representative of a form of egotism that is clearly opposed to the values of solidarity that should have guided the cooperative's work. The cooperative's inability to represent the interests of an entire community was manifested in its decision to allow the well to be settled in the northern part of the neighbourhood, an area with a smaller population but with a greater need of water for irrigation. In practice it happened that some 30 members of the cooperative opting for an autonomous management of the water network took the control over the well by force and, by liquidating the other cooperative members, caused the break-up of the cooperative.

The exhaustion of the cooperative through the division of the in-

frastructure network led to a process of administrative subdivision that culminated in 2006, when the legal personality of OTB San Jorge A was created. In spite of this conflict, which escalated into accusations of fraud and a lengthy court case that ended in 2005, the well had been drilled. However, it remained inactive until 2011. During the eleven years that elapsed while waiting for a new legal personality to be defined, the neighbourhood did not have the possibility of accessing public funding, neither from the State nor from the municipality, as its juridical personality was not recognized. During this transition period, San Jorge A accounted for an unfinished infrastructure system: the well was drilled but since no distribution network was put in place, the agricultural fields and the houses were still disconnected from water supply. This forced the inhabitants to produce their own water services individually. This occurred through the redeployment of the earliest practices of water collection at the household level, namely buying water from private vendors or collecting water from the irrigation canals.

We had no drinking water, so for nine years we bought water from the water vendors, which initially cost 150 Bs then 300 Bs, for 10,000 litres. You see how we suffered from the water problem. The situation was tragic. We were getting water from the ditches. We were looking for water day by day, hour by hour. Where I live there was very little water, so we had to put it in small pots to fill the barrel. This is what supplied us. We survived. Even now, in the western part of the district, the inhabitants, who are not connected to the network, still take advantage of the water passing through the canals to wash themselves, to irrigate.

145.
Farmers washing clothes with water feeding the irrigation canals

5.6.4 THE CONSTRUCTION OF THE DISTRIBUTION NETWORK AND THE EMERGENCE OF NEW CONFLICTS

In 2006, after years of struggle, San Jorge A acquired legal personality, which enabled the implementation of co-production schemes through the access to public funds. The neighbourhood obtained two important public funds in 2009. Municipal funds (POA) contributed to finance the construction of the largest part of the system's main infrastructure: an elevated tank with a capacity of 36,000 litres, a semi-underground tank with a capacity of 180,000 litres, as well as the distribution network, which was initially connected to an old well. Moreover, in 2011, the well that had been built in 1999 was activated with technical support and funding provided jointly by the State and the inhabitants. These co-planning and co-funding scheme were approved by the Ministry of Water and the mayor's office.

While the main distribution network consisting of 3,000 linear meters and the storage tanks was financed by the municipal government, the secondary and domestic connections, including the installation of water meters, were contributed by the inhabitants. The community had a very important role in this process of infrastructure extension, being in charge of the excavations works and the installation of the main pipes.

Since 2011, San Jorge drinking water and irrigation system is managed by the OTB. It is estimated that 90% of water resources are used for irrigation while 10% for domestic consumption.

The price of water varies according to the use. While the cost per cubic meter of water for domestic use is 1,50 Bs (0,22 $), water for irrigation costs 10 Bs (1,5 $) per hour.

The elevated tank is filled twice a day, at 7 a.m. and 12 p.m., and takes about 30 minutes to fill, while the semi-underground cistern, which only distributes drinking water, is filled in about three and a half hours. While the drinking water network works through valves and meters that ensure automatic metering of the water flow, in the case of the irrigation network, the opening and closing of the gates is operated by a plumber contracted by the OTB. His role is to regulate the distribution of water to the various agricultural fields on the basis of the farmers' requests while the secretary of the OTB ensures collection of water tariffs.

Notably, the cost of water has been rapidly escalating over the years in the neighbourhood, in parallel with increasing urbanisation. Although water tariffs have remained more or less unchanged, what has risen

sharply is the cost of subscribing to the service and connecting to the network. Indeed, if the initial contribution from neighbours for the construction of the infrastructure and the affiliation to the water service was 100 $, this membership fee now stands at 800 $, a particularly high figure compared with other neighbourhoods investigated in the city. The high cost of affiliation creates considerable tensions in the neighbourhood. On one hand, it represents a tasty source of income for the OTB which is ensuring a great fund for the future extension of the network in light of increasing urbanization. Indeed, the leaders in charge of managing the water network are key players in the urbanization processes of the territory, promoting allotments outside the regulatory instruments, by providing connection to the water network. On the other one, the perception of high costs and their opaque management encourages protests, especially from new residents who are demanding to pay a lower tariff given the fact they demand water only for domestic consumption.

> There is a resolution from the governor's office
> that it should be maintained as an agricultural zone.
> But the current OTB leaders are not enforcing this resolution.
> Instead, they are promoting the division of farmland,
> destroying the entire agricultural system of our community.
> All the current allotments that have been made are allowed
> by of the management of water and irrigation. These new
> leaders are interested in taking the 800$ and dividing
> the land into plots. They have seen that it is easier
> to take the money in this way.

The co-production of the hydraulic networks in San Jorge has created a perverse mechanism that encourages uncontrolled urbanization in a protected area, classified as agricultural. This mechanism of patronage and corruption which allows for chronic forms of speculation on the land sector not only takes place outside municipal and state regulations, but also outside the collective arenas of political discussion and decision-making that the OTB is supposed to regularly foster in its assemblies. Namely, the organization is acting beyond the purposes for which it was created.

As reported, one of the main problems of the current leadership is that it does not operate transparently, nor does it inform about the management of water fees and the new affiliations to the water network.

Residents said that until 2013 there were about 160 members in the network, but to date this number is not known. While in the past each new member of the water service was introduced to the assembly, this practice is no longer used, which makes it difficult to know how many people actually live in the neighbourhood and are connected to the water network. Moreover, a fierce conflict is emerging between old and new inhabitants. In fact, while old inhabitants need large amounts of water for both irrigation and domestic consumption, the new ones only need water for domestic consumption. However, the affiliation costs do not depend on water use and this is exacerbating conflicts and protests in the settlement, with the consequence that a high number of inhabitants do not recognize the current leadership and do not attend assemblies.

New members are indeed more numerous than those who need water for irrigation, and this practically creates an imbalance which jeopardize the legitimisation of the organization as well as the ecological balance of a fragile land, threatened by a form of violent urbanization, based on uncontrolled building speculation and led by an oligarchy that, based on favouritism, takes advantage of the management of a common and endangered resource to pursue private interests.

146. 147.
The two collective water tanks in San Jorge A

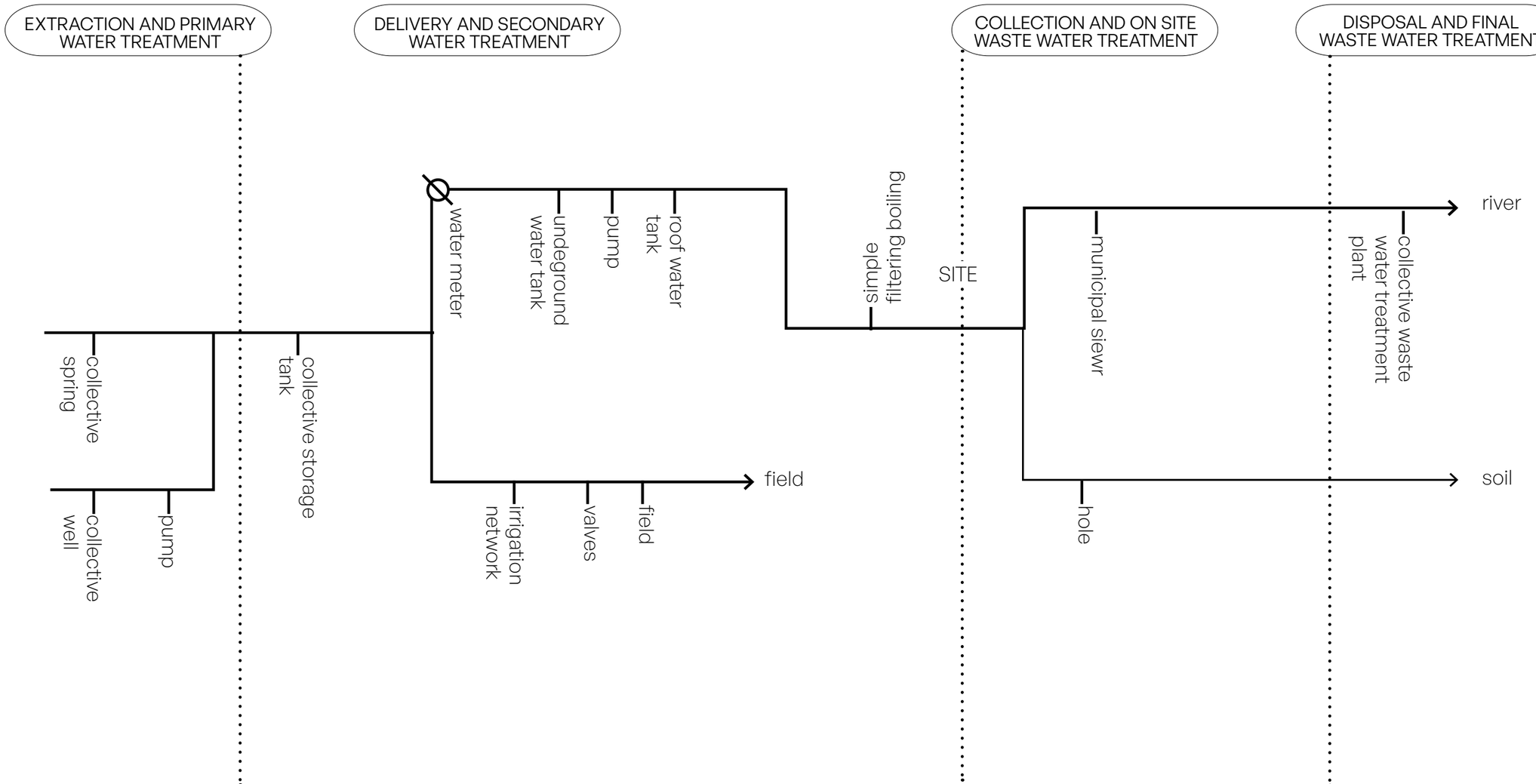


Figure 148.
Technical devices employed in the flow of the co-produced WSS services

149. 150.
San Jorge A under construction

5.6.5 CONCLUSIVE REMARKS

The case of San Jorge related some of the ways in which land policies intersect with water policies, and the intermediary role played by water co-production in triggering incremental conversion and land occupation in the tumult of informal urbanisation, which in the absence of efficient regulations, is swallowing up the agricultural fabric and fragile water ecosystem in the Andean region. A few considerations lend themselves to being made regarding the role played by co-production in this neighbourhood.

Firstly, the conflict between the agricultural and urban dimensions of the neighbourhood has been at the origin of a process of institutional fragmentation that has originated in the planning and implementation of water infrastructures in the neighbourhood and has led to the disintegration of the cooperative responsible for providing services to the community.

Today, this conflict does not seem to have subsided; on the contrary, it is fostered by OTB's dual role as service provider and private land speculator. Indeed, the Grassroot Territorial Organisation in charge of managing the water network in San Jorge proved to be a key player in the urbanisation processes of the territory, promoting allotments outside the regulatory instruments.

In spite of a law which prevents the transformation and construction of rural classified area (as it is the case), the OTB allows for land speculative deals, in order to make profits from the extension of the water network. They demand 800$ each new affiliation (a very high figure compared with the affiliation costs found in other areas of the city already urbanized).

Conflicts also emerge within the neighbourhood, between residents who use water for both domestic consumption and irrigation (old inhabitants) and those who only consume drinking water (new inhabitants), who demand for a diversified water tariff and affiliation cost based on water use. In view of patronage management of the community organisation, individual practices of access to water emerge in the neighbourhood, especially among low income households, where, as in the past, water from the canals is used in certain domestic activities (e.g. washing clothes or dishes) to cut costs.

CO-PRODUCTION FLOWS

→ **Water**
in-house individual connections to the OTB decentralized water system + households' storage devices (water tanks, barrels, jarrycans)

→ **Irrigation**
field distribution through valve system to decentralized water system

→ **Sanitation**
on-site individual or shared disposal (i.e. holes, septic tanks)

CO-PRODUCTION ACTORS

→ **Water**
Base Territorial Organization
OTB San Jorge A + households

→ **Sanitation**
households

CO-PRODUCTION AREA

→ **Water**
Individual house space
for households' storage devices

→ **Water**
Field unit

→ **Sanitation**
Individual and shared garden compounds for holes and septic tanks

MAIN CHALLENGES FOR CO-PRODUCTION

→ The OTB in charge of managing the water network is a key player in the urbanisation process of the territory, promoting allotments of farmland outside the regulatory instruments

→ In spite of a law which impede the transformation and construction of rural classified area, the OTB allows for land speculative deals, in order to make profits from the extension of the water network.

→ The co-production organization is not anymore perceived as a community actor, but rather as a private provider whose management is deemed to be opaque and corrupt.

→ Conflicts emerge within the neighbourhood, between residents who use water for both domestic consumption and irrigation (old inhabitants) and those who only consume drinking water (new inhabitants), who demand for a diversified water tariff and affiliation cost based on water use.

TRANSFORMATIVE/ADAPTIVE NATURE OF CO-PRODUCTION

→ From a co-produced system managed by the Water Cooperative, to one managed by the OTB

→ Cooperative exhaustion and administrative fragmentation led to a re-configuration of the water network and of the neighbourhood unit

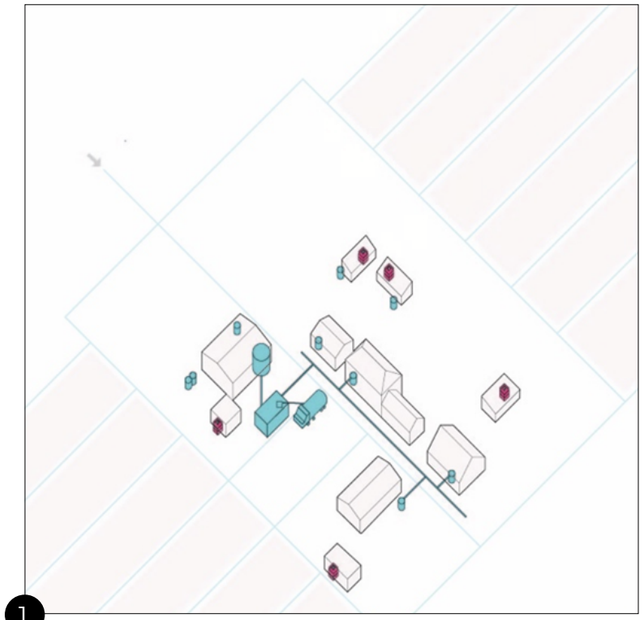
→ Adaptation strategies adopted by the households in a context of decreasing resources such as the redeployment of water from ditches and canals for drinking, or water purchase

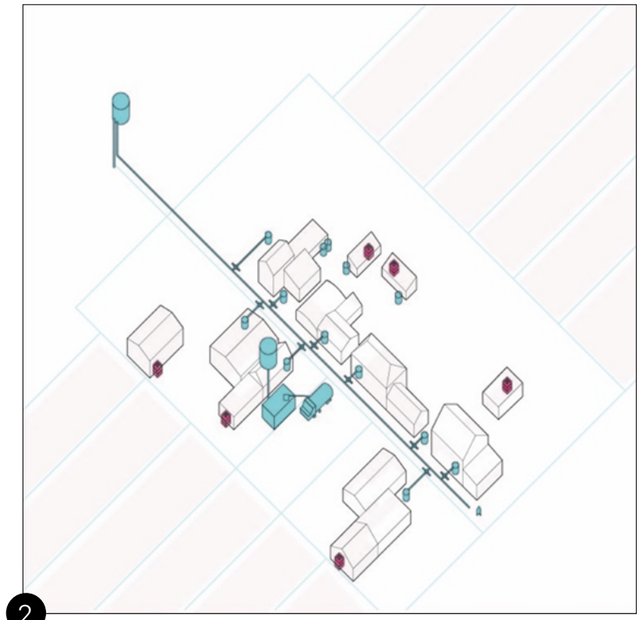
→ Increasing connections to the decentralized network linked with the conversion of farmland in urban land (the high affiliation costs are used to make profit from urbanization)

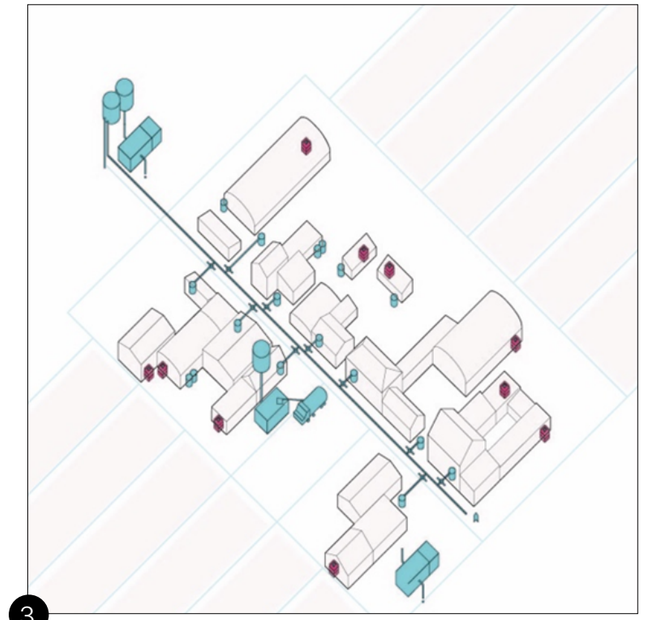
1.
Earliest collective water distribution network in San Jorge A with water tanks periodically filled by vendors. Irrigation system fed by water canals whose springs were located in the upper side of the village.

2.
Earliest collective water distribution network in San Jorge A with water tanks periodically filled by vendors. Irrigation system fed by water canals whose springs were located in the upper side of the village.

3.
The current two collective water distribution networks in San Jorge A with water collected from two different wells. One network is used for irrigation and one for domestic supply.







Figrue 151
San Jorge evolution

5.7 C3 Networks in-the-making in the Southern area of Cochabamba: co-production and marginalisation

5.7.1 THE UNPLANNED DEVELOPMENT OF COCHABAMBA "ZONA SUR"

La Cancha, one of the largest informal markets in Latin America, is the current economic engine of the southern part of the city of Cochabamba. To its presence we owe much of the urbanization of the southern part of the city since the mid-1950s. With the approval of the Agrarian Reform in 1953, many farmers from the highlands, freed from the yoke of *hacienderos* (land tenants), migrated to the city which progressively became an important economic center. In the 1980s with structural reforms and the closure of the country's mining centers, the southern area of the city underwent rapid expansion due to two phenomena (Cabrera, 2015).

On one hand, with the opening of the country to the logic of the market, the city began to import agricultural products liquidating the productive competitiveness of the areas of the valley, forcing farmers to migrate to the city, in search of work. On the other hand, the closure of state mining companies increased unemployment and thousands of miners found themselves forced to migrate to the main urban centers of the country or to the Chapare area.

It is estimated that as a result of these reforms, Cochabamba's population increased from just 200,000 in 1976 to more than a million in 2008 (Ledo, 2009). New informal settlements and dormitory neighbourhoods began to populate the landscape of the southern part of the city and to accommodate the growing number of traders who found work in the Cancha market.

This phenomenon of rapid urbanization has occurred in a disorderly and spontaneous way, with the progressive phagocytosis of agricultural areas, jeopardizing the hydro-geological balance and food self-sufficiency of the Cochabamba region. The famous "*campina cochabambina*" to which the city owes its name, once the granary of Bolivia, has been disappearing, with the contamination of the soil and the deterioration of water resources that once allowed its agricultural vocation.

At the same time, the urbanization process has led to a strong differentiation between the northern and southern areas of the city. While the northern area, invested in development projects and plans, has experienced the gradual appearance of tower blocks, shopping centres and modern infrastructures, the southern part of the city, in spite of widespread poverty, has a vibrant and articulate character, visible in the physical-spatial conformation of the neighbourhoods. According to Ledo (2009), this peculiar urban landscape is product of informal and incremental development and in its structuring is the result of multiculturalism: its image and physiognomy is the product of a process of permutations of different traditions and cultural customs due to migrations that have contributed to conform different types of spaces within the city. Immigrants from rural areas who arrived in the 1970s introduced a form of precarious housing, namely the "*choza campesina*" (peasant hut) that evolved within the patterns of modernism, until it became a model of rooms in rows locally called "*media-aguas*", whose morphology ranges from the traditional look of rural houses to more sophisticated facade compositions that strive to resemble the housing typology found in northern neighborhoods (Ledo, 2009). The same happens with immigrants from the mining areas. Many of their houses reproduce the image of their habitat in the mining centres, generating a kind of transfer of the housing type to a different ecological environment.

The population that inhabits the southern area of Cochabamba is a poor one, counting scarce survival resources and suffering from the systematic lack of basic services, precarious housing conditions, absence of medical and educational facilities and heavy contamination of the ecosystem (Linsalata 2015, Ledo 2009). However, water shortages are the main problem. The public water company SEMAPA only covers the northern area of the city, leaving the inhabitants of the southern area excluded from drinking water service and forcing them to be supplied with expensive bulk water, distributed by private operators "aguateros". The surveys submitted in fifteen neighbourhoods distributed throughout the territory of Cochabamba, have revealed that a family living in the southern zone destinates about 10% of the monthly income for drinking water services. In these marginal neighbourhoods, disregarded by the government and planning, dwellers self-organise. In multiple ways they manage to access to basic services, mostly contributing economic and material resources to carry out collective projects and build basic

infrastructures, i.e. roads, water and sanitary networks.

"They have been able to recover in an original and innovative way the organizational skills learned in the rural communities and mining camps of origin, learning not only to dig wells, but also to manage the drinking water service in their neighbourhoods in an autonomous, efficient and, above all, community-based way. They are the engineers of this extraordinary collective work."

(Linsalata 2015, p.119)

There are more than 200 community systems of various sizes in the South of Cochabamba to date creating a complex social and technical framework within which water is managed through a series of self-management mechanisms generated and controlled by the population in absence of public institutions.

It is worth noticing that these community systems in the year 2000 have scaled up and formed a cohesive front which resulted in a notable public-community experience, that of Asica-Sur.

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152.
View over Las Penas settlement in the south of Cochabamba

5.7.2 THE EXPERIENCE OF ASICA-SUR

Given their disconnection to centralized networks, the inhabitants of the southern area of Cochabamba are organized around community management systems which allowed them access to basic services, especially water and sanitation. The Water War that was fought in the year 2000 had allowed these community organizations to become aware of their role as service providers through the experimentation and consolidation of management models that were autonomous from the state. In other words, the experience of the Cochabamba Water War, as stated by Oliveira in Linsalata (2015) allowed for a reconceptualization of the role and meaning of the Committees in relationship with the management of a common good. The infrastructure which they contributed to build *"not only was a well or water pipes, but it was more than this, it was collective property."* (p.219)

After the Water War, the leaders of the Water Committees operating in the South Zone organized and coordinated in order to create a broader water management organization, with the belief it could drive broader changes and gain more bargaining power in decision-making systems.

Starting from the definition of common objectives, a model of public-community management of water services was developed in Cochabamba, through the experience of ASICA-SUR. On February 29 2004, 45 community systems gathered in an Assembly (Asociacion de Los Sistemas Comunitarios del Sur) with the following objectives: i) demanding recognition of access to water as a fundamental human right and not as a good/commodity; ii) asking for the participation of the state as a funding body for community models of OLPE management, iii) testing co-management between the public water company SEMAPA and the community systems of the southern zone, united under ASICA-SUR (Linsalata, 2015).

The emergence of ASICA-SUR organization embodied the need of the various neighbourhoods in the South of Cochamba to scale-up their action, with the belief that the creation of a larger network would allow them to play a bigger role in bargaining with public authorities.

"We have founded an organization, it is working with the issue of water and finally what we have to gain is that water reaches the south. We have to fight together, we cannot fight alone. Neither you nor the

neighbouring area, this is simply going to be achieved together."
(In an interview by Lucia Linsalata with the former president of Asica-Sur Abraham Grandydier, 2015 p.)

In an interview, Linsalata (p.226) highlights the perception by the inhabitants of the southern area of SEMAPA's inefficiency and, more generally, their distrust of a public administration deemed corrupt, clientelist and hyper-bureaucratic.

The residents of the southern zone, those who during the Water War had marched and fought in the streets to defend their committees and regain control of SEMAPA had declared that they did not want to become passive users of a public service. In other words, they did not want to loose their ability to make decisions for their own sake and to manage their own networks. They wanted SEMAPA to provide water (which was not locally extractable) but to maintain the autonomy of the committees in the management of their networks, which had been built through the efforts and resources of the communities themselves.

However, problems of coordination and collaboration emerged already in the first moments of the organization's life. First of all, in the management of state funding. With the economic resources that were allocated, four mega water tanks were built in strategic areas, whose location was the subject of discussion and conflict between the neighbourhoods. Moreover, the finances that the state poured were not used to build the main pipelines, requiring additional resources from Water Committes through community funds. In general, as Linsalata (2015) argues in her careful analysis of the process of formation, consolidation and decline of ASICA-SUR, there has never been the political will to entrust autonomy to this organization. Both SEMAPA and the government have showed an ambiguous attitude. On the one hand, they implemented a series of strategic works to provide the Southern area with water. On the other hand, they disregarded the legality of the Water Committees (OLPEs) recognized in ASICA-SUR, preferring to work directly with Grassroots Territorial Organization (OTBs) to define a plan to extend the centralized network. This lack of alignment between the OLPEs and the OTBs, bounded to the municipal administration and handled by the political systems, increased conflicts between the Committees and SEMAPA, who showed an instrumental attitude in this process to obtain its own purposes. This conflict between the Committees, SEMAPA and the government escalated in 2006, with the Committees request for autonomy of the southern zone. By demanding the establishment of a Municipio Autonomo de la Zona Sur, the committees expressed the desire to exercise a form of social democratic management that would allow the communities to decide autonomously on the key issues (i.e water, health, education and basic services, resource allocation and local life). This request, articulated in the *"Manifiesto de los hombres y mujeres de la zona Sur"* published in March 2006, was ignited with hope in 2004 with the victory of Evo Morales of the MAS Movement in the presidential elections. In this year ASICA-SUR participated in a congress on *La Defensa del Agua, los Servicios Basicos y la vida*, following which the Coordinadora Nacional En Defensa del Agua y la Vida was established. This new organisation proposed a substantial restructuring of the Ministry of Water, with the establishment of a Social Technical Council with a role of consultation. The objective was to generate a form of participation that would allow social movements and water organizations to be recognized within the institutional state system and participate in decisions regarding water services. This proposal was not only criticized, but rejected within the MAS itself, unleashing disappointments in the southern area of Cochabamba that had placed a lot of trust in the MAS movement.

Linsalata's research work has helped to highlight the reasons that led to the birth of this organization and its decline, attributable to the process of institutionalization that contributed to weaken the horizontality that had characterized the organization and internal decision-making processes since its inception and of the direct participation that had dictated the logic of community democracy. Bureaucratization, in the view of Linsalata, had thus led to an internal fragmentation of the organization and its slow dissolution. The institutionalization of ASICA-SUR and the birth of the Ministerio de Agua allowed ASICA-SUR to receive state contributions, through a manager who joined the ministry as director of basic services, succeeding to channel an important funding from the European Union. Problems began to arise with the indistinct operation of SEMAPA, which had received funding from the IDB to extend its network to the south. The case study that is the focus of this chapter reflects these tensions between an autonomous, decentralized management advocated by Water Committes (formerly represented by ASICA-SUR) and a centralized management pursued by SEMAPA that, however, to date has not really brought significant improvement in basic services in the Southern part of the city.

5.7.3 SERENA CALICANTO

Serena Calicanto is located in district 8, about 12 km south-east of the centre of Cochabamba, in the Valle Hermoso area, in that large part of the city which suffers most from the systemic lack of water and basic services. This neighbourhood is particularly interesting because it witnesses the failure of two policies: a social housing experiment conducted in Bolivia in the 1990s FONVIS[20], dismantled in 1998 just six years after its establishment, and the ASICA-SUR experiment that was introduced in the previous pages.

Serena Calicanto is a neighbourhood planned and built in 1995 as part of a social housing program promoted and financed by the national government to support a re-location process which, with the closure of the mines in the second half of the 1980s, forced thousands of unemployed miners to move to the country's main urban centres.

The Bolivian government attempted various measures to address housing needs. One such mechanism was the creation in September 1992 of FONVIS , the National Fund for Social Housing, based on the previous government Housing Fund and Institute, in order to provide support for low-income households (Richmond, 1997). This fund was created for the construction of low-cost housing by paying out 1% of workers' paychecks and 2% of employers' paychecks. The aim of the fund was to act as a source of financing that primary lenders could use as long-term housing loans. The UN report (2008) explains the functioning of this programme as well as the reasons why it was dismantled in 1998. There were two strategies adopted by the government to channel the funds: 1. lending to mutuals through the Habitat programme; 2. earmarking the bulk of its resources for a trust programme, which consisted of contracting banks as agents to administer large-scale housing construction projects and to originate and service the associated mortgage loans. According to the report, the programme has not succeeded in solving the housing shortage, as it is estimated that only 20 per cent of taxpayers have had access to credit, and the number of social housing projects implemented has been well below expectations (25,000 housing solutions and 32,000 loans were granted in the whole country). One of the problems identified by the authors of the report was that financial intermediaries provided very little credit while draining resources by charging high fees (6%) on the funds they administered. A second problem that emerged is the management of this public program which

20. By Supreme Decree No. 23261, dated September 15, 1992, the FONDO NACIONAL DE VIVIENDA SOCIAL (FONVIS) is created, replacing FONVI and IVS, absorbing the pending tasks of the social housing programs since the establishment of the Housing Regime Popular 1956.

153.
View of Serena Calicanto

has been misrepresented by the presence within the decision-making mechanisms of subjects linked to political parties who have managed to obtain advantages outside of what would be the normal rules for the allocation of the house units.

Serena Calicanto was constructed in the framework of this state-led program. Through FONVIS, people could purchase lots at a subsidized price of $8000.

The neighbourhood was planned on a plot of approximately 370,000 m2, divided into 734 lots and with 600 dwellings, organized in a system of terraces dictated by the topography of the land. The area was mainly planned for residential use, with the exception of a portion of the district which was intended as a green area and another one in the southern part of the neighbourhood conceived as area of public interest. While the former one was fully urbanised, the latter now houses a sports ground, the OTB headquarters and the neighborhood' water committee.

Two types of dwellings were built in the neighbourhood, one of 36 m2 with two rooms and the other of 80 m2 with three rooms, with a rectangular and compact spatial conformation and located on plots of 230 and 300 m2, approximately 5 metres from the main road and 3 metres from the rear boundary of the plot. The dwellings were accessible from two sides, with the main entrance in the living room, and the secondary entrance in the back side, where the core services (bathroom

and kitchen) were located. The houses were built using traditional materials and techniques, with external walls of exposed perforated brick, corrugated fibre cement tile roofs, cement mortar floors and wooden frames.

Despite its planned nature, the occupation of the plots and the progressive expansion of the neighbourhood took place informally. Several problems emerged right from the allocation of the homes. First of all, as it is also described in the UN-Habitat Report (2008), the political party on duty at the time favoured access to the housing to those who were affiliated with the party and, as a result, many of those who benefited from the project were not officially allocated. A second issue was related to land use rights. Indeed, of the 600 dwellings delivered, 240 were built on 10 hectares that did not have consolidated ownership rights (the current Huanuni sector). Basically, an association of miners from Huanuni had previously bought a piece of land from a private individual which was later allocated to FONVIS for the social housing project. The dispute was resolved through a judicial process in which FONVIS was forced to allocate the housing on that portion of the land to the miners' association that had acquired the land, which benefited from the project. Finally, the condition of the neighbourhood once the housing was handed over far lower the expectations, with buildings and infrastructures that were not completed. Windows, doors and other architectural elements were missing, some of which had been stolen in the period between the allocation of the housing and its occupation. In addition, the lack of basic services made life in the neighbourhood difficult, as residents told us.

> Our area is called Valle Hermoso (beautiful valley),
> but as you can see there is nothing beautiful here.
> People arrived little by little, starting in 1997. Back then there
> were no roads, no electricity, no water and in some parts
> of the neighbourhood there was no sewer system.
> It was an almost inhospitable place and not many people
> lived there. The houses were not in decent condition either.
> The construction company handed over half-built houses.
> In addition, thieves and miscreants attacked us. Including
> in my house, they stole the doors and windows. Many
> houses were completely dismantled before people moved
> in. Some inhabitants paid guards to make sure their houses
> would still be there. We suffered for long years. Then, when
> we brought services, people started to move in and slowly
> the situation improved. But we fought for it.

FONVIS beneficiaries did not immediately populate the area but gradually moved in as improvements and services appeared. With the arrival of asphalt and networks (electricity, water and sewage), the neighbourhood saw a progressive increase in population together with different forms of re-organization of the built environment. Houses were progressively extended and new settlers started to occupy those areas which, according to the FONVIS plan, were destined to public space. Moreover, the transformations in the urban fabric have led to a diversification of the owners, many of whom are no longer miners, but people who have subsequently bought the houses from FONVIS beneficiaries. There are currently about 3000 people living in Serena Calicanto, made up of four sectors (Llallagua, Huanuni, Independiente, 15 de Mayo) which have very marked differences between them. Sector 15 del Mayo has an irregular origin resulting from the occupation, since 2005, of the green zone by some 160 families. The majority of them are migrants from the countryside and live in poverty conditions. Apart from electricity, this recently built sector still lacks connection to water and sanitation networks.

154.
Serena Calicanto plan and 15 de Mayo sector.

5.7.4 ASICA-SUR, CO-PRODUCTION AND THE BIRTH OF THE WATER NETWORK

Today, Serena Calicanto is equipped with a sewerage system connected to simplified decentralized treatment and drinking water distribution network connected to a storage tank regularly filled by private operators who extract water from wells located in the north of the city and bring it by tanker truck to the area. Three out of four sectors in Serena Calicanto are connected to these micro-networks operated by the Community Water and Sewerage Association. In addition to these systems of collective co-production, there are individual forms of co-production, especially related to water purchase, storage and treatment.

Despite the planned nature of the district, water and sanitation infrastructures have been built and upgraded at various times, through different forms of co-financing mechanism which involved both inhabitants (through their intermediary organizations), the construction company and international donors.

When the houses were delivered by FONVIS, the roads were not paved. This prevented water trucks from reaching the area. Although a water tank of 70,000 l capacity had been built by the construction company, no water distribution network was put in place. The inhabitants were buying water in barrels for domestic consumption, while for washing clothes they used to walk down to the Tamboriada river, whose water was not drinkable, being heavily contaminated with iron.

> There was no water as there were no roads for the tanker trucks to arrive. Once we settled, we set up a water committee, which preceded the formation of OTB. It was made up of four people, Don Andrés, Don Berno, Don Anselmo, Doña Ilda Más and myself. The committee was formed with the aim of having the liquid element to live in the neighbourhood. We asked ourselves how we would get the water. They told us that to get money we needed a project, because no one would give us anything otherwise.

When in 2005 the Water Committee of Serena Calicanto was formed, it played an active role in seeking funding to build the water distribution network. Access to water services arrived in the area, following a

mobilization that entirely concerned the southern zone, through the intermediary role of ASICA-SUR, an institution which managed to channel European funds to the southern zone, allowing the installation of various drinking water networks. Through this organization, Serena Calicanto benefited from funds provided by international donors for the provision of basic services. In 2009, the drinking water network was built, co-financed by the European Union and the Water Committee, which was asked to contribute US$3,000 for the project. This co-financing scheme foresaw that the European Union fund would cover the cost of the distribution network, while the Committee was called upon to contribute to the installation of individual connections and water meters. Each committee member then contributed between 150 and 250B (21-36 $) for the construction of the network. In 2015, following the expansion of the neighbourhood and the informal urbanization of the green areas, the committee realised that it was necessary to increase the capacity of the water tank, which was only supplying 70,000 litres, an insufficient quantity to meet the water demand in the neighbourhood. While the first tank was decommissioned, a second cistern with a capacity of 250,000 l was built and now serves the distribution network for the entire neighbourhood.

On November 23, 2005, the drinking water system was inaugurated. It is currently managed by an Associacion Comunitaria de Agua y Alcantarillado, which is part of the OTB.

The water is distributed by a network connected to the recent concrete water tank placed at ground level at an altitude of about 100 meters above the lowest part of the village. The distribution system operates by gravity, without the need for pumps. The water is supplied from Monday to Saturday by private tanker trucks, contracted directly by the OTB, whose cost amounts to 170B (25$) for each refill. To meet the demand for water in the neighbourhood, the tank is filled 6 times a day. Don Anselmo, the plumber contracted by the Water Association is paid 100B (14,5$) per month for his work which consists of regulating the water flow through a system of valves. In this way, the system alternately distributes water to the three sectors: the Huanuni sector receives water on Mondays and Thursdays, Independiente on Tuesdays and Fridays, and Llallagua on Wednesdays and Saturdays. Each household receives water for about 2 hours a day generally from 7 to 9 am.

While in the past the affiliation costs were contributed by ASICA-SUR, today, the cost of getting connected to the water and sanitation networks is 1370B (199$).

Affiliates are asked to contribute with a minimum monthly fee of 29.50B (4,3$) per month, which covers the operation of both water and sewerage networks, as well as other social activities. Of this amount, 17B go to water supply (minimum consumption of 1 m3), 1B goes to finance the sports facilities, 0.50B goes to the payment of stationery costs, 2B is the so-called monthly fee that OTB uses in social activities such as village festivals and for the salaries of the people in charge of OTB, and 9 B are used to cover the costs of running the sewerage system.

In the future SEMAPA will distribute water from mega tanks (under construction) built for the District 14 to the collective tank, while distribution will be still operated by the committee. The community is expecting to see the new system operating within the next three years and that the cost of water will decrease from 17B (2,5$) per m3 to 12,5B (1,8$) per m3 once SEMAPA will distribute water.

As far as the sewage system is concerned, when the neighbourhood was built it was equipped with a concrete-piping network, financed by the construction company, which was later upgraded and replaced with PVC pipes with the inhabitants' contribution. There are two sewer networks, built on the basis of the topography and connected to simplified wastewater treatment plants.

155. 156. 157.
From top to bottom. Extension of the housing systems. The collective water tank. Individual storage systems

5.7.5 FRAGMENTATION AND CONFLICTS AROUND WATER MANAGEMENT

Conflicts, discontent and protests dominate the landscape of Serena Calicanto, generated by the perception of a non-transparent management of the technical network and its operating costs among an increasing number of households. Although the technical solutions of the water and sanitation system were planned by technicians, the current management has created strong internal conflict and inequalities within the neighbourhood. One of the main problems that emerged during the interviews is the excessive cost demanded by the Water Association, which, according to the OTB leaders, can be explained by the presence of air in the water that tampers the meters. Many residents complain that they pay much more than they consume. This causes friction and accusations of mismanagement and corruption, putting the work of the committee in a bad light.

When the water committee was established, I started paying a monthly fee of 40B. After a while the price increased to 60B, afterwards 80B, 120B and now I end up paying 180B each month. I asked myself, but why? Especially now, that with the pandemic we are all at home, including my sons who are not going to school, the cost of water should increase. But It keeps stable on 180B. So, I always asked to the Committee why the price kept increasing, while I was always using the same amount of water. They replied that it is because of air consumption. Perfect, so I understand that there is a utility and a remnant. The Committee keeps saying that has no money. How comes if everybody complains? Even my neighbour who does not live here, pays 90 B each month without consuming a single drop of water. It is unbelievable.

Many of us are tired of this bad management. With some neighbours we developed a strategy to test how the Committee works. We shut down the valve and did not consume for a month. We only bought in barrels from water vendors. Then the bill came, and you know what? The price was the same. Look…this is the problem that we have with water. They charge us what we don't consume and this is not right. We now prefer buying water individually, since the water vendors keep coming in the area every day. That water is more expensive but at least we are sure we pay what we use.

The lack of transparency in the financial management of the Committee and the excessive cost perceived by residents are producing disconnections to the system and, at the same time, increasing individual forms of water supply. Despite the fact that the price paid to tanker trucks is double that of the Committee, 7B (1$) per 200 l against the Committee's 3.5B (0,5$), an increasing number of households prefer buying directly from private water vendors coming in the area. Another problem that emerged from the interviews regards meter reading, which, according to many, is not done transparently.

I think the Committee leaders do whatever price they want. At the moment they cover me over 100B per month, which is very high. Even though, the price is constantly increasing. I have always paid what they have asked. I always look at the meter, but when they control it they don't call me or knock on the door, so I don't know how they check consumption. Many argue with the Committee leaders on a daily basis, they are in open conflict. They complain about the increase in the price of water. Some have already gone back to buying water from private vendors and many of us collect rainwater to save money. I do it, you see this bucket? It is connected to the gutter.

In addition to these disputes, there are other conflicts triggered by external factors following the recent occupation of the 15 de Mayo sector which, as established in the FONVIS urbanization plan, was planned as a green area. Since 2005, the area has been progressively occupied by families who have built their own houses. The process did not happen in a totally spontaneous way, as the land was sold illegally by some people who did not have any right on that land, being formally owned by OTB. This is about 104 new lots, of which 50 cannot have a recognized title and therefore be regularized. The vice president of the sector 15 Mayo explained the socio-economic difficulties of those who occupied this sector, mainly migrant people and farmers lacking basic services.

Notably, these dwellers have been recognized by OTB but not by Water Committee. Therefore, the sector is currently disconnected from the community drinking water network. The problem with this disconnection does not appear to be technical in nature, despite the area being at a higher elevation than where the current drinking water tank is located, as much as it is legal and political in nature. The lack of official plans for the urbanization of the area, which have not yet been approved by the Municipality, pushes the Committee to refuse to extend the network in the area. The families suffer from the lack of services and periodic flooding (overflow) from adjacent settlements built on a higher level.

> We proposed to the Assembly to let them connect with 1500 B, instead of 2800 B which they can't afford. They said that 15 de Mayo is an independent sector, and that they want it to remain so. We want to help these people as they are really poor. But nothing can be done with the current management.

Aware of widespread discontent in the area and growing disconnections from the network, the Association admits that it does not have the financial resources to extend the infrastructure to the currently disconnected area. There is a strong sense of ownership over the system, which is understood to be purely the result of community effort, even though the investments that have made it possible have mostly been of external origin. This is certainly due to all of the experience that has been involved in the gradual occupation and production of the neighbourhood and all of the support that has been necessary for the realization of these projects. In fact, the desire for disconnection was enunciated well by these words of one of the OTB executive board.

> Non-payers want to change the rules.
> They want everything for free without putting anything in.

The affiliation costs of 2800 B are considered too high for those who live in the 15 de Mayo sector, who on several occasions during the assemblies have expressed their desire to be connected, proposing to contribute 1800B for the affiliation to the service and to carry out themselves all the work of excavation, purchase of material and installation of the network. The proposals were always rejected. This constituted a

form of alliance between the residents of 15 de Mayo and those unhappy with the current system of management of the Committee, who composed a protest front that declared itself independent, electing its own assembly.

The persistence of the current committee is not in danger, because until SEMAPA's expansion plan or Misicuni's pipelines materialize, there is a kind of oligopoly of the resource by the Association and the OTB, who do not want to give up control of the network. OTB's internal conflicts, with the 15 de Mayo sector claiming affiliation to the system and a part of the population that has taken away trust from the local operation, are bringing out pushes towards redefining the committee's boundaries and the internal rules and regulations for managing the network.

158.
A woman washing clothes on the street, where water is stored in barrels

159.
Precarious conditions in 15 de Mayo sector, disconnected from networks

160.
Precarious conditions in 15 de Mayo sector, disconnected from networks

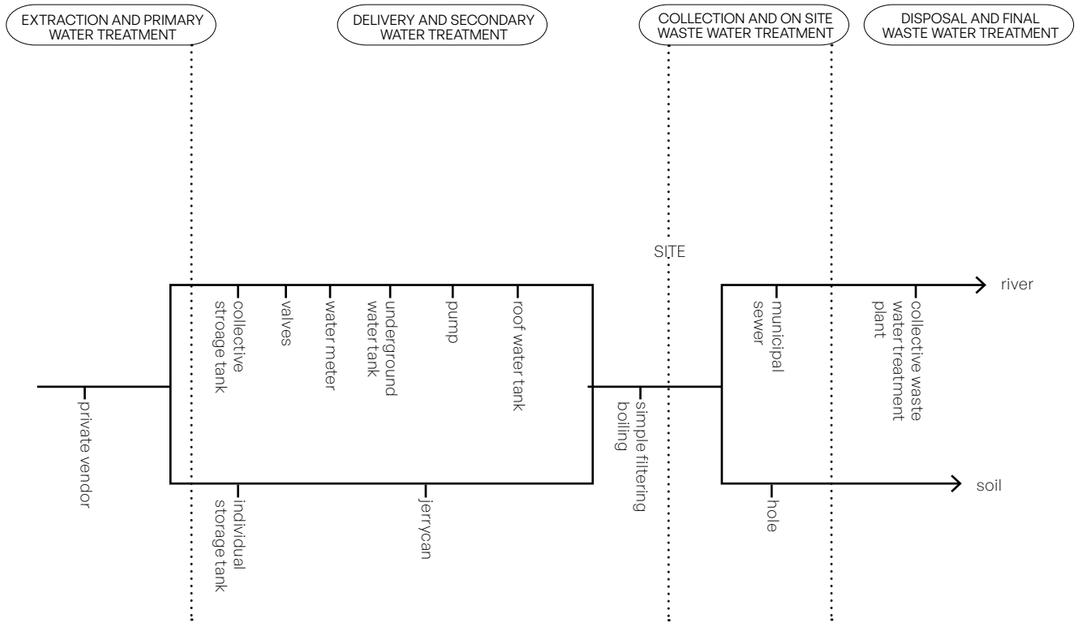


Figure 161.
Technical devices employed in the flow of the co-produced WSS services

5.7.6 CONCLUSIVE REMARKS

The case of Serena Calicanto shows the inefficacy of the governmental policies of social housing production promoted by FONVIS, which were not able to guarantee minimum standards in the housing delivered and basic services, nor the allocation of housing to the project beneficiaries. Deprived of basic services, the inhabitants of Serena Calicanto took action and, through the construction of a cohesive front of the various committees of the southern area, with the intermediation of ASICA-SUR, managed to mobilise international funds that allowed the construction of a water and sewage system, now managed by the Water and Sanitation Association which is part of OTB. Although the two organisations have different aims, OTB's control over the Water Association is the source of disputes and internal conflicts that are questioning the legitimacy of the current leadership in the co-production of water and sanitation the services. The Neighbourhood Committee and Water Committee are distinct institutions, but their roles overlap and the former exercises a degree of control over the latter. This incentivizes mechanisms of exclusion and fragmentation within the neighbourhood. For example, only those who have the committee's water network membership plaque can vote at OTB assemblies. The others, especially lower income dwellers, are systematically excluded not only from the access to the community services, but from decision-making processes which affect planning activities within their settlements. The inequality is glaring, especially looking at the 15 de Mayo sector which is currently disconnected from the network even though it is part of the OTB. The dissatisfaction with the quality and cost of the service, as well as perceived maladministration and a lack of transparency in the management of funds collected through water fees increases distrust towards the current management of collective co-production practices. As a consequence, disconnection from the existing community network seem to lead to a decline of collective co-production, while the rise of household strategies to access basic services, suggests an increase in individual forms of co-production.

CO-PRODUCTION FLOWS

→ **Water**
house individual connections to the collective de-centralized water system + individual storage (water tanks, pumps) + household rainwater harvesting system + household water purchase

→ **Water**
(15 de Mayo sector) house individual storage devices fed by private water vendors

→ **Sanitation**
collective systems connected to on-site shared treatment facility (DEWATS)

→ **Sanitation**
(15 de Mayo sector)

CO-PRODUCTION AREA

→ **Water**
plot unit (household self-provision) and village unit (collective co-production)

→ **Water**
(15 de Mayo sector) plot unit (household self-provision)

→ **Sanitation**
village unit for sewerage system and DEWATS

→ **Sanitation**
(15 de Mayo sector) plot unit (septic tank or hole if present)

CO-PRODUCTION ACTORS

→ **Water**
EU (co-funding)
+ ASICASUR (co-planning + co-management): mini network for drinking water
+ Water association (co-design + co-management + co-funding)
+ Households (co-management + co-funding) of alternative systems, i.e. rainwater harvesting, individual storage…

→ **Water**
(15 de Mayo sector) Private water vendors + households (co-management + co-funding) of alternative systems, i.e. rainwater harvesting, individual storage

→ **Sanitation**
Water association and Village inhabitants (drainage system + septic tanks or holes)

MAIN CHALLENGES FOR CO-PRODUCTION

→ The location of the neighbourhood does not allow to draw from an own source but depend on vendors to charge the tank with high costs compared to the rest of the city

→ Problem of service management and equity, since the network does not cover the whole territory of the district (fragmentation and divisions)

→ The service is managed by an elite that exercises control over both organisations (OTB and Water Association): disconnection from the network does not allow participation in political decisions in the neighbourhood

→ Increased dissatisfaction among the inhabitants due to the high cost, lack of transparency in the management of funds and water tariffs. Consequent increase in disconnections from the network and increase in self-provision

TRANSFORMATIVE/ADAPTIVE NATURE OF CO-PRODUCTION

→ In-between the construction of the neighbourhood and the rise of co-production, a number of incremental and coping practices for water supply and sanitation

→ Shifts in co-production organizations acting as intermediaries

→ Possible future transition from decentralized water network relying on private vendors to decentralized water network with water resources provided by the municipal water authorities to be shared with neighbouring villages

1.
Serena Calicanto earliest settlements with core-houses connected to sewerage system. No water distribution network was built at the time, although one collective storage tank was put into place in the highest part of the village. Households would fill individually tanks with water daily distributed by vendors.

2.
Construction of the water distribution network and its connection to the main storage tanks. Costruction of two DEWATS for wastewater treatment. With the core-house incremental expansion complementary technologies (storage tanks and small pipes) were introduced by each house.

3.
New settlers occupy the northern part of the village, once green space but they are not allowed to get connected to the decentralised networks. They rely on water purchased from vendors while for sanitation they would install holes and septic tanks.

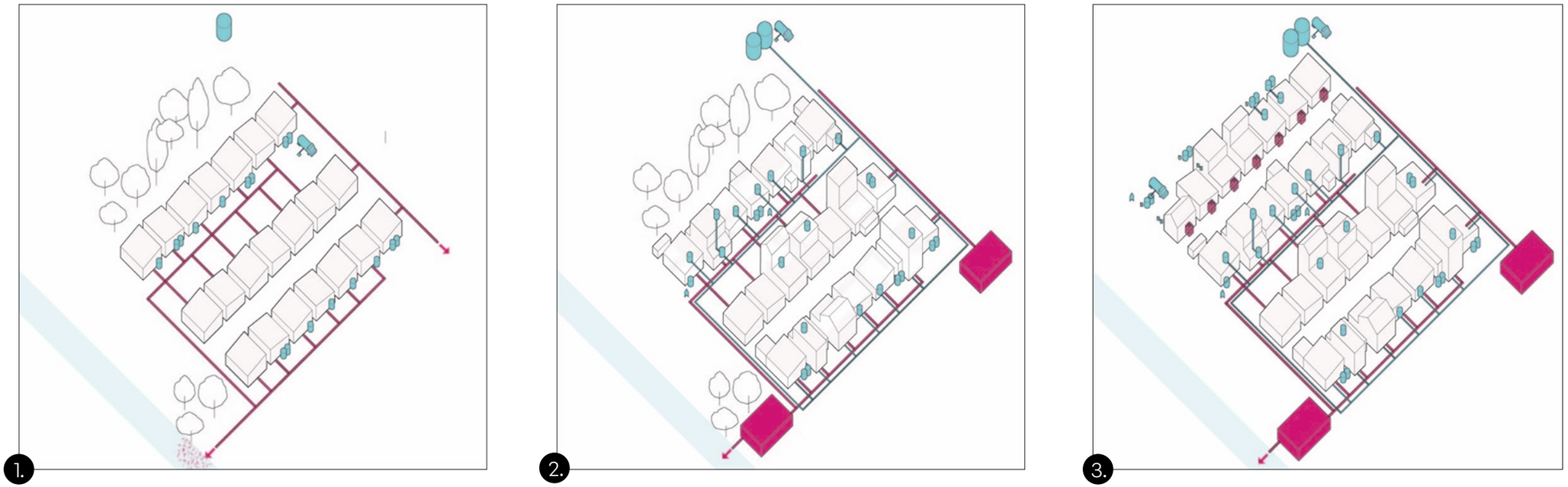
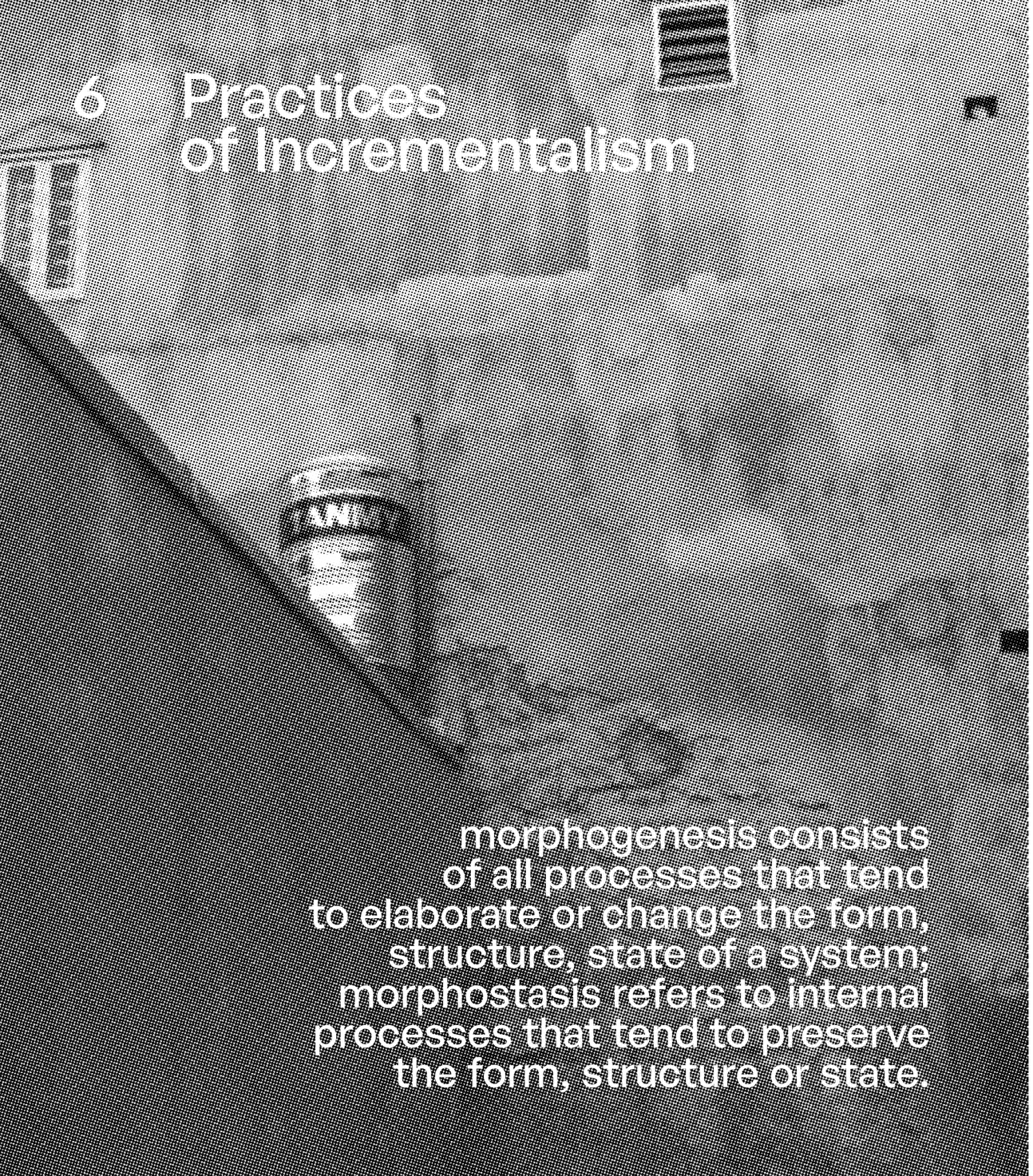


Figure 162.
Serena Calicanto evolution



6.1 A taxonomy of incremental change

" Our subject, then, is not
architecture, but built environment.
It is innately familiar.
Anew, we observe what always
has been with us - not to discover,
much less to invent,
but to recognize."

John Habraken, The Structure of the Ordinary, Prologue

The practices of dwelling observed in the two cities inquired in this research depend to a large extent on practices of incrementalism, through which individuals and communities add one piece after another to their built environment, layers of physical and social networks. Recognising the spontaneous and incremental practices enacted by dwellers to reconfigure their housing units and water networks invites us to consider change as an integral part of the growth and consolidation of human settlements: a natural and organic way, albeit made up of technological and structural design choices, through which communities adapt their environments, ensuring functionality over time (McFarlane 2011, Habraken 1998, Hamdi 2004).

The taxonomy developed in this chapter draws on this perspective. It is an attempt to describe and articulate the endogenous process of urban transformation through the observation of the multiple practices in which two physical dimensions of *housing* (infrastructures and built fabrics) are co-produced by a number of actors and co-evolve over

time. This taxonomy is constructed on the basis of a multitude of spatial reconfigurations observed across the case studies in the two cities. Although some of these transformations emerged from the answers to the questionnaires, most are the result of interviews and direct observation. Their inventory was performed later, in a deductive manner, trying to extract some informal rules or logics that are embodied in wider processes of transformation observed and that can apply to both the built fabric and the water infrastructure. I must point out here that these practices are not necessarily related to each other, i.e. that a certain transformative practice that insists on the built environment is matched by the same practice on the water network. For example, it is not always the case that the extension of a building also corresponds to the extension of the network. The relationship between the evolution of one and the other dimension is way more complex and articulated and far from being causal. For reasons of bounded time and resources as well as the purpose of the research, only some of these relationships are explored in depth in the case studies.

The aim of this tentative reading of the urban evolutionary dimension through its classification in punctual practices is not to reduce its complexity, although I cannot deny that part of the scientific method, as well as the elaboration of theories of human thought and conceptualisations, is the result of a necessary process of 'simplification'. Ordering reality, reducing it through its decomposition into something more graspable or measurable somehow comforts us as human beings and is also expected from scientists. Even with this awareness that what has been done is nothing but an approximation, the aim of this exploration is rather to surface the complexity of inhabiting and to reveal the rationality behind the evolution of ordinary environments, often dumped together in the pot of the "informal" or the "unplanned". Although "bounded rational" these self-sustained increments may conceal broader goals, both in relation to time and space. They shape the rhythm and limits of urban life just as they give the territory the traces of the communities dwelling there. They tell the taste of the process of inhabiting which is here understood as 'popular' art that escapes the control of architects and planners (Illich in Volontà 1-2/89). This lens for reading the urban metabolism finally verifies to what extent it is possible to extract from the existing informal and spontaneous laboratories of participation some values, principles, rules and categories to fully develop and systematise a new rationale towards co-production as a way of approaching the housing and water services subject matter for the near future.

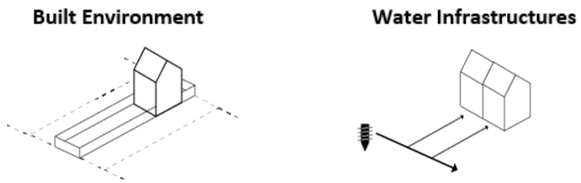
PRACTICE	BUILT ENVIRONMENT	WATER INFRASTRUCTURES
1. settling	It refers to the earliest establishment of the constructions and generally implies, after plots subdivision, the organisation of the buildings and of their distributive elements, and the construction following a first design step.	It refers to the initial development of water and sanitation infrastructures. It generally implies the installation of more simple technologies and devices, as it generally pre-exists the development of a network (i.e. the drilling of a well).
2. dividing	It refers to a process of spatial reconfiguration that does not increment built-up spaces, but leads to a sub-division of existing ones as for plots, or house units whether to host new incomers or functions (i.e. plot division for hosting new house units).	It refers to the split of the existing infrastructure systems into different, independent sub-systems. It may imply a differentiation of water resources on which the infrastructure systems are relying on (i.e. one water network serving one area is split into two networks).
3. joining	It refers to the process of aggregation of existing buildings or plots into one. It does not necessarily imply a modification of existing buildings but a shift of control (i.e. one apartment is enlarged by including the neighbouring one) although where joining concerns lots, it may be functional to a reallocation and redevelopment of the built environment.	It refers to the aggregation of existing infrastructure systems, into a single one. This may imply reallocation processes, namely that control of the infrastructure is handed over a single agent (i.e. two villages join their networks by using the same resource system).
4. attaching	It refers to a process of spatial accretion by attaching new elements to the existing built environment. This transformation does not modify the existing buildings on a structural level, which is why it generally has a semi-permanent character and makes use of light materials (i.e. balconies anchored to existing building façades).	It refers to a process of infrastructure consolidation which implies the adding of technical devices to the existing infrastructure, without impacting on the connectedness or the morphology of the main components of the infrastructure system (i.e. adding a filter to the water supply, adding low-level pipes).

PRACTICE	BUILT ENVIRONMENT	WATER INFRASTRUCTURES
5. replacing	It generally consists in a progressive change of materials from more temporary to more permanent ones. It aims at improving the quality of constructions or for repairing them (i.e. replacing a bamboo semi-permanent structure with a brick one).	It refers to the upgrade of existing water and sanitation infrastructures through the progressive substitution of the technical devices used (i.e. drilling a deeper well, substituting a tank with one of higher capacity).
6. inserting	It implies the introduction of a new built element into an existing, consolidated urban fabric. Even if this type of construction does not affect existing buildings, as for attaching or extending, it allows a spatial reconfiguration of the built environment. This process might be triggered by a practice of division (i.e. new house units built in-between the blocks).	It implies the introduction of a new supply system parallel to an existing system of provision in order to improve accessibility or regularity of service at the plot level (i.e. introduction of rainwater systems to increase the quantity of water) or at the neighbourhood level (i.e. duplication of networks in one area).
7. extending	It refers to a process of spatial accretion of the existing built environment, horizontally or vertically. This transformation also regards existing structural elements. Therefore, it has generally a more permanent character (i.e. adding one floor to a house).	It refers to a process of infrastructure transformation which has an impact on the main infrastructure network, in term of morphology and connection (i.e. connecting new households to a network).
8. reallocating	It refers to process of shifting control over the built environment. It may include privatization, selling of existing housing stock (therefore from government to community control) or, on the contrary, the appropriation by the government (from community to government control).	It doesn't imply any physical transformation of existing infrastructures, but a shift in their controlling agents (i.e. community water networks absorbed by municipal utilities).
9. redeploying	It refers to the reconfiguration of existing spaces to host new functions (i.e. former house units converted into commercial spaces).	It refers to the re activation of existing, maybe neglected infrastructure systems, because of changing spatial or environmental conditions (i.e. past rainwater systems are reused once groundwater is heavily contaminated).

PRACTICE	BUILT ENVIRONMENT	WATER INFRASTRUCTURES
10. drifting	It is a process characterized by the absence of upgrading and maintenance of the existing built environment to changing circumstances. It can be mobilized as an active strategy for some actors to lead to the exhaustion of existing models and their replacement with new ones (i.e. not responding to environmental risks in slum areas to justify clearance and land redevelopment).	It is a process of infrastructure decline occurring because of lack of maintenance and constant upgrade. In spite of the natural infrastructure obsolescence, drift can easily occur in situations where maintenance tasks are not clearly defined, whether some actors have interest in the exhaustion of existing supply schemes, or whether a new supply system inserted is able to capture economic resources previously destined the other supply system (i.e. community based water supply networks become obsolescent since most of dwellers are connected to centralised network).
11. exhausting	It refers to a process in which spatial behaviours occurring under or outside existing rules operate to undermine these, leading to construction breakdown rather than change (i.e. the building extensions when numerous enough might trigger the collapse of a building system).	It implies the abandonment of existing infrastructure systems, or technical devices because of changing spatial, environmental or legislative conditions. (i.e. exhaustion of a water network relying on groundwater because of lowering of the water table).

163.
The transformative practices identified in the analysis of the case studies.

6.1.1 SETTLING



The nature of the relationship between the implementation/settling of the built environment and that of the water and sanitation infrastructure is enquired into.

Offner (1993) describes and characterises the development pathway of infrastructure networks. A mix of political pressures, market logics and technological opportunities determine the emergence of technical networks which, starting from a pre-existing network, develop in a relationship of competition or complementarity.

Yet, the different characteristics of the built environments shape the infrastructure development and it seems there are marked differences in formal and informal settlements. As Habraken (1998) argues, in self-built neighbourhoods largely dominating the urban landscape across the Global South just as in pre-modern European cities, the construction of infrastructure networks generally follows the construction of the built environment. Here, the bottom up and incremental housing starts with land occupation and shelter construction while the provision of infrastructures and services generally comes after land regularization (Cities Alliance, Van Noorlos)[21].

As it has been observed in the most recent cases of urbanization in the South of Cochabamba where informal settlements are sprouting infrastructure networks have not yet been developed. Households access water and sanitation services employing simple technical devices and mainly individually. Indeed, when dwellers start to inhabit the area all their efforts are oriented towards the construction of the housing systems.

In these informal and newly established settlements households generally employ local resources when available. Drawing water from rivers or ponds (C2-H3) or storing rainwater (C3-H3) are widespread practices in the two cities. When local resources are not available, households may rely on distant resources, through water purchase. In the new settlements in Cochabamba Southern districts water is distributed by both public and private water trucks (C3). Very simple technologies are generally employed and, as the houses are under construction or unfinished, they are often located outside the house and employed at the household level.

21. Indeed, the sites and service schemes implemented throughout the 1960s until the 1980s were grounded on the recognition of legal land tenure (security of tenure) as fundamental for households to invest in housing improvement and for governments to provide serviced infrastructures.

The choice of the location of the primary elements of a collective infrastructure is a delicate political choice prone to the emergence of conflicts when interests of the users are divergent. In San Jorge (C2) the decision to locate the well in the northern part of the neighbourhood, the area of influence of farmers, was the subject of controversy and conflict that led to a veritable urban guerrilla, which ultimately caused a double rift both within the organisation in charge of managing the infrastructure network (OLPE) and that in charge of urban development (OTB). The dispute ended with the fragmentation of both the neighbourhood council and the water committee, which redesigned and scaled down both the administrative and urban boundaries of the neighbourhood, which is now composed by San Jorge and San Jorge A.

If in informal settlements the creation of networks generally follows the occupation of the built space, formally planned areas tend to operate in the opposite way. The creation of infrastructural networks generally precedes the design and construction of the built environment. In Hanoi, the “land-for-infrastructure” mechanism regulates the urbanization process. It consists of land-based financing scheme through which planning authorities use land as in-kind payment for the installation of the technical infrastructures in New Urban Areas.

In the case of Serena Calicanto (C3), itself a planned neighborhood built within a social housing program adopted in the 1990s by the Bolivian government, the incomplete construction of the infrastructure and housing systems required the inhabitants to self-organize in order to fill the void left by the lack of basic services. Indeed, despite the fact that the plan approved by the municipality had provided for some basic installations, construction companies have benefited from government funds but have not guaranteed compliance with minimum standards. This is an issue encountered in a number of social housing plans , where often pro-poor housing policies end up benefiting political elites and financial intermediaries, leaving beneficiaries with additional, often unsustainable, costs for implementing and managing basic services (Maroso and Rosati, 2014).

Spatial conditions, both related to the morphology and accessibility of water resources availability and land characteristics, influence the earliest configuration of built and sanitation infrastructure.

In Vietnam, the widespread presence of water bodies (i.e. rivulets, waterways and ponds) was a determining factor in the development of the hydraulic civilisation. The vernacular forms of settlements organization, where houses were built on stilts and their later development on moving land to protect from flooding, and their configuration along watercourses are all part of those spontaneous, pragmatic planning processes that have given the Vietnamese built environments a peculiar spatial organisation highly connected to the complex architecture of its waters. A similar interdependency is found in Bolivian Andean villages, where the morphology of the watercourses represented the basic structure on which the network of villages gradually developed (Cabrera 2017).

The organization of the built fabrics as well as the that of technical infrastructures employed to deliver water and sanitation services is strongly geared to land characteristics, in particular topography. For example, in Hanoi, the flat topography of land combined with the low pressure of the municipal network, requires the installation of pumps in the houses to receive water at sufficient pressure at the upper floors. By contrast, the hilly topography of Cochabamba enables water to reach homes without the need to install pumps but a system of manually opened and closed valves is necessary to ensure that the water is evenly distributed to the various sectors once the network has reached maturity.

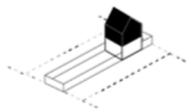
The accessibility of water resources is also a decisive condition for both the settlement of the built environment and water infrastructures. In Hanoi the easy access to underground water (just 8 m above the ground) makes it possible for households to drill private wells at low cost. By contrast, the location of the water table in Cochabamba (below 100 m depth) makes it necessary to install collective infrastructures, such as wells with related aqueducts and mini-grids.

164.
Cochabamba. Unfinished houses and water purchasing characterising Las Penas neighbourhood.

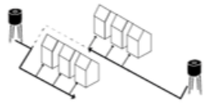
165
Hanoi. A floating village on the Red River banks.

6.1.2 DIVIDING

Built Environment



Water Infrastructures



The urbanization processes observed in the two cities depend to a large extent on practices of subsequent division of land, lots, and infrastructure networks often outside the control of the planning authorities. The earliest forms of land division in the two cities can be attributed to the agrarian and land reforms involved in the countries' transition to a neoliberal form of government in which land became a private asset. In Cochabamba, the large portions of agricultural land estates *the haciendas* were abolished and sold to farmers who progressively parcelled out land contributing to the city's rural-urban transition. San Jorge (C2) is a witness to this ongoing process today. Similarly, in Hanoi the process of subdividing land and allocating it to private individuals occurred in the framework of agrarian reforms, marking a shift from a collectivist economy and form of land management. While initially the process of subdivision was invited by governments through mechanisms of land redistribution, allocated to private individuals, the process of subdivision of plots has increased over time outside planning regulations and at a smaller scale. The progressive subdivision of lots has allowed landowners large margins of profit, feeding those forms of chronic land speculation that allowed cities to reach their current densities.

Practices of division also affect infrastructure networks. The increase in population density in the city of Cochabamba, where most neighborhoods are supplied water through mini-networks, has tended to lead to a progressive extension of the networks to a point where the overexploitation of water resources due to the excessive increase in the number of users has reversed the process. Many networks in Cochabamba, as the case of San Jorge (C2) testifies, have fragmented due to the emergence of internal conflicts within neighborhoods. In this particular case, the division of the network was marked by a dispute that emerged over the settling of the primary element of the infrastructure

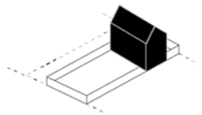
network: the well. In the case of Linh Dam the fragmentation of the water network is to be attributed to an increase of the density because of the construction of four new towers that have made insufficient the supply through wells in the district.

In the case of Nguyen Cong Tru, the sale of the formerly state-owned flats resulted in an increase in individual-level services for both water access and toilets. Thus, what used to be shared service blocks between several units (kitchen and toilet) have been divided among the inhabitants and are now for private use.

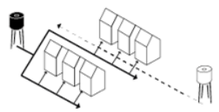
166.
Hanoi. Subdivision of collective services in Nguyen Cong Tru and view of a private toilet.

6.1.3 JOINING

Built Environment



Water Infrastructures



The processes of joining are usually state-led as they require large investments, resoruces, time and power. Joining plots in the Vietnamese capital, follows the acquisition of land by the state and is carried out by planning authorities to implement new real-estate developments that require large spaces for construction. The construction of Linh Dam (H2), as other NUAs, took place by joining agricultural land taken from the neighbouring villages and reallocated to the state enterprise HUD for construction. The combination of the practices of joining and reallocation thus allows the implementation of the top-down plans and urban redevelopments in the Vietnamese city. In the case of these large-scale urban fabric reconfiguration processes, there is no relationship between joining of lots and joining of infrastructures: in fact, redevelopment usually involves disruption and redesign d rather than incremental adaptation or reconfiguration.

Joining processes are also widely found in Hanoi self-built neighbourhoods. For example, the vernacular Vietnamese *tube house* found in the densest neighbourhoods of Hanoi has a depth of 10-12 m and a minimum width of about 2.5 m. It is not uncommon to encounter tube houses with wider street fronts, precisely generated by the process of joining multiple lots.

From a socio-economic perspective, these joining processes occur where there are already favourable economic conditions that allow for the purchase of additional land use, as opposed to subdivision practices that usually occur in order to increase one's economic resources through the sale or the rent. It is worth mentioning that this practice, as with the following transformation practices described below, has spread as a result of the liberalization of the housing market, which has been witnessing a gradual diversification of the built environment along with the emergence of socio-spatial differences among Vietnamese

167.
Hanoi. Tube houses with variable depth characterising Kim Lien lake waterfront.

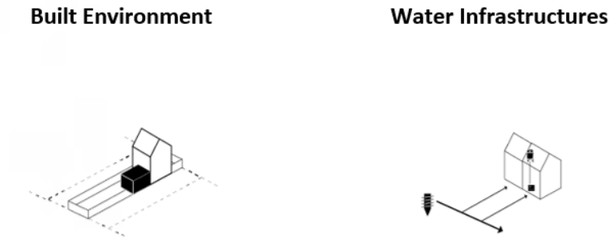
communities. Similarly, some examples of joining housing units were found in the KTTs, following the state sale of the housing stock. In the neighborhood of Nguyen Cong Tru (H1) multi-unit joining practices occur both in the residential fabric where some households have expanded their dwelling surface by annexing that of the contiguous apartment unit (curiously observed in two dwellings of TDP representatives) and in the commercial fabric.

Joining of water infrastructures was also registered despite the fact that most of the cases observed witnessed infrastructure division practices. In Cochabamba the reconfiguration of networks through the joining of several systems, generally takes place in situations where, due to the impossibility of obtaining a local resource, it is strategic to enter into agreements with other communities. It is the case of Villa Moscu neighbourhood (C1), where 70% of drinking water is supplied by surface water, the distribution of which is shared with the agricultural community of Andrada, located upstream. Joining processes between communities sharing a water infrastructure or a resource system are generally governed by contracts or agreements, which may be formal or customary. In rural Cochabamba, most of these agreements are customary, a

legacy of an old tradition of collective management of irrigation canals operating through regulated shifts called 'mitas de agua'. This practice has been found in the agricultural district of San Jorge (C2). Similar situations are found in Hanoi rural villages as a legacy of the collectivisation period, when joining of land and related water infrastructure, especially irrigation, was encouraged by the state as a way of managing land and its products oriented to increase the productivity of the country. In the peri-urban village of Lang To (H3), remnants of this collective form of land management is still visible in the waterscape, dominated by the presence of a dense network of irrigation canals and drainage and pumping systems, shared with neighbouring villages.

168.
Hanoi. Peri-urban development

6.1.4 ATTACHING



As a 'living organism' the urban fabric is structured through progressive additions, often variable in terms of surfaces, materials used and level of consolidation. The incremental city, as opposed to the planned city, builds its image through these organic additions affecting both the built environment and the infrastructures that serve the living spaces. In order to increase space given opportunities or to increase possibilities for trade, housing is often reconfigured around new functional spaces that allow families to consolidate and improve their livelihoods. In the case of Nguyen Cong Tru (H1), the semi-permanent additions called *tiger cages* reconfigure the façades of the Soviet blocks, creating a differentiation in materials, textures and functions. Attached to the façades of the buildings, these structures not only provide an extremely dynamic character to the monotonous blocks planned in the 1960s, but their function is to support domestic life, by extending the living space. These are sometimes small balconies used as drying rooms or for gardening. Other times these temporary structures are meant to support technical infrastructures and water devices connected to the houses, as for water tanks. In certain cases, the relationship between additions in the built environment and that in the infrastructure systems is tightly coupled. This is the case illustrated in the image below that I took of a north-facing façade of a KTT block whose additions with iron structures anchored to the structure serve to support water tanks.

Although this relationship is not always found, the same gradual addition of technical devices and infrastructures is common throughout the case studies with the aim to improve accessibility and quality of water services and to compensate for deficiencies and infrastructural gaps

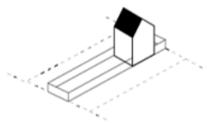
left by existing networks, either centralised or decentralised. Thus, tanks are added to water networks to guarantee a regularity in the availability of the resource, while adding a filtering system to the water network often represents the safest way of consuming a resource that is not purified and treated in any other way. The nature of these additions and the type of devices involved clearly depends on the resources available to households, both in terms of economic possibilities and space available for installation. The plug-in of simplified technologies to the existing infrastructure systems is also found in planned settlements where the built environment hasn't experienced any transformation visible from the facades. It is mainly occurring for water treatment at the household level, as in the case of Linh Dam (H2) apartment towers where most of households have installed filter columns.

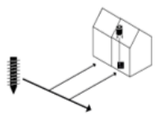
169.
Hanoi. Water storage tank on the rooftop.

170. 171.
Hanoi. From top to bottom. Tiger cages used as balconies and water tanks supports in KTTs.

6.1.5 REPLACING (UPGRADING)

Built Environment **Water Infrastructures**





Incremental settlements are replete with different surfaces that tell stories of accumulation and loss, contractions and expansions, desires and constraints. Single streets as alleys, in the case of Hanoi and Cochabamba, are often the inventory of a multitude of spatial and material values that are embedded in the configuration of the built environment and of the infrastructure systems sustaining life in it. The selection of roofing, tiling or facades, such as aluminium, bricks, bamboo, ceramics, wood, concrete not only reflect differences in environmental qualities and conditions, but also in affordability, cultural values, social status and aesthetic aspirations. What the cases have highlighted is that the choice of materials generally reflects incremental adjustments of the built environment, with materials spanning over time from more temporary to more permanent. When it comes to informal settlements, buildings are often constructed in temporary materials that are later upgraded to concrete and cement block, along with small adaptations of both inner and outer space distribution and function. The on-going process of upgrade charactering the urban fabric and the built environment, is also affecting technical infrastructures for water and sanitation often hidden beyond the architectural elements. Economic possibilities and spatial conditions often trigger technological upgrade mechanisms. Sometimes it is a question of replacing obsolete or shoddy materials with more durable and efficient ones, as in the case of Serena Calicanto (C3) where upgrading activities were conducted by dwellers and regarded the change from cement pipes to PVC pipes in the sewerage network. Other times, it is a question of increasing the power and capacity of the technical devices already in use (e.g. replacing a storage tank with a larger capacity one in order to increase the quantity of resource available

in the house, or replacing the pump with one of greater power when the water table has lowered).

In some cases, the level of finish of the urban fabric influences the consolidation of technical infrastructure and the cost of services delivered. In Villa Moscu (C1), the cost of water delivered from the centralised network to those excluded from the access to the community network, varies not so much on the basis of consumption as on the basis of the classification of the housing unit. The classification is made by SEMAPA on the basis of the number of floors, the finishing materials of the house, its size, in short, on the basis of its level of consolidation: the higher the level of refinement the house shows from the outside, the lower the water rate paid per m3. This prompts many households, as revealed in the interviews, to upgrade and consolidate their homes over time in order to access the lowest water service tariff.

Although in Hanoi, the water tariff is uniform, there is a similar interdependence between reconfigurations of the housing systems and the upgrade of technical infrastructures. The extension of dwellings, or their subdivision or conversion, often requires a technological upgrade to facilitate water distribution.

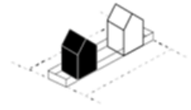
In both cities, there is an interdependence between the co-production of water services and the upgrade of public spaces or service delivery. This is found both in Cochabamba, where funds collected from water tariffs are often reinvested in the neighbourhood, whether for a technical infrastructure upgrade (e.g. to replace a pump) or for a public space upgrade (e.g. to build sports fields or schools and health centres) or for delivering various community services. In Hanoi, this mainly occurs through the operation of TDP resident groups that collect fees from the residential community periodically, which are used both for cleaning, maintenance and upgrades of shared technical infrastructure (mainly drainage networks and collective septic tanks) and for improvements to streets and interstitial open spaces in between the private built fabric.

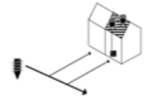
172.
Hanoi. Upgrade of existing water networks in the Westlake.

173.
Cochabamba. OTB Padre Berta upgraded public space and community water tank.

6.1.6 INSERTING

Built Environment **Water Infrastructures**





Densification in the neighbourhoods addressed by this research takes a diversity of forms that are associated with an accretion of the built surface of the existing urban fabric. One of these modalities is the insertion of new buildings or portions of them in the interstices left by the built environment, both in private and public lots. The allotment and insertion of new buildings in public space of planned neighbourhoods may occur outside existing planning regulations. It is the case of Serena Calicanto (C3), where the insertion of new dwelling units in the 15 de Mayo sector, has followed an irregular practice of allotment that has allowed the building of an area planned as a green area. A similar process of informal development has occurred in Nguyen Cong Tru (H1). Here the progressive occupation of the public space adjacent to building blocks took place through the construction of new dwelling units, usually of two stories that allowed new families to settle in the neighbourhood. This process that took place outside the existing regulation also had repercussions on the reconfiguration of the infrastructure system, but with very opposite outcomes in the two neighbourhoods. In Serena Calicanto (C3), the newly settled inhabitants are not allowed to connect to the decentralised water and sanitation network managed by the water committee. Excluded from the community services, they have to implement individual practices to access water services. They purchase water from water vendors who are filling on a daily basis the storage cans located outside the houses while, not having access to individual toilets, they often practice open defecation.

In the case of Nguyen Cong Tru (H1), on the contrary, the municipal water network allowed the new households to connect the new

network, although their houses have no legal titles and in the case of neighbourhood redevelopment they have no right to compensation. Likely, the resident groups managing are generally tolerant towards the connection to the drainage system which they manage, with the payment of a sum. However, these new housing units are not connected to the collective septic tanks and so they discharge black water directly to the existing drainage system. It must be acknowledged that the extension of the drainage system in the neighbourhood, caused by the insertion of the new housing units, not having seen an overall reorganisation of the system nor an increase in the ditches'section, presents problems in day-to-day management, with frequent blockages and localized flooding episodes requiring frequent maintenance interventions.

The case of Linh Dam (H2) showed us how the settling of four new buildings (VPs) occurred through the conversion of a portion of the neighbourhood that was classified as a green zone and then made buildable. The settling of the water infrastructures (the ten wells in this case) in the area, has been planned through a population and water demand forecast. The construction of the four new high-rise buildings, which occurred through land-use change, was not foreseen in the planning of the water infrastructure. It became reason for a conflict and as a consequence two different networks are found in the area; the decentralised one (planned in advance in the masterplan of the area) now connecting the older building blocks and the centralised one, which was extended in the district to serve the most recent towers.

Densification through insertion is also common in private space, especially in rural and peri-urban villages when the size of the plots allows for new constructions. In Cochabamba, the toilet block is inserted in the lot only after the consolidation of the housing and is generally located close to the road or the drainage system. This practice is extremely common in rural areas such as San Jorge (C2) lacking sanitation networks. In Hanoi the most common practice of inserting occurs as a result of a subdivision of the plots which is generally operated by families to increase their income by renting or selling the new construction to other households, or by hosting new commercial functions. This practice characterize the in-situ urbanization found throughout Hanoi peri-urban villages like Lang To (H3).

In the case of water and sanitation infrastructure, the insertion of new in parallel with the existing infrastructure portfolio increases complexity in the system and, at the same time, ensures a differentiation

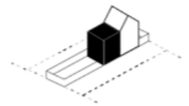
of resources. Indeed, new technical infrastructures (in the shape of networks or more simple technical solutions) may also develop in consolidated settlements when environmental or urban pressures demand a technical adaptation, as in the case of Lang To (H3). The successive iteration of technical infrastructures to respond to emerging challenges (i.e. increasing water pollution, decrease in local resources, exacerbation of water-related risks) is shaping the evolution of a landscape of co-produced networks in many neighbourhoods across the two cities. We have seen how in the case of Serena Calicanto (C3), rainwater harvesting is superposed to the existing water supply system to reduce the amount of water purchased from the Water Committee or private water trucks and, consequently to reduce the cost of water purchase. While in Cochabamba this practice seems to be taking hold as a matter of cost-effectiveness, we have seen how in Vietnam the inclusion of new technologies usually occurs to reduce the uncertainties of existing infrastructure systems and to address the progressive contamination of underground resources. Likely, the purchase of bottled water in New Urban Areas (H2) and the use of rainwater in villages (H3) guarantees a better quality and reliability of water provision.

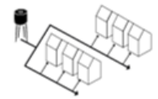
174.
Hanoi. A newly built housing unit in a peri-urban village plot.

175.
Hanoi. Rainwater storage system in peri-urban village

6.1.7 EXTENDING

Built Environment **Water Infrastructures**





Informal neighbourhoods are built upon progressive extensions of the dwelling units hosting a diversified range of functions. This process occurs over time, generally among different generations and takes different spatial forms, depending on contextual factors, such as morpho-typological characteristics of the building fabric, as well as socio-economic factors, as access to access to formal land titles and financial resources.

The most common housing system in Hanoi is that of the tube house takes and is mainly achieved adding one floor after another and following the growth of the household: thus, the generations dwell on top of each other with the older ones on the lower floors and the younger ones on the higher ones. In the dense central neighbourhoods of Hanoi, including those traditional villages absorbed by the urban agglomeration, the extension of the housing systems generally occurs vertically, with traditional one-storey houses now reaching up to 5-6 floors. This is due to the small size of the plots that does not allow a horizontal extension. In the case of KTTs collective blocks, as Nguyen Cong Tru (H1), more permanent types of tiger cages contribute to the horizontal extension of the housing units. Through corrugated metal structures which add on weight to the main building concrete frame, new spaces of living are progressively anchored to the facades.

In the various neighbourhoods addressed in Cochabamba, as well in Hanoi rural villages , as Lang To (H3) not yet absorbed by the urban agglomeration where the size of the plots is larger, extensions of the residential units occur simultaneously vertically and horizontally, with new rooms or units added over time to the lot sharing a common courtyard garden.

The densification of the built fabric is generally an engine for the

extension of networks, whether centralised or decentralised. Although practices affecting one or the other kind of infrastructure networks are similar in their nature, a distinction of scale and type must be made.

The extension of the centralised network, as a largely hierarchical structure, can occur in different ways and at different levels, that of trunk (a higher level) or branch (a lower level). In Hanoi the extension of water infrastructures to the disconnected areas takes place thanks to the construction of the New Urban Areas. The main trunks of the network first allow connectedness to the new settlements, while the connection of traditional villages found in-between these urban islands follows right afterwards. In Lang To village (H3) at the time of the workshops, the primary water trunk had already been installed along the main road by the municipal company. However, the inhabitants still did not know whether this trunk would be connected to the grid in use at the time, represented by the decentralised network run by the cooperative, or whether secondary and tertiary connections would be placed by the water company parallel to the old network. In other words they did not know whether their decentralized network would be reallocated to the water company or would be maintained as a back-up solution.

While in Hanoi the extension of the centralised network is mainly financed by the private sector, although cost recovery is expected to be reached once thanks thorugh households contributions once the water tariff increase is implemented, in Cochabamba the extension of the trunks by the water utility is co-financed by the communities. The cost of affiliation is much higher than in the Vietnamese capital and this is one of the reasons why the extension of the network meets with strong resistance among the population, especially in those neighbourhoods that have self-built their own micro-grids and these are still well functioning.

The extension of the centralised network can also occur in neighbourhoods where it is already present through the creation of new connections and the creation of new infrastructural branches at a lower level of the hierarchy. We have seen in the building blocks in Nguyen Cong Tru (H1), connected to the centralised water and sanitation network, how the privatization and horizontal extension of housing units has generated the extension of the networks at the tertiary pipeline level, with the introduction of private meters.

Even in the case of the decentralised networks of Cochabamba, a variety of extension modes and types of networks can be found.

Where local resources are available on site, the extension of the

primary infrastructures generally takes place at the same time as the plot subdivision and dwelling costruction, with contributions from the inhabitants through the payment of a membership fee (usually increasing over time as the grid extends). In addition to co-funding, communities are also called upon to contribute through community work to the laying of the primary and secondary networks, as well as their periodic management. Each household is then responsible for the extension of the network withing the boundary of each private plots.

177.
Hanoi. Horizontal extensions in the Old Quarter and in Kim Lien KTT.

178.
Hanoi. Vertical extensions in the Old Quarter and in Kim Lien KTT.

179.
Cochabamba. Housing expanding vertically and horizontally in the Zona Sur

6.1.8 REALLOCATION

The practice of reallocation is generally a driver of transformation of urban and infrastructural systems, although this modality refers to organizations and forms of control and not physical changes. Most forms of incremental development in the cities of Hanoi and Cochabamba have taken hold with a reallocation of land and housing systems. In the case of Hanoi, the ability of residents to own homes, prior owned by the state, made all of the incremental activities discussed above possible. The case of Nguyen Cong Tru (H1) has shown how the privatization of the building stock also marked the reallocation of the water network, handed over the water company, and the sanitation network, handed over resident groups. Both infrastructure systems were formerly managed and owned by the State. If in the Vietnamese context the process of reallocation that followed the Doi Moi reforms marked the passage from centralized and state management to community and private management, the case of Cochabamba suggests an inverse trend.

The attempted reallocation of community water infrastructures in the city of Cochabamba into the hands of the Tunari water consortium marked bitter conflicts that resulted in the Water War in the year 2000.

6.1.9 REDEPLOYMENT

Drift and exhaustion of infrastructure and building systems might be temporary and pre-existing infrastructure systems and technical devices might be redeployed due to changing conditions. From the point of view of the built fabric we have seen how in both cities the need to produce services and commercial activities to generate new sources of income have converted over time the houses, or part of them, especially on the ground floor, allowing the emergence of new functions within areas purely planned for residential purposes. It is the case of Nguyen Cong Tru (H1), where the possibility of increasing living space through attaching, extending and inserting processes, has allowed the conversion of the ground floors into shops, restaurants and other service units.

Forms of redeployment are also found when looking at infrastructure systems. It is the case of Lang To (H3), where rainwater harvesting has been widely redeployed once groundwater pollution has reached high levels, making it unsafe to use water from community systems for drinking. Similarly, in San Jorge (C3) the redeployment of abandoned practices of water supply (i.e. from irrigation canals or private purchase) is cyclically verified once networks present some gaps, or household are excluded.

6.1.10 DRIFT

The term stems from institutional theory describing efforts holding a status quo despite major shifts in the context or, in other words, situations in which goals of policy change, without changing the instruments to implement them (Howlett et al. 2018). So write Howlett and Rayner (2013, pp.18) “Drift occurs when elements of a policy mix are deliberately maintained while the policy environment changes. The impact of this policy mix is thus likely to change.”

Although generally applied to the analysis of gradual institutional changes, the concept has also been applied to the analysis of LTS (large technical systems) to indicate, during the maturing phase, the emergence of forms of contestation between various social groups for control over a system. Drawing on the concept of "infrastructure lifecycle" proposed by Bolton and Foxon (2015) and Offner (1993), Howlett and Rayner (2013) suggest that in the cyclical process of infrastructural development, made of decays and innovations, drift occurs in the contestation phase, i.e. when control over a system is tested to the point of crisis.

They write: “[…] contestation refers to the challenge of control over the system, where entities dispute, contest, compete, and contend some aspects of LTS functioning, placing them in stasis or jeopardy” (p.1079).

The relationship between contestation and reconfiguration of a socio-technical system is dynamic and dual: contestation can lead to either a decline (negative impact) or a reconfiguration (positive impact).

Socio-technical infrastructures and built environments when they reach a level of maturity, need to constantly maintain their capacity to

adapt to change. However, they are often subject to pressures from actors with divergent interests, what Savacool et al. (2018) call “fragmentation of consensus” (p.1080). When some relevant social groups win or contest for control over the system, episodes of drift may occur. Furthermore, as illustrated by Van der Haijden (2014) regulatory ambiguity can also impede the adaptation and upgrade of existing structures to changing circumstances and, consequently, lead to their decay and exhaustion.

It is clear that cities represent fertile grounds in which to explore logics of contestation and conflict over the control of resource systems. Although it is rather complex to apply theories of gradual change of institutions to processes of transformation in the built environment, some considerations can be made from what has been observed in Hanoi and Cochabamba.

Drift can be intentional. The gradual reconfiguration of the building blocks and related infrastructures (made of additions, joining, division and extensions) that took place in Nguyen Cong Tru (H1) and operated by households, did not meet any upgrading action on the whole system. The privatization of the building fabric was in fact partial: while the single housing units were sold to the occupants, the building structures including the common areas and the main infrastructures remained state-owned. The absence of a clear regulation and share of responsibility between the state and the inhabitants on the management of common spaces prevented any collective action from rehabilitating the buildings and main infrastructure. At the same time, the lack of maintenance by the public sector has enhanced the progressive decay of the building stock. This state of obsolescence is now mobilised by the municipal government as a key argument to justify a process of redevelopment of these areas. By endorsing this perspective drift may be interpreted as a strategy for some actors, in particular Hanoi planning departments under the pressures of the real estate sector, to erase this legacy of the collectivist period and impose on these settlements a new rational order that, by increasing density, might lead to higher profits. Demolition of the collective buildings and the construction of new high-rise buildings is already occurring in the city.

I see a similar process in the peri-urban villages, which was recounted in the case of Lang To (H3). The authorities are acting ambiguously: warranted by heavy metal contamination, they impose restrictions on the use of underground resources. Instead of allowing or incentivising

small community-managed water treatment plants to invest in pollutant-eliminating technologies, they are planning to dismantle them, while encouraging the extension of the centralised network, driven by private capital investment.

From these two cases we can test the hypothesis that regulatory ambiguity, referring to a situation of changed impact of existing buildings and infrastructures due to shifts in their controlling organisations and a lack of adjustment to environmental transformations, may lead to drift.

Drift can also be unintentional. It also refers to the fragmentation of consensus regarding the management of water services in Cochabamba Northern areas where the centralised network is extending to the increasing urban population. Indeed, the decrease in affiliation to the community water networks is compromising their survival, since the funds generated by the sale of water are no longer sufficient to cover the costs of maintenance and upgrade of the networks. It is the case of Villa Moscu (C1). I here assume that the community organisation managing water is entering in a phase of drift, especially since SEMAPA, the municipal water company has already reached the neighbourhood and the residents, complaining about the lack of transparency in the management of water tariffs, no longer feel represented by the committee. What cannot yet be assessed is whether this drift will lead to stagnation and progressive exhaustion of the co-produced network or whether a reconfiguration will take place that will see a hybridisation of the two systems: the centralised and the decentralised.

6.1.11 EXHAUSTION

Exhaustion refers to a ‘process in which behaviors invoked or allowed under existing rules operate to undermine these ... [leading to] institutional breakdown rather than change’ (Streeck and Thelen 2005, p. 29). The concept is also mobilised to describe situations in which older design elements are undermined because they do not function properly in the light of newer policy elements (Van Geet et al. 2019)

Because exhaustion refers to a process of breakdown or fading away rather than actual change, it is no longer included among the me-

chanisms of incremental institutional change (Mahoney and Thelen 2010).

However, for the purpose of this research, it is a concept that is helpful to be mobilised as representative of the transformation processes, with their cycles of birth and decay, that the co-production practices of water and sanitation services observed in the two cities undergo. Indeed, change in the built environment and water infrastructures not only originates from growth and expansion but also from transformation and decay. Water networks in Cochabamba and Hanoi, as emerged during the workshops with the inhabitants, are built progressively over time on pre-existing networks. In some cases, traces of this layering process remain the neighborhoods, i.e old technical systems as common wells and water tanks are kept although not in function, as well as a few vernacular dwellings remain intact within a dense reconstructed fabric. These physical structures inscribed in the streetscape tell about ways of inhabiting space, accessing water and services, and community life in pre-urbanised societies. In other cases, they are dismantled. The causes of the depletion of these practices are multiple. When it comes to water infrastructures this may be attributable to the disappearance or pollution of the resource system on which they are based, i.e. the depletion of underground water resources or to the insertion of a new system, such as the extension of the centralized network. In the case of sanitation systems in Cochabamba, the arrival of the sewage system has tended to lead to the exhaustion of on-site treatment and collection systems (i.e. septic tanks and holes). Almost the entirety of that collective infrastructure in the Vietnamese city has been dismantled, thanks to major socio-technical and economic transitions in the country. First from the moment it became possible to draw resources with individual wells and then to pump water from underground by supplementing it with rainwater, and secondly with the arrival of the centralised network. With these transformations, for example, the common wells from which the community drew water are now ponds that have retained their symbolic function because of their location, being placed in front of buildings with public functions such as pagodas or temples, but have lost their function as water sources.

Peri-urban villages as Lang To (H2) still witness these transformative phases in the socio-technical hybridisation that characterises practices of access to water services.

6.2 Scale

The above section has explored the taxonomy of incremental development considering both building systems and water infrastructures and highlighted some of the interrelations between them. Variations in one dimension reverberate on the other, though not necessarily in a causal relationship, shaping extensive territorial transformations over time.

The technical portfolio mobilised in water services co-production depends on contextual features, such as settlement characteristics, land location, and distance and/or connection to the centralized networks (Moretto et al. 2018). The urban morphology (plot, street, constructed space, open space) and the building typologies (single housing, multi-storey houses, apartment towers) define the opportunities and constraints of incremental development.

Incrementalism describes the progressive grafting of building systems on top of the existing built fabric occurring through successive parcelling and new construction as well as the spontaneous room-by-room process of accretion that extends the building systems horizontally or vertically . This densification process, driven by the imperatives of resource accumulation, family ties and spatial conditions (i.e. land availability, informal/formal land market…) is more likely to occur in neighbourhoods composed of small-scale plots and housing systems (such as the tube houses in Hanoi and the single-family houses in Cochabamba), as they allow many people to engage directly in designing, building and maintaining their built environment (Brandt 1994). This is the case of Villa Moscu (C1), where both forms of individual and collective co-production exist and develop to respond to spatial densification. As the built environment grows and the number of service users demanding for water connection increases, the water infrastructures that sustain them are re-configured and extended: new technological devices are added, water collection systems expanded or upgraded, or, when incremental development of the built fabric exceeds the capacity of the resource system from which the network draws, a new system replacing the previous one or added in parallel is introduced.

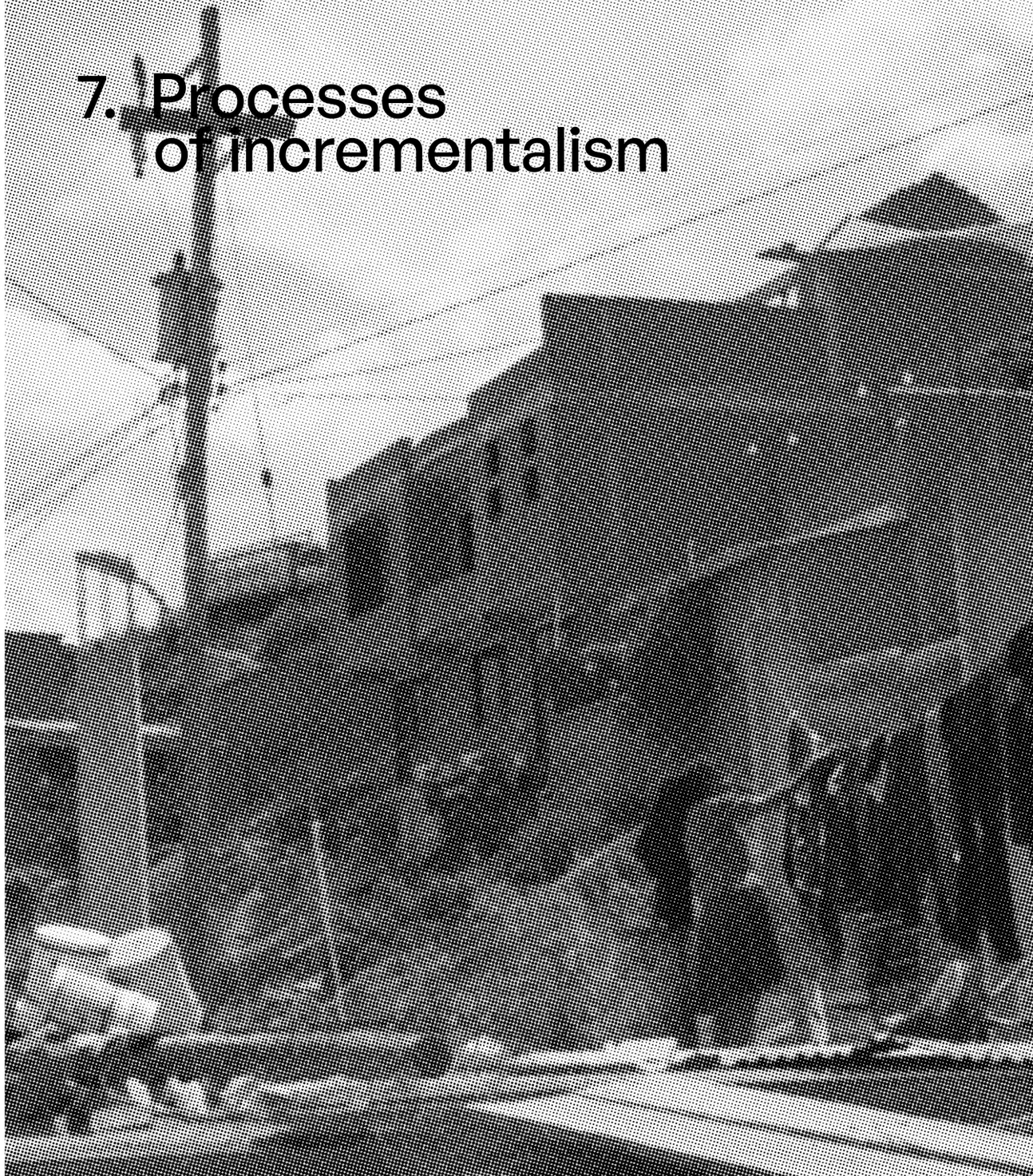
In large-scale property developments, as in Hanoi New Urban Areas, processes of incremental adaptation are not likely to develop in the same way and the upgrade of water infrastructures seems more problematic and costly once densification occurs.

In Linh Dam (H2), the insertion of three new 30-storey skyscrapers in an area initially conceived as green, did not allow for the extension of the existing, decentralised network that draws on a series of wells. Instead, densification has led to an overall redesign of the infrastructure system, with the extension of the centralised network in the area, only serving the new building blocks. The neighbourhood thus sees a superposition of two networks that draw on distinct resource systems, the decentralised one managed by the neighbourhood and the centralised one managed by the municipal drinking water company.

However, it seems that co-production has transformed more consistently on the intermediate scale of the condominium typology, as the scale of the buildings and the public space organised between the built-up areas has allowed both vertical and horizontal expansions of the built space and the overall redesign of the technical infrastructure employed.

In Nguyen Cong Tru (H1), the original design of the buildings and the open space between blocks represented an opportunity for individual households to extend their private space, while installing individual facilities (kitchen and toilets). This situation, in turn, contributed to the switch from a group level of co-production of water supply to an individual one, through the multiplication of small-scale technologies that are easily installed in the blocks and suitable to the building's height. In the reconfiguration of these building blocks, the technical infrastructure has become visible: once hidden behind the facades of the buildings, it now composes the facade itself, producing a complex architecture of pipes, tanks, and other anchoring technical devices.

7. Processes of incrementalism



" What seems to be unchanging does change; what seems to be changing is unchanging."

Karl Weick, The Social Psycology of Organizing

The taxonomy of incrementalism developed in the previous pages has highlighted, by unpacking it into a few pragmatic actions -practices- that change in continuity that characterises the evolution of urban fabrics and water infrastructures over time, which represent the physical dimensions of wss co-production.

The material presented here composite, heterogeneous and fragmented is meant to reflect the multiformity of the various social, technical and spatial situations addressed by the research and to propose an exploration of the process of inhabiting, through the lens of co-production. A process that can never be concluded. It is to the complexity of this process here inquired into, highlighting some trends identified from a transversal analysis of the empirical cases. Bringing out the multiple shapes and tensions in the evolution of wss co-production over time, this session seeks to unveil how different typologies of wss co-production are constituted, consolidated and transformed over time. It does so by looking for interdependencies between processes of reconfiguration of the built environment, water and sanitation infrastructures and their governing organisations.

Wss co-production is here interpreted not only as a system, sum of physical and social structures, but as a complex social, spatial and technological process that enable or disable particular kinds of planning and action in the contemporary city. In this process, made of networks and fragments, expansions and contractions, design and redesign, creation and disruption, order and disorder, the persistence of certain constitutive invariants of built environments, water infrastructure and governing organisations is combined with their permanent evolution. In this vein one would say the following pages want to explore how co-production navigates between continuity and change.

7.1 Cyclicality

" Cada acto de creación es un acto de destrucción."

Pablo Picasso

Existing literature presents co-production as a linear process and tends to differentiate types of co-production based on the stage in the service cycle in which citizens are engaged in collaborating to produce the service (Moretto and Ranzato 2017). Co-production is generally disaggregated into co-planning, co-design, co-delivery, and co-evaluation, referring to the stage within the service cycle in which community and state actors work together to produce something of value (Nabatchi et al. 2017). This linear understanding of the collaborative process in service delivery diverges with the cycles of growth and fall which are found across the three dimensions of wss co-production addressed in this research. The evolution of organisations, built fabrics and water infrastructures seem to be more akin to circular rather than linear processes.

Departing from the observation of the technical dimension of co-production, we see that “infrastructure disruption is the norm rather than the exception” (Lawhon et al. 2017). Networks are productive elements in the sense that they are both circulatory machines enabling the circulation of flows, and tools for territorialization enacting the transformation of the natural environment into a human artifact. At the same time, they also appear as destructive elements of territory, “disrupting spatiotemporal references and blurring geographical scales” (Offner 1993, p.11).

The case study analysis suggests a cyclical pattern of technological change, in which periods of incremental change in water and sanitation infrastructures are interrupted by subsequent technological breakthroughs (Anderson and Tushman 1990,; Geels 2002). Incrementalism, here understood as a process resulting from the deployment and more or less random combination of different spatial and technical practices over time, generally involves a feedback loop of disruption and redesign, which fuels co-production activities as dwellers are constantly repairing,

disrupting, and redesigning their built environment and embedded infrastructure systems.

On the one hand, the widespread participation of users in the production and maintenance of infrastructures allow the emergence of ad-hoc strategies for fixing disruption. Sometimes, these grass-roots socio-technical solutions address the lack or deficiencies in infrastructure systems (disconnection, water shortages, uneven pressure, unsafe quality, or clogged sewer pipes) during a transitional phase. In other cases, they may rise to address processes of reconfiguration of the built environment. Indeed, when building systems are reconfigured a certain degree of disruption and redesign of the technical elements that it supports is needed. The physical reconfiguration of the coproduced infrastructure analysed is largely based on hybrid and/or decentralized systems that can complement, upgrade or replace the infrastructure network.

On the other hand, coproduction once associated to incrementalism may also cause disruptions and the growth of a built environment can threaten the smooth operation and proper maintenance of current water infrastructures to the point where they collapse. The more complex an infrastructure system becomes, the more serious the maintenance issues, technical breakdowns, and deficiencies that users and/or providers face. As the case of the Nguyen Cong Tru (H1) shows, despite a smooth, centrally controlled flow of water in each block, households continually face problems in access to water and sanitation services. Tenants living in the lower floor tend to suffer from water shortages as well as being affected by localised flooding as the drainage system is overcharged. Similarly, in Villa Moscu (C1) the extension of the water infrastructures which for a long time ran parallel to land occupation, became inconvenient as the demand increased and resources began to dwindle.

In addressing and simultaneously fuelling disruption, incrementalism implies that dwellers become more engaged in service co-production, as they are constantly redefining their spatial conditions and redesigning the technical portfolio they employ.

The adaptability of the practices observed in this research is source of innovation for the organisations delivering these services. A number of adaptation strategies is found in the case studies highlighting the **learning nature of wss co-production.** These actions are incremental, small adjustment that do not require radical changes in the management of resources and infrastructures. These include technical upgrade

(i.e when the water table decreases, drilling a deeper well or changing the pump could increase water supply without the need to search for other sources) and the re-design of operating rules (i.e. rationing water by reducing the number of days or hours of distribution or increasing the water tariff) However, when environmental changes cannot be confronted with these incremental strategies, co-production organizations may opt for more substantial changes and radical actions. Examples of these may include reframe their boundaries (i.e. establishing networks and agreements with other communities to share resources) and switch to other types of services and resource systems (i.e. buying water from private vendors, getting connected to centralised networks).

In this sense, we understand that the co-production of water and sanitation services is a self-feeding process that, by its nature, through ruptures and adaptations, produces innovation and further transformation. “Indeed, there is some evidence to suggest that this kind of piece-by-piece adaptation is a leading cause of innovation, acting a continuous feedback loop of experimentation, which, through many small increments in practical knowledge, can produce large changes” (Graham and Thrift 2007, p. 5).

7.2 Complementarity and concurrency

The literature has shown that technologies mobilized in co-production can contribute to the improvement of the current conventional system, or can introduce an additional layer of complexity in the network (Allen et al. 2017; Jaglin 2012; Moretto and Ranzato 2017). The cases addressed in Hanoi City and Cochabamba show that technical hybridisation in water and sanitation services leads to a coexistence of operational networks, where large-scale centralized infrastructure systems and small-scale decentralized technologies are deployed simultaneously to provide services to city dwellers.

In his analysis of infrastructures’ life-cycle Offner (1993) analyses how networks emerge, develop and eventually disappear over time. He argues that the birth of a network takes place on the basis of a previous,

material or immaterial network in a concurrent or complementary relationship.

When applied to centralized infrastructures, co-production arrangements can lead to **complementary networks** that citizens adopt to improve access to water supply and sanitation. In this sense, these self-help initiatives reconfigure and complement unfinished networks through alternative small-scale sociotechnical devices installed and operated by households (Zérah 2000). This model applies to both the houses of Villa Moscu (C1) and the Soviet blocks of Nguyen Cong Tru (H1), where smaller networks are developed and technical devices implemented at the household and block levels to correct gaps in service delivery (i.e., water pumps are installed to compensate for the low pressure in the pipes, which does not allow water to reach the upper floors, filtering or boiling practices are meant to improve drinking water quality while storage tanks compensate for an irregular water distribution).

Complementary practices of co-production are also found in decentralized networks. In the neighborhoods of Serena Calicanto (C3), although the hilly topography of the terrain allows water to reach high pressures without the use of pumps, the distribution of water in shifts makes it necessary to install storage devices, including underground and elevated tanks and barrels to have a constant water flow into homes.

These compensatory strategies represent what Kyessi (2005), referring to the technological upgrade of water infrastructure in Dar Es Salam, would call a "step-by-step" development model (p. 10). The devices installed depend primarily on the financial capacity of households, as well as the characteristics of the settlement in which they are to be installed.

Moreover, their implementation can be triggered by the various practices of urban densification described in the previous session. Thus, reconfigurations in the built environment play a relevant role in the emergence of complementary technologies and practices for service delivery. We have explored, in the soviet blocks of Nguyen Cong Tru (H1) how the densification of the building blocks, not supported by an overall upgrade of the public infrastructure networks, triggered individual practices of co-production. The installation of secondary pipes and individual water tanks, are complementary strategies that allow the public network to reach the last built-up units. They have emerged on top of a previous collective network which is now almost disappeared under the hundreds of house extensions and new pipelines. A similar situation has

been reproduced in Villa Moscu (C1), where although a part of the neighbourhood is connected to the centralised network, some stop-gap and back-up solutions are developed to increase the reliability and regularity of the water service. For those who are also connected to the community-managed decentralised systems, tre provision of water through the municipal one is considered a back-up solution, thus a complementary network.

These grass-roots technical devices coexist with large-scale technical infrastructure, as in the case of Linh Đàm (H2), where, despite the use of high-tech and large-scale solutions in the apartment towers, groundwater contamination force households to equip their apartments with filters to purify water or to purchase bottled water.

Technical hybridization can also occur on larger scales, such as the neighborhood scale, and can lead to the coexistence of concurrent networks. In Linh Đàm, the existence of two water networks can be explained by increasing groundwater contamination and overpopulation in the area, caused by the contruction of 4 new 32-storey apartment towers in the open space between the older apartment towers. The expansion of the technical portfolio, due to the differentiation of water resources (from groundwater to both groundwater and surface water), must be understood within broader program applied at the metropolitan level. The plan calls for increasing surface water use, especially due to declining groundwater levels and increasing arsenic, coliform, and nitrogen contamination (Bui et al. 2018), and extending centralized infrastructure to those peri-urban areas that remain disconnected.

We have seen the presence of competing infrastructure in Bolivian neighborhoods as well. The extension of the centralized network in the Villa Moscu (C1) neighborhood was facilitated by the refusal of the OTB in charge of managing the community water service to extend the network by facilitating new connections. Remaining excluded from the community water service, the sectors of Villa Moscu of more recent construction had no other possibility to access water services if not resorting to the centralized ones.

In both cases, the infrastructure system developed primarily from a decentralized solution (wells connected to an independent network) to a centralized model.

As also Offner (1993) pointed out it is very common to register situations where both complementary and concurrent networks coexist. In the peri-urban village of Lang To (H3), residents supplement the exi-

sting micro-grid operated by the agricultural cooperative with a range of technologies and infrastructure at the individual level that allow for diversification of resources according to uses, e.g. water from individual wells is used for washing and gardening, while rainwater offers an alternative to mains water, which has high amounts of arsenic. The arrival of the centralised network will create an additional layer of complexity in the system.

As we have seen, urban and infrastructure incrementalism helps to produce more complex networks through a differentiation of infrastructure and technical devices. This incremental development allows for navigation from more formal to more informal modes of service delivery and vice versa (Misra 2014), producing an assemblage of centralized and decentralized technical solutions that characterize the hybrid nature of service co-production.

7.3 Shifting boundaries

73.1 BOUNDARIES CHANGE AND CONTROL

The previous session (linearity and cyclicality) has highlighted the circular and self-reproducing nature of co-production, showing how feedback loops are mediated by disruption and redesign. Here, I want to place emphasis on co-production infinite and in-the-making nature. The taxonomy developed in the previous sub-chapter (practices of incrementalism) shows how through co-production and mostly in an incremental fashion, urban fabrics and water infrastructures are reconfigured and evolve over time. Although I have not ventured to explore further into the historical institutionalism scholarship and path-dependency theories that would certainly provide tools for an evolutionary analysis of the actor dimension of co-production, it is clear from the case study analysis that transformation processes also shape the boundaries of organisations involved in the delivery of water and sanitation services.

Scott (1985) refers to the incomplete nature of organizations by showing how their survival depends on continuous exchanges with other systems. The rational and natural system perspectives insist that organizations in order to continue to exist must maintain boundaries that distinguish them from the environment. So, Kaufmann (1975) in his analysis of the boundaries of organizations states: "As a tentative rule of thumb, however, the demarcation and defence of organizational boundaries might be useful as a key continuity" (p. 115-116). Boundaries are indeed maintained through boundary rules, which entail “complex rituals and beliefs” (Ostrom 2000). Various expedients are performed by organisations to ensure their survival over time. As Hernes (2008) argues, it rather seems more appropriate to say that organizations perform various types of demarcations, such as expressions of identity, to delineate the self from the other. The adoption of signs of belonging such as uniforms and certificates; the enactment of rituals of boundaries crossing, such as initiation or expulsion ceremonies; the sharing of benefits and responsibilities among those who belong to the organization, are some of the mechanisms used by organizations to define, redefine and overcome their boundaries (Kaufmann 1975).

At the same time, the blurred and ambiguous nature of boundaries has been pointed out by different scholars in the field of organization analysis. Weick (1979) characterizes boundaries as changing, Scott (1985) compares them with sieves, Pfeffer and Salancik (1978) claim that they are ambiguous, whereas March and Simon (1958) point out that they are permeable.

The case study analysis has sought to unravel the mechanisms through which actors involved in service co-production react, through forms of adaptation, to the uncertainty of an environment and resource system by constantly re-configuring their social, technical and spatial boundaries. The boundaries of co-production organizations in the cases analysed are often blurred and almost always fluid. Incrementalism allows co-production practices to be extremely adaptable over time and to respond to changes in environmental conditions in a process of continuous learning. Notably, the elasticity of boundaries which characterizes the community organisations delivering water service in Cochabamba allow them to have strong margins of autonomy to alter the morphology and functioning of the micro-networks they manage. The community organizations in charge of water services progressively extend their boundaries by connecting new residents to the water networks in parallel with increasing urbanization. In Villa Moscu (C1) this expansion occurred until resources began to dwindle at which point the process froze and a reverse process of boundaries contraction began. It can be argued that at a certain point in time, transaction costs related to the functioning of

these community organizations could be reduced and the uncertainty related to a decrease in resource availability faced by preventing new connections and their institutional upscaling.

While these dynamics of boundaries control are put in place by organisations to reduce the uncertainty of the system in which they operate and to ensure their own survival, some cases have shown how mechanisms of exclusion due to freezing of boundaries can instead generate conflicts between those prevented from access to the resource system that may jeopardize the stability and legitimacy of the organizations' leadership. This opens up a reflection on the emergence and control of what are termed "counter-organisations". As Morgan (1991) explains, in situations where a group of individuals succeeds in creating and maintaining a power concentrated in a few hands, opposing forces tend to coordinate their actions in order to create an opposing power structure. The emergence of counter-organisations can have the effect of challenging the boundaries of an organisation if not their unbounding.

In the case of Serena Calicanto (C3), a group of dwellers composed by those households excluded from the water networks and some households connected but critical towards the ruling organisations' opaque management, push to take over the control of the two community organizations (OTB and Water Committee) managing the neighbourhood. Although the interests of the two groups are multiple and of a different nature, the formation of a coalition allows them greater strength in the pursuit of certain objectives: to have a say in political decision-making system and to extend the water networks in their portion of the territory, both arenas from which a group of neighbours are currently excluded; and to change the ruling class, so as to have greater control over the management of resources.

It would be interesting to see how the conflict between these two groups of interests will impact the boundaries of the current organisations managing the neighbourhood: that is, whether these will be extended to include those that are excluded, or whether, as in the case of San Jorge A, the dispute will end in fragmentation and thus in the emergence of a new organisation that will exert its control over the boundaries of the part that is currently excluded from the OTB.

Another aspect of boundaries that I would like to point out is that some organisations appear extremely rigid in the management of their boundaries and in perception of their own identity and tend to counteract changes in the external world that in their imagination can be merely

represented as opportunities or threats to their own survival. These organisations, which can be defined as "egocentric", where they fail to develop "systemic wisdom", i.e. to understand the conditions of the environment on which they depend and thus to consider taking on different identities when these change, risk "maintaining unrealistic identities or giving rise to identities that tend to destroy the very context that guarantees their existence" (Morgan 1991, p. 298).

Here I would like to quote a dialogue I had with the leader of the OTB of Villa Moscu during the focus group, as it is an emblematic picture of the issue of organisational egocentrism. To the concern she showed with respect to the progressive fall of memberships to the community organisations (due to a sharp increase in criticism within the neighbourhood related to corruption and patronage mechanisms), I asked her the following question:

> But if the committee was to lose its role as a service provider due to the arrival of the centralised network, and thus face a consequent loss of economic resources from the sale of water, what scenario would open up?
>
> We will have to do something so that the board won't die. We could for example invest in tourist activities, turning our neighbourhood into a resort. Our neighbours could take advantage of the new services we could offer by charging a certain fee to the board. We could also turn the water tanks into swimming pools… but this in fact we should weight it, as we may need to keep the water networks for any emergency situation.

It is often the egocentrism of these organisations that makes sharp conflicts to emerge. However, if observed from an outside perspective, conflict can also be interpreted as a way to ensure the survival of the organisation over time, restoring those founding values that prompted the first residents to take collective action. Indeed, as Weick points (1979) "conflict is functional and persist" and those organisations showing high levels of conflict and appearing unstable sometimes are durable following reform processes. Where the change of the ruling class and the system of command deemed corrupt and inequitable allows organizations to re-configure their boundaries and re-found themselves on

those principles of reciprocity and care for the common good that had characterized their origins, organizations may in fact be removed from the "egocentrism" that undermines their purpose.

7.3.2 THE AMBIGUITY OF BOUNDARIES

I have observed variations in the boundaries of co-production practices in Hanoi and Cochabamba respectively. In the case of Hanoi, I have mainly focused on the evolution of built environments, by examining the relationship between dwelling typologies and their incremental development possibilities in contexts connected to centralised network. The focus has been mainly directed towards the co-evolution of centralised networks and that of small-scale co-produced practices which drive change in those low-level structures of the large hierarchical networks. Here, the spontaneous densification the built fabric feeds the emergence of various grass-roots scale technologies at the scale of the dwelling (Graham and Marvin 2011) which allow wss co-production to navigate from more collective to individual modalities of service delivery.

In the case of Cochabamba, I was mainly interested in the evolution of decentralised networks. I explored the relationship between network infrastructure typologies and the possibility of their incremental evolution, showing how the consolidation and evolution of networks contributes to shape the territorial and spatial organization of neighborhoods.

The analysis made it possible to verify that in the case of both centralised and decentralised networks, the boundaries are permeable and mutable and that in this process of boundary extension and contraction, co-production, i.e. the simultaneous participation of service users and providers, plays a pivotal role.

Recognition of the ambiguity of boundaries in the various forms of co-produced management of water networks in the case studies opens up a further dilemma that calls into question the literature on common pool resources institutions (CPR).

In Governing the Commons, Elinor Ostrom (1990) shows how, if certain conditions are met, communities can self-regulate and access resources avoiding their destruction in the long run. One of the conditions is the clarity of the boundaries that the organisation establishes for

itself in the possibility of taking resources from its environment through forms of self-government within the limits of a well-defined territory. The adherence, therefore, between those who appropriate resources and the territorial system that carries resources occurs through the definition of precise boundaries that determine who is inside the system and who is outside, who can therefore access resources and who is excluded. CPR theory's boundary principle asserts that institutions whose boundaries are congruent with the scale of the physical boundaries of a common-pool resource are more likely to be successful and sustainable over time. Ostrom (1990: 91) notes: "Without defining the boundaries of the CPR and closing it to 'outsiders,' local appropriators face the risk that any benefits they produce by their efforts will be reaped by others who have not contributed to those efforts." The CPR systems that Ostrom observed have the characteristic of being durable, robust systems, and of being located in rural environments, far from the rapid urbanization dynamics that characterize the cities and neighborhoods addressed in this research work.

If we read the built environment as a living organism that is characterized by incremental changes which constantly impact on the resource systems and related service infrastructures, it becomes relevant to observe the processes of reconfiguration of its boundaries at various territorial scales and address its impact on CPRs. How, then, do Ostrom's theories apply to the observation of water and sanitation networks and related community management practices in urban contexts, when the growth of the territory constitutes a constant variable of change and evolution of these?

Observation and analysis of the case studies immediately raises questions about the applicability of this condition in the complex and ever-changing contexts towards which the thesis is directed. Already complex system perspectives scholarship has challenged the concept of boundary by coupling the concept of resource systems with that of network and flow, just as research in geography has focused more on the concept of 'liminality' that emphasises transition (Blueming et al. 2021). Similarly, several authors dealing with literature on urban infrastructures are focusing on the hybridisation of networks (Jaglin and Rateau 2020, Moretto et al. 2023) and thus on the combinations of what Jaglin and Rateau (2020) call incomplete infrastructuralisation and uneven heterogeneisation.

Blueming et al. (2021) suggest an analytical framework that starting

from some considerations of the philosopher Varzi on the ambiguities found in the very concept of boundary (bona fide ambiguity, methodological ambiguity and semantic ambiguity) tries to support the concept of boundary in CPRs and to show the importance of diversifying the types of boundaries in order to assess the sustainability of CPR institutions.

The first dilemma is that the boundaries of natural resources are not easy to recognise in all contexts. Water, as a 'fluid' resource, is mobile and interrelated in space at different scales. Moreover, even where the natural boundaries of a resource can be defined, there is not always consistency with the social/institutional ones that appear constantly redefined in the light of problems, changes, transformations. Finally, there are situations in which environmental systems do not perfectly coincide with the boundaries of the social systems within which they are managed, and several authors note that in these situations it is unlikely to find a system of rules put in place by any institution that is adequate for resource management (Blueming et al. 2021, Ostrom 2007). This discrepancy between natural and social boundaries is especially found in interlinked CPRs (such as groundwater basins or rivers).

The ambiguity of the boundary and the complications related to interlinked CPRs is particularly clear in Cochabamba where there are inconsistencies on several levels. First, there is often a lack of adherence between the boundaries of the territorial units (the OTBs) and the water networks managed by the OLPEs. The extension of the water networks can be smaller than that of the territorial political unit of reference or larger, extending over neighbouring territorial units. The case of Villa Moscu (C1) is emblematic in this sense, since the water network managed by the OTB does not cover the entire territory under its jurisdiction, forcing a part of the district to use the centralised system; at the same time, a part of the network extends to cover a portion of the neighbouring OTB Lomo de Aranjuez. This non-adherence of boundaries creates internal conflicts within the community organisation that manages the services.

Secondly, there is a lack of adherence between the natural boundaries of the water resource from which these micro-networks draw and the boundaries of the networks. As also pointed out by Cabrera and Teller (2021) the OLPEs have control over the water resource they distribute and thus over the territory included in the network boundaries, although the ecological perimeter impacted by their groundwater abstraction activities is totally uncontrolled but certainly larger in scale than that of

the territory they control.

The issue does not only concern Cochabamba and the boundary management of decentralised micro-networks. It is also to be found in Hanoi where the centralised water network provides almost total coverage of the urban agglomeration but only 10% of the wastewater is treated. The NUAs for example must be by law equipped with wastewater treatment facilities. However, where this treatment is actually carried out, the treated water is immediately recombined with the black water from the rest of the city as soon as it leaves its institutional/space boundary. Similarly, agricultural cooperatives in rural areas that have to manage all hydraulic infrastructures, including pumping stations, weirs and channels in the villages are impacted by the pollution and overflow that comes from the gigantic development of the upstream urban areas. In other words, in almost no case is this principle of adherence between natural, infrastructural and organisational boundaries found. Different degrees of adherence correspond to complex social and spatial interactions that put the issue of interlinkage between different scales and territories on the table.

As pressure on natural resources has increased considerably in recent decades in line with urbanisation and research questions what are the best organisational forms to sustainably manage resources, there is an urgent need to adopt appropriate lenses of observation that do not overlook the issue of transformative and ambiguous boundaries.

First of all, the various boundaries that come into play when observing wss co-production must be distinctly observed: the boundaries of the organisations that produce the services, those of the infrastructure networks, those of the built fabric served by them, the natural boundaries of the resources from which they draw and also of those that are fed back into the system (look at the full water cycle). Observing the control mechanisms of the boundaries, which can therefore vary their levels of permeability and activate their transformation (expansion or contraction), allows one to understand the convergence or divergence of interests within and between the different organisations that co-produce the services. It is important to consider the multiscalar dimension and the interconnectedness water resources as well as the diversification and multiplication of resources employed by users in the observation of co-production where long-term ecological impacts are to be assessed.

Last, instead of looking for static boundaries, stable over time, the employment of an incremental perspective towards wss co-production shows the need for a more nuanced understanding of 'boundaries' where one wants to capture the evolutionary, complex and relational nature of the social and material fabric of the contemporary city.

7.4 Fragmentation and internal differentiation

7.4.1 UNBUNDLING NETWORKS AND DIFFERENT SCALES

Graham and Marvin (2001) 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, i.e. the economic liberalisation of infrastructures and the development of new technologies, contribute to the disintegration of network infrastructure, fostering the fragmentation of the social and material structure of cities. The authors argue that while the universalisation of services embedded in the modern infrastructure ideal had an integrating character, their privatization and liberalization have contributed to the disintegration of ubiquitous 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 or urban elites would promote the separation and segmentation of the infrastructure into different elements and packages. The figures of the archipelago and the enclave represent the dominant spatial conditions in the contemporary urban landscape (Petti 2007) and the spatial result of that infrastructure unbundling of which the authors of splintering urbanism speak. This segmentation that characterises post-modern infrastructure development 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. This “cherry-picking” process recalls the selective nature of infrastructure networks development: once networks rise in scale they can enable a more strategic activity designed

to increase profits. This often implies the extension of connections to the most profitable markets and the “dump” of unprofitable ones (Guy, Graham and Marvin 1997). The selectivity of large-scale centralized infrastructures is clear enough in Hanoi and Cochabamba, where the extension of water networks is embedded in the process of metropolisation that, rather than guaranteeing spatial and social cohesion, produces large-scale fragmentation while increasing marginalization of the urban poor. In Hanoi, the functional and rational by-pass strategy implemented by the urban planning authorities, the so called “land-for-infrastructure” mechanism, contributes to extend the boundaries of centralised networks, financed by private investors in the real-estate sector. Networks thus extend to the peri-urban interface by initially including the new real estate developments (NUAs) and only later, when it becomes economically viable, the traditional villages found in the interstices between these urban islands are connected in turn.

The construction of these extensive real-estate islands with autonomous infrastructures increase the vulnerability of the neighbouring villages by undermining their socio-ecological balance. Indeed, they contribute to the city subsidence and, as they limit the space for water replaced by concrete, they increase flooding episodes in the city due to uncontrolled flows of wastewater that compromise both underground and surface water resources from which communities draw drinking water and feed the irrigation networks (Rosati et al. forthcoming, Schramm 2016, Fanchette 2014).

As centralised networks are extended, community organisations managing water and sanitation infrastructure in villages are gradually loosening their role as service providers. This transition towards centralisation is facilitated by ministerial regulations that decree the dismantling of the decentralized water systems that produce and distribute water to the villages. If on the one hand it sours an urban fragmentation due to these new settlements that do not dialogue, in terms of scale and typologies with the existing urban fabric, on the other hand by extending the networks it claims to have a unifying spatial effect by introducing a single tariff and making everyone, regardless of the territories in which they live, passive customers of a service.

However, as we have seen in the previous two sections (complementarity and concurrence; shifting boundaries) the unfinished nature of infrastructure networks is found in the parcel-level branches where smaller heterogeneous complementary systems or decentralised hou-

sehold-managed technologies are deployed. Co-production practices found in the lower-level structures of centralised networks challenges their apparent uniformity: indeed when observed at a micro, dwelling scale, they reveal themselves incomplete, technically limited and in-the-making.

One of the weaknesses of the splintering urbanism thesis, probably due to the fact that the object of observation is mainly large networks in northern countries, is related to the fact that it does not consider unfinished networks (Jaglin 2004). Fragmentation may well be temporary from this perspective. Coutard (2002) 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. I have tried to highlight in the previous paragraphs the evolutionary nature of infrastructure networks and the role of co-production in stimulating and supporting urban and infrastructural transformation processes at different scales by increasing differentiation. Arguably, the vision of Graham and Marvin (2001) is centred on the fragmentation related to centralised 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, as it has also been observed in the decentralized systems largely found in Cochabamba, as also pointed out by Cabrera (2016) and Cabrera and Teller (2021). The small-scale water networks produced by the Bolivian OLPEs play an ambivalent role with respect to the issue of spatial justice and equity, with the exclusionary processes being comparable to centralised networks.

First, even if the communities strengthen their own internal socio-spatial cohesion, solidarity with the rest of the city and the surrounding neighbourhoods are limited to situations of need. As much as these small organisations have developed sophisticated management mechanisms and have proven over time to be able to adapt to changes in their environment, including coping with reductions in their own resources, each community shows little or no interest in the problems of access to the resource in other neighbourhoods. This lack of solidarity is not only manifest on a social and political level (each district is autonomous in terms of managing resources for its own urban and infrastructural development) but above all on an ecological level. Indeed, their micro-networks that mainly pump water in an uncontrolled way are

compromising the recharge capacity of the aquifer and risk in a few years to lead to the depletion of underground resources, as is already verified in several neighbourhoods analysed where water wells have turned dry.

Secondly, like centralised infrastructures, decentralised ones also extend in a selective manner. In Villa Moscu (C1) and Serena Calicanto (C3) the micro-networks are incrementally extended in line with expansion of the built environment in order to increase affiliations (and so profits) up to a point frozen because externalities occur (for example when resources become scarce). Selectivity then emerges.

Finally, the observation of co-production practices in both centralised and decentralised networks revealed several phenomena of "micro-fragmentations" within a given area (Navez-Bouchanine 2002; Moretto et al. 2018). In all cases observed in Cochabamba community-based practices are unable (or unwilling) to connect the entire community of users demanding access to water services. Similarly, in Hanoi, the gaps found in the services delivered through centralised networks require the implementation of co-production practices at the household level, which do not favour a fair distribution of resources. As the case of the Soviet blocks in Nguyen Cong Tru shows (H1), despite a regular, centrally controlled water flow in each block, households continuously need to address inequalities in the way they access water services. When the tenants of the lower floors store too much water (by buying tanks of greater capacity or providing their units with more than one tank), the tenants of the upper floors suffer from water shortages. Likely in Lang To (H3) peri-urban village it is accounted that only the 30% of the households collect rain water for drinking, as this technology requires a certain amount of space and financial resources to operate. Confronting with water contamination, those who don't have the possibility of storing rainwater, generally low-income residents and migrant workers, have to rely on the more expensive bottled water. Similarly, in Cochabamba's decentralised networks, resources are not equally distributed. The need for storing water is confronted with the different financial possibilities of the households. The greater the spending capacity, the greater the ability of households to rely on multiple resource systems and to be equipped with technological infrastructures that allow water to flow directly into their dwelling units. In contrast, poorer households generally store water in barrels outside the home and transport it to the kitchen and bathroom via jerry cans. Very often these low-income households do not have the financial means to equip their houses with toilets and open de-

fecation is still a widespread practice, especially in squatter settlements in the South of the city.

To conclude, the observation of the case studies reveals phenomena of socio-spatial fragmentation related to co-production practices at different scales. Whether these are related to the community-based water management practices enacted to respond to the lack of centralised services in Cochabamba peri-urban areas, or to the stop-gap solutions needed to compensate for the deficits of the centralised system in Hanoi, it can be said that co-production, as a practice that nourishes technical differentiation and incremental development, contributes to the city's evolution as a complex and fragmented landscape of unconnected networks (Pastore 2015, Monstadt and Schramm 2017, Cabrera 2016).

7.4 2 CONTROL OVER TECHNOLOGY

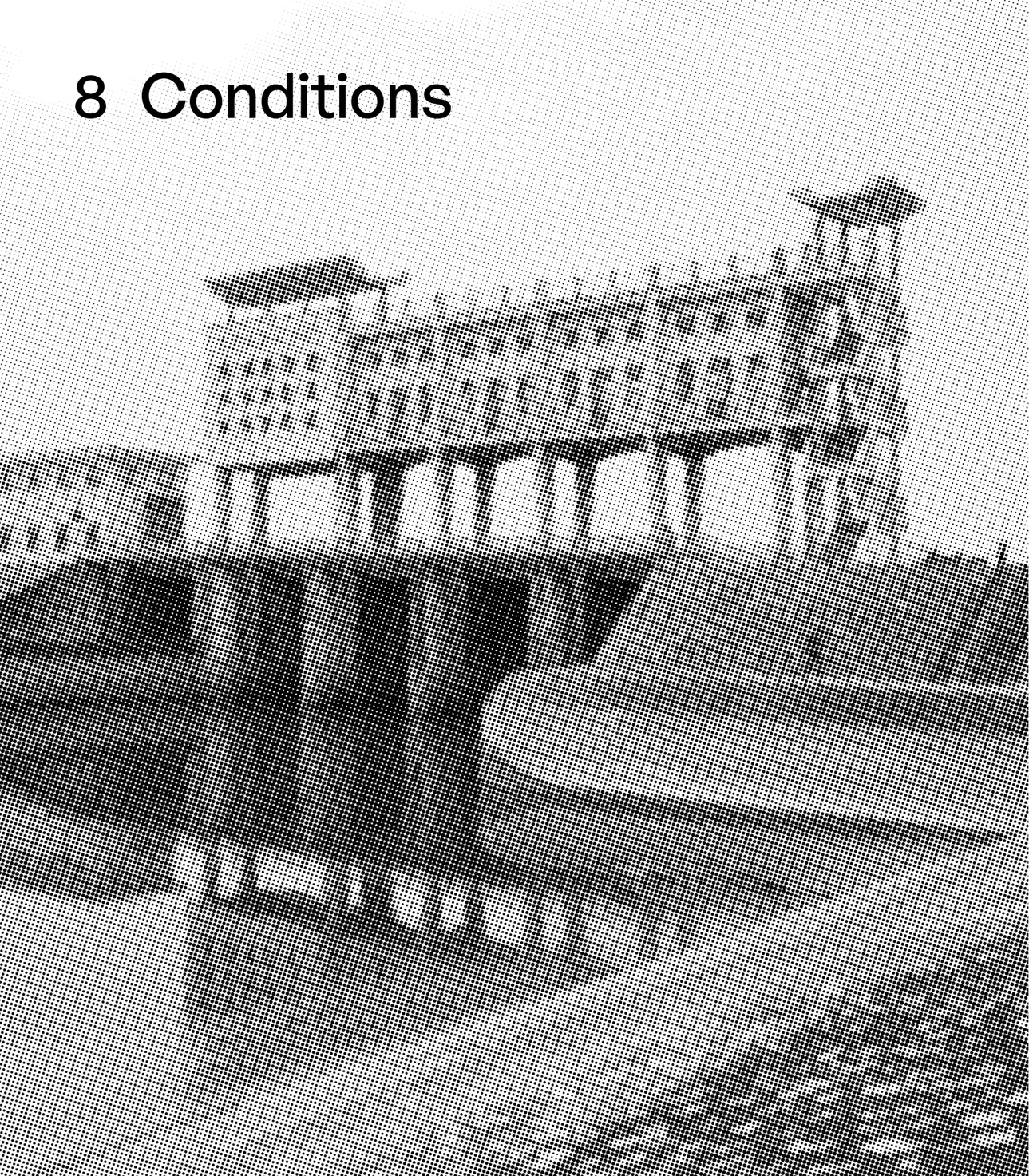
This dynamic of fragmentation raises an equally central question, that of power. Fragmentation may appear an unintended effect of co-production practices linked to the unfolding of neo-liberal economic forces that allow the use of certain technologies on the basis of households' economic possibilities. It may also often emerge as a planned consequence of the action and management of the organisations involved in co-production, in other words a matter of power and control exercised over infrastructures. This is particularly clear in the Cochabamba cases, while more subtle in Hanoi.

In her analysis of Villa Israel neighborhood in the South of Cochabamba, Wutich (2009) draws three main conclusions on community organisations deliverying water services in the Bolivian city. First, she finds that community organizations in charge of basic services, operate with adherence to the 8 principles identified by Ostrom (1990) in her analysis of the robustness of Common Pool Resources Institutions (CPRs). In addition, she asserts that these institutions, both from the perspective of social structures and operational norms, are sensitive to external events and are affected by variations in the quality and availability of water resources. Finally, the author shows how while some of these institutions have historically had an adaptive development with respect to contingencies, managing to ensure their survival over time, others are more vulnerable, risking succumbing to such transformations.

Starting with Trawich's (2002) studies of Andean irrigation systems in the Peruvian communities of Huyacotas, Wutich applies certain principles (autonomy, uniformity, proportionality, contiguity, transparency and regularity) to the analysis of community water institutions in Cochabamba and discusses their adherence. She then considers that these principles developed by pre-inca societies that managed rural Andean territories and related water resources have been transposed in urban contexts. She also states that most of these principles are verified, thus contributing to sustainable resource management. In particular, the author argues that in the presence of scarce resources, the community organizations ensure that scarcity, i.e., the reduction of resources, is absorbed equally by all resource users. The research I conducted in the city of Cochabamba, somehow contradicts with what the author observed. In the three case studies that I analysed more in depth, although this has also been observed in other neighborhoods, environmental variations, especially related to the decrease in water resources, further exacerbate dynamics of socio-spatial fragmentation. Once mature networks confront with water scarcity, the community- based organizations managing them seek to preserve at all costs the control over their boundaries, as well as over the resource systems.

Once adaptation and reconfiguration activities are needed to confront with environmental changes, the role of the plumber in charge of the drinking water system is central because, from the moment he or she is entrusted with power and control over the valves, he or she establishes the ways in which the organizations' internal operating rules must adapt to environmental variations. In accordance with Wutich's (2009) observation, the plomero (plumber) monitors water availability and adjusts its allocation to all network users if it becomes scarce. In this way the community organisation managing the micro-grid ensures that a proper balance is maintained between the exploitation of the resource and local conditions. However, if on the one hand these strategies are designed to ensure the maintenance of a certain balance and equity among the different service users, on the other hand it is often arguable that this balance is respected in practice.

8 Conditions



This session is structured around four themes, possible types of problems for which the usefulness of incrementalism and mutual adjustment, as techniques for dealing with complexity, must be weighed against the usefulness of more synoptic and centrally coordinated strategies. These conditions have been identified as those factors which impact the incremental evolution of WSS co-production practices The identification of these categories was based on deductive analyses found in the scientific literature, i.e. implicit assumptions that several authors have considered in order to assess the usefulness of coordinative mutual adjustment mechanisms and on the empirical work contained in the previous sections, especially chapters 6 and 7.

8.1 Balance between input and output resources

Literature focused on urbanization processes in the Global South highlight the interdependence between resources availability and upgrade of the built environment. The transformative and incremental processes shaping Global South cities, both in terms of housing production and infrastructure development, require, but are not limited to, a certain amount of “equipment” to take place. How this translates on the ground is the subject of analysis by various authors, focusing on the urban development in the informal city. The incremental production of the built environment tends to start with land division and dwelling construction, while services and infrastructures come later, generally depending on regularization of land tenure (De Soto 2000). In other words, higher-level structures emerge only gradually, fuelled by successful lower-level development (Habraken 1997). Indeed, in most of the contexts observed the construction of physical networks (i.e. water and sanitation infrastructures, road systems) generally occur at a later stage.

Similarly, in rapidly growing cities of the Global South, for a decade or so, all resources that dwellers have on disposal go into completing the dwelling. Makeshift powers and other infrastructures are eventually formalized under political pressure. The sites-and-services schemes applied in a number of countries across the Global South to guarantee

affordable housing provision, were grounded on the recognition of the importance of ensuring secure and legal tenure. Available resources in the process of incremental development are also related to the financial capacities of urban dwellers. Dwellers without access to affordable credits from formal financial institutions generally seek alternative financing strategies that enable them to incrementally expand their houses or water infrastructures depending on what they can afford (Hamdi 2004). The city appears as a growth machine mediated by micro-capital and changes to housing units often reflect the need of integrating income-generating activities. The temporary occupation of the streets and alleys for informal businesses in Hanoi or the conversion of the ground floors into “tiendas”, small supermarkets, in Cochabamba are performed to increase financial resources that further sustain co-production activities. The search for new economic opportunities throughout processes of reconfiguration of the built environment and the dwelling space allows citizens to improve, along with their dwelling and living condition, access to water and sanitation services (i.e. buying filters or investing in a more advance technology).

Co-production of water and sanitation services is based on a close relationship of citizens with resources and it 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. In peri-urban Cochabamba disconnected from the centralised networks, citizens are generally engaged collectively in the earlier phases of the water service cycle (production and treatment, distribution). They contribute a multitude of resources (labor, material and funding) for the construction and maintenance of the hydraulic systems. In Hanoi’ urban areas connected to the centralized networks, the gap left by public utilities in terms of pressure and quality of water supply is encouraging dwellers, mainly at the household level, to install and manage a series of technical devices for storing water and treating it before drinking. In the Vietnamese city, citizens also co-produce in the last phases of the water cycle (post-treatment and delivery), at either the plot, the building or the alley scale. This intense user–resource relationship on which co-production is grounded, is usually related to a lack of access to the main service and/or to remote water resources.

Furthermore, a careful analysis of the case studies shows that co-production of water services tends to take hold following the production and consolidation of the urban fabric, which in turn requires mobilization of a certain equipment of resources.

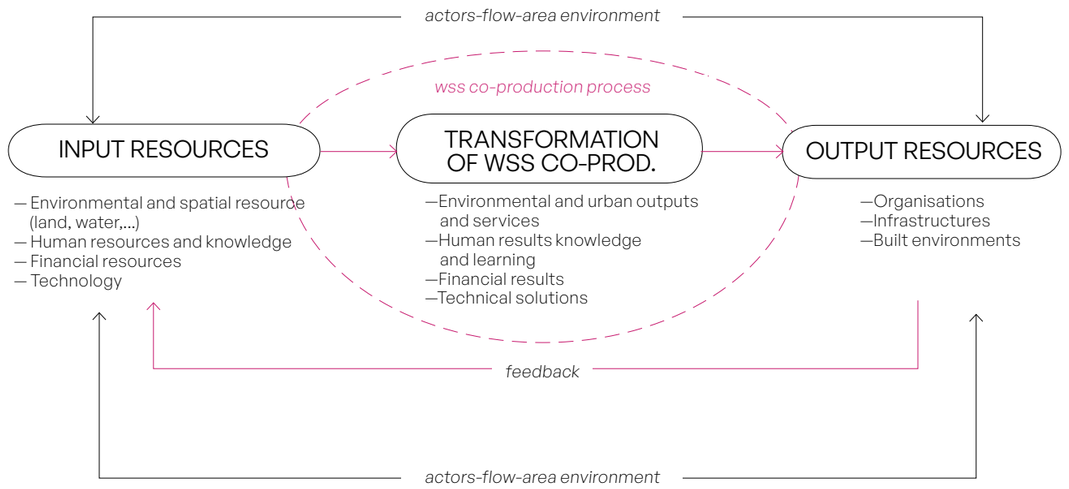


Figure 180.
Input-output resources in wss co-production

A number of scholars in the field of organization and policy theory argue that incrementalism, as a method of policy-making, is only appropriate in a narrow range of decision-making situations where the environment is stable, no imminent crisis threatens the survival of the organization and, finally, when available resources are not desperately scarce (Lustick 1980, Woodhouse 1993). Lustick (1980) asserts that if an organization has abundant resources at its disposal, it can afford to use them in a disconnected way in order to learn from the mistakes made. In the opposite situation, it will be unlikely to invest in learning processes that allow marginal improvements in policies. As resources dwindle, the likelihood increases that many partial successes can lead to a total failure. In this case, the author states that organization will tend towards a rational choice model based on a centralization of decisions in order to maximize the efficacy of political decisions. The scarcity of resources appears in this view as condition that reduces the comparative advantage of trial-and-error experimentation with respect to the separation between context analysis and practical actions involved in the implementation of rational plans.

In Cochabamba, the organizations in charge of drinking water pro-

duction develop in parallel with urbanization processes, by extending their organizational boundaries over time. Including new users in the water networks is economically viable as it allows them to make profits through the payment of membership fees and drinking water tariffs which exceed the investments done for building and maintaining the infrastructure system. This model of co-production thus generates new resources, which are often reinvested in neighborhoods, either to improve public space and facilities or to promote solidarity actions. However, this way of proceeding incrementally is somewhat altered as pressures on water resources increase. At a certain moment water starts to diminish, the organizations involved in co-production may opt for more radical choices in service delivery in order to ensure their survival over time.

On the one hand, co-production depends on availability of resources but at the same time produces, mobilizes new resources in service delivery. For example, in case of scarce resources or relevant efforts needed to manage them exceeding the possibilities of each single household, collective action allows service delivery. In some situations, these resources are contributed by the inhabitants and co-funded by the authorities. The Labour Fund for Public Interest is an example of co-funding scheme operating at the Commune level in Hanoi rural villages. Built upon annual contributions of resident's, this fund is mobilized to conduct maintenance and repair works, like for the road, sewerage or drainage infrastructures in traditional villages to which residents have to yearly contribute with 10 days of public works. A similar pattern can be found in Cochabamba, in the relationship between the municipal government and OTBs, which annually, through the POA, receive resources in terms of material and machinery to carry out work, requiring residents to work long hours to construction or repair activities in public space and shared infrastructures.

I would like that these forms of co-funding between citizens and authorities for the provision of water services, followed in both countries a process of political and economic transition toward market economies that favoured at the same time the emergence of gradual (Vietnam) and more rapid (Bolivia) processes of institutionalization. Thus, practices of self-governance and collective actions that had enabled the construction of the first networks and community services without public support, began to benefit from public funding.

There is a contradiction in these co-production practices, which on the one hand seem to arise spontaneously and incrementally where

there is a scarcity of resources or where these are difficult to access except through forms of collaboration (see the wells in Cochabamba or the irrigation networks in Hanoi). On the other hand, at some point the diminishing or deteriorating resources make it necessary to rationalize them, adopting more radical changes, which may help reducing uncertainty. For example, scarcity or water pollution sometimes encourages the mobilisation of alternative resources that are normally wasted (i.e. rainwater). In Hanoi and Cochabamba rural villages, dwellers have traditionally relied on rainwater, given the lack of piped water schemes and the high level of rainfall during the monsoon period. As a trend, the possibility of using multiple resources allows households a certain flexibility in diversifying sources according to uses, as well as the economic advantage of cutting expenditures. However, this close relation with the resource does not prevent resource waste or guarantee conservation. On the contrary, what I have been able to observe in all the 30 case studies addressed in this research is that co-production, in the same way as self-management and private management, totally fail to take care of a fundamental part of the water cycle, i.e. the treatment before discharging the resources back into the environment. This perverse mechanism that is indeed transversal to all forms and modes of service delivery in these two cities requires urgent attention since the quality of the resources that are taken out of the environment and thus the need to resort to compensatory adaptive strategies (frilage systems, use of alternative resources such as rainwater, separation in agriculture) depends on how they are disposed after use.

8.2 Evaluation and feed-back mechanisms

In public administration literature, the resources that organizations mobilize are also intended as knowledge. The goal of organizations is the processing of information and the removal of equivocation (Scott 1985).

Weick (1969) points out that the fundamental raw materials on which an organization operates are information inputs that tend to be equivocal, uncertain and ambiguous and that the act of 'organizing' serves to reduce uncertainty, i.e. to establish such a level of certainty that the organization can operate. Drawing on Campbell's (1969) environmentalist approach, Weick (1969) argues that organizational behaviour occurs in three stages: enactment, selection and retention. Enactment introduces into the system the variety of information that is processed according to the practices and norms adopted by organizations (Scott 1985). The greater the knowledge of the input, the greater the rules activated to react to it. The application of rules through selection reduces the equivocalness of the information and in the final stage of retention, organizations define what information should be retained for the future (Weick 1969).

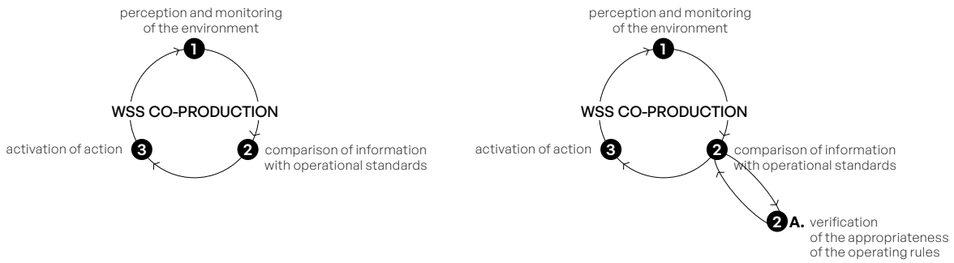


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Figure 181.
Single and double-loop learning in co-production

what information should be retained for the future (Weick 1969).

Co-production practices rely on the constant interaction that actors establish with resources, be they environmental, social or knowledge. Input resources feed co-production activities and at the same time, co-production outputs impact on available resources. For example, community-based drinking water systems that use subsurface resources, through operational rules governing their use and distribution, impact the long-term sustainability of their resources.

This circular interaction influences the evolution of co-production over time and feeds its learning capacities. The trial-error learning process and the successive limited comparison method characterizing the incremental way through which co-production develops is based on multiple feedbacks, generated to continuously assess co-production inputs and outputs and to adapt in light of changing environmental conditions and availability of resources. Organizations involved in co-production may develop a series of adaptation strategies that span from technical upgrade (i.e when the water decrease, drilling a deeper well or changing the pump is a viable option), multiplication and diversification of resources (i.e purchasing bottled water or rainwater harvesting), to the re-design of operating rules governing resource distribution (i.e. rationing water, increasing the water tariff or affiliation cost). However, when environmental changes cannot be confronted with these incremental strategies, co-production organizations may opt for more radical choices through which they may reframe their boundaries, i.e. establishing networks and agreements with other communities to share resources, or switch to other types of services (i.e. private vendors, centralized networked services). This feedback loop helps organizations or individuals engaged in co-production to gradually improve policy and actions by acquiring, at each step, further knowledge and information (Lindblom 1979). Moreover, it allows co-production organizations to continue to exist in a new and different future. In this sense, as Weick implies, in Scott (1959) "organizations continue to exist only if they maintain a balance between flexibility and stability".

Gifford (1983) suggests that incrementalism, or the “muddling through” strategy, works in situations where an organization can obtain sufficient information needed to decide on future steps or learn about past conditions (A. Pal 2017, Jones and Baumgartner 2005). Again, the observation of reality reveals a tension with respect to theory.

On the one hand, the modus operandi of co-production organi-

zations is generally grounded in time-established cultural systems and practices of interaction of communities with the natural world. As noted, the communal drinking water management systems in Cochabamba and Hanoi are rooted in millennia-old knowledge deposited in the communal works of irrigation canal management in the Andean mountainous areas and the Red River Delta. Adopting a historical perspective would reveal the ways in which communities, initially organized into clan systems, developed cooperation and forms of reciprocity in land management to cope with the uncertainties of a hostile natural environment. This deep knowledge of water resource management gained over time to manage surviving with uncertainties arising from variations in the natural environment has allowed community organizations to adapt over time, through a process of continuous learning. Legacies of this adaptive capacity can still be found in certain urban environments even if urbanization dynamics deeply altered the original equilibrium between human activities and natural resources.

Moreover, as scholars point out, prior adoption of policies and actions by neighboring organizations is more likely to increase knowledge and influence incremental adjustments than comprehensive change. Because of bounded rationality and lack of perfect information, organizations are often uncertain about the consequences of adopting a specific policy. Examining the effects of a policy or action adopted by a neighboring organization is a way to make means-end connections clearer and to reduce uncertainty about the effects of adopting unknown action (Walker 1969, Miller 2006). This is also shown by Ostrom (1999) analysis on CPR institutions. In the case of Cochabamba water supply management, institutions sharing similar problems in the Southern areas of the city started first independently to adjust their moves to the ones of the neighbours and ultimately coordinated among them to exchange information and reach common agreements. The creation of arenas for joint discussions triggered a certain level of cooperation among the different organizations that finally reached agreements to form a broader inter-organization (Comite de Agua de la Zona Sur) which helped to apply for aid funding.

However, the case studies show that the incremental way in which co-production practices operate does not always occur on the basis of consistent information on which organizations orient their choices. First because the multiple tests and feedbacks needed to continuously assess co-production outcomes, are generally not afforded by organizations (i.e. addressing the impact of water drilling on the whole aquifer of Cochabamba requires coordination, knowledge and investments that exceed the capacity of each single autonomous organization). Second because of the concept of bounded rationality (Simon 1972). As Weick (1969) points out, this limited fashion of proceeding implies that when problems occur, organizations will act on the basis of sufficient knowledge rather than complete knowledge, often by adopting simple rules and, if possible, using shortcuts. Indeed, co-production organizations generally search for solutions in the immediate proximity of their problems (i.e. when groundwater level decreases, they drill a deeper well; or when water for irrigation is scarce, the heavily polluted wastewater is diverted into agriculture fields).

The case studies highlighted the adaptive component of co-production practices, especially with regard to local territorial transformations. The trial-error way of proceeding help services users and providers involved in co-production to gradually improve policies and actions by acquiring, at each step, further knowledge and information (Lindblom 1979). Lindblom legacy has potentially contributed to the “evidence-based policy making” approach. It commonly recognizes the relevancy of knowledge of what is successful, and works in the evaluation and the adjustment in the process of redesign of policies (Sanderson 2002).

In general, it should be noted here that feedback mechanisms are lacking in all observed practices, state, market and self-managed communities as the entire water-cycle is never considered.

8.3. Adaptation to crisis

"Even in the midst of radical uncertainty and in spite of the discontinuity that affects their normal course of life, they are able to design and experiment with new routines and forms of action."

Gian Francesco Lanzara, Shifting Practices, Reflections on Technology, Practice and Innovation. p.7

This is how Lanzara (2005) describes those people and organisations endowed with negative capability, that is, the capacity to dwell in uncertainty, being satisfied with a partial knowledge of reality and managing to find drives and resources to act in spite of a lack of direction and certainty. In crisis situations, he further writes, these organisations are better capable of designing and experimenting with new forms of action, in other words, of producing innovation. Where innovation is not necessarily understood as radical or revolutionary action, but as action that allows one to "trespass an accepted boundary" (p.7). In other words, it is not a matter of inventing new actions but of revisiting and repositioning customary routines in a different way.

A number of studies state that incrementalism, as a decision-making process undertaken by organisations before taking action is generally applicable in stable situations and is not proper in a crisis situation (Nice 1987). Accordingly, in very dramatic situations (i.e. wars, revolutions and environmental catastrophes) where the process of understanding is weak and knowledge is limited, organisations will tend to proceed non-incrementally as in situations where somehow policy problems are more familiar (Weiss and Woodhouse 1992). These discourses convey, to a certain extent, to Lustick's observation about the importance of having enough resources for the incremental process (1980). Indeed, the author states that instabilities well short of the crisis phase may fatally disrupt

the efficiency of the incremental way of proceeding.

However, some authors support the opposite theory. Hayes (1987) shows that even in dramatic and rapidly escalating situations, organizations often proceed incrementally. Lanzara (1983) describes the modalities through which in certain crisis situations, "ephemeral organization", endowed with negative capability are more capable of reacting efficiently than large, hierarchical organizations. This occurs because, as heterarchical systems namely grounded on autonomous small sub-systems, these organizations are more flexible and their way of progressing is incremental, based on a continuous and rapid feed-back process.

Many of the dwellers and communities involved in co-production are endowed with negative capacity and dwell uncertainty. In peri-urban Cochabamba, the lowering of the water table along with increasing urbanisation is jeopardizing the survival of community-based organizations relying on local underground resources. Similarly, in Hanoi's traditional peri-urban villages located downstream, the dramatic increase in wastewater flowing down from the fast- growing metropolis without adequate treatment is severely compromising their socio-ecological balance. However, so far these organisations managing water networks have demonstrated a great ability to respond to the uncertainties and challenges posed by constant changes and pressures in their environment, by reframing their institutional-operational arrangements as well as spatial-technical boundaries.

By adopting rapid feedback actions, they are navigating into instability revealing themselves "able to work through the discontinuity between the previous and the emerging arrangements" (Lanzara 2005, p.7). They are capable of mobilising new material, economic and labor resources to invest in technical improvements (i.e. pumping water at lower levels, upgrading technical devises and increasing storage capacity); of modifying their operational systems for capturing, distributing and treating resources, including rationing strategies; and to revise their internal norms. They are so accustomed to dwelling with uncertainty that in some cases, they rather plan strategies for dealing with it on a long term. For example, in Cochabamba several communities observed have deposited a fondo de emergencia (emergency fund) that is composed of a monthly share derived from the sale of water. This fund is expected to help them surviving in the future discontinuities, namely in the time between the emergence of the crisis and the implementation

of the appropriate responsive solutions, may it regard changes in technological or resource systems. In some cases of severe water crisis, these organisations succeed in establishing new bridges and linkages with other organisations, including bargaining with the municipal water company to purchase water from the centralised system.

When co-production practices arise in connection with large centralised networks, they generally help dwellers coping with uncertainty of unstable and unreliable supply. At the same time, when co-production goes in hand with rapid reconfigurations of the built environment, it may also contribute to enhance uncertainty and instability.

The increase in density, which is already at a very high level in the Vietnamese capital, means that both companies responsible for water and sanitation as well as dwellers, households, groups of residents or communities (in villages) have to constantly cope with technical breakdowns, clogging of sanitary systems and flooding events and to respond with maintenance, repair and technical reconfigurations. It is indeed very common, especially during night hours to see the urban landscape uncovered in its ditches with teams of workers removing tons of waste mixed with sludge that clogs the pipelines causing localised flooding. In the KTTs, it has been reported that when breakages affect those infrastructures owned by the state, maintenance is generally slower than when intervention is required on infrastructure managed by the individual dweller or resident groups.

I believe this has to do with the size, autonomy and closeness of the organisations and leaders in charge of co-producing services to the problems that affect the community, being themselves dwellers. In Cochabamba and Hanoi the legitimacy of the water operators and resident groups comes from the affiliation of the users to the service who contribute to the maintenance of the network through the fees collected by these organizations. In spite of the differences in the two countries' political systems, both organizations are institutionalized but still operate with a certain autonomy from the bureaucratic apparatus. However, in Cochabamba these organisations seem to be more unstable: in fact, having a more preponderant role in the provision of water services and not being directly included in the state apparatus, their survival depends on the quality of the service they provide, and the leadership can be challenged in the assemblies.

In Hanoi, on the other hand, the resident groups are part of the state apparatus; their survival does not depend on the quality of the

service they provide but on state legitimisation, Their leaders are voted although they tend to be chosen by the ward authorities (Koh 2004) and furthermore their primary role is that of mediating with ward authorities. The management of public space and sanitation networks is a secondary responsibility which do not involve massive mobilization of economic resources when compared to the OLPEs.

In addition, when analysing the ability of co-production to act in uncertainty, the substantial difference between water and sanitary services should be emphasised. A situation of crisis in the supply of drinking water, essential to life, leads to more immediate action, compared to a crisis in the management of sanitary networks.

The situations addressed in the two cities seem agree with Lindblom(1959) and Lanzara (1987, 2005), who, drawing respectively on neoclassical market theories and loosely coupled systems applied to organisations, argue that coordination under conditions of uncertainty, could best be achieved at the epiphenomenal level or as a by-product of autonomous efforts by various actors to achieve their goals through mutual adjustments, rather than through sponsored attempts at central level to achieve coordination through rational comprehensive approaches.

However, in spite of divergences in the two contexts, hardly any radical action is taken until the organizations themselves are at risk. And this seems to confirm their negative capacity, i.e. their ability to remain in perpetual crisis. The hope of the leaders of these organization is to continue to survive until new opportunities arise to solve imminent problems, or, rephrasing Wildavsky (1987), new problems arise. Indeed, most of the corrective actions are stop-gap and temporary solutions, often retroactive. When crisis occur, co-production practices often step back on solutions already experienced, on which the organizations have gained a prior knowledge. The redeployment is an example of a retroactive process which allow organisations to adapt to crisis by mobilizing previous service supply systems i.e. purchasing water individually from private vendors or rainwater harvesting, as before the water network was installed. However, if convenient, on a longer term, they might agree to switch to a new supply form, i.e connecting to the centralized water network if convenient (or imposed). The analysis of the case studies seems to suggest that, in spite of rapid resources decreasing and imminent choc, co-production is more oriented to progress incrementally, waiting for the choc to happen and re-organize

at that stage. At the same time, the perception of the imminent loss of the resource available to the micro-networks of Cochabamba pushes the organizations to suspend their incremental approach, especially with regard to the extension of their organizational boundaries and infrastructural networks. The survival of the organizations urges them to reorganize their operating rules and often, lead to non-incremental ways of proceeding. This incremental way of operating is well known to the municipal and/or state authorities in charge of centralized services in both Cochabamba and Hanoi who take advantage of reaching a situation of severe crisis that co-production organization won't be able to address, to extend their networks into those areas where services are produced by communities.

In other words, the instability that characterises these organisations will rather be exploited by institutions taking advantage of the coming crisis to extend centralised networks than studied and learned because of the adaptive capacities it shows.

8.4 Distribution of power and control

"Power, by definition, is only a means; or to put it better, to possess a power is simply to possess means of action which exceed the very limited force that a single individual has at his disposal. But power-seeking,

owing to its essential incapacity to seize hold of its object, rules out all consideration of an end, and finally comes, through an inevitable reversal, to take the place of all ends. It is this reversal of the relationship between means and end, it is this fundamental folly that accounts for all that is senseless and bloody right through history."

Simone Weil, Oppression and Liberty,

The transformation of the territory is made explicit in the continuous manifestation of forces that claim control over the space. In this sense, in the case studies analysed, the territory can be interpreted through successive acts of "occupation" that denounce the presence of agents (actors) claiming control over the relative space (Petti 2007). Reading co-production in an incremental perspective, therefore, implies reading the process through which a plurality of actors claims, negotiates or appropriates control of a space through the exercise of power over technical infrastructures.

According to a number of authors, incrementalism as a decision strategy and mutual adaptation is more successful in situations where power and control are equally distributed to a number of agents across an organization's environment. If the decision-making process of an organization is influenced by a plurality of actors with greater power than others, the series of incremental decisions resulting from a mutual adaptation will be distorted in favor of the preferences of the actors with greater power. The mechanism of bargaining that allows to apply interactive learning by trial and error is lost since the weaker components will be

excluded and therefore will not act as “watchdogs” of decision-making processes (Lustik 1980; Habraken 1998).

The figure of the intermediary, i.e. the one who regulate and control the distribution of an increasingly valuable resource, is central in this struggle, since through its operation on water infrastructure, he exercised control over the territory.

We have seen how in the cases of co-production observed in the city of Cochabamba, the intermediaries, represented by the local water organizations and their managers and employees, play an equally key role, and how this role of control over infrastructure networks is likely to be transformed into a tool of power that is not only exercised over the territory of competence (that of the water networks) but tends to extend over the entire territory into areas of competence that should be excluded. The case of Serena Calicanto is emblematic in this sense: we have seen how the current leadership of OTB holds the monopoly of the resource and uses this monopoly to exclude a portion of the neighborhood (the most recent sector 15 de Mayo) not only from access to basic services, but also from access to voting and therefore from the possibility of changing the internal rules and mechanisms of operation of the same organization. This is possible thanks to an internally established rule, which has no basis in municipal or national legislation, that only gives voting rights to those who are affiliated the drinking water network. However, this oligarchic management of the network and of the territory is threatened by the increasing protests and the recent appointment, by those who are excluded from the current system and by those who are included but unhappy with the management, of a new assembly that seeks to extend its control over the neighborhood and to supplant the current leadership. Serena Calicanto is in this sense a neighborhood in which conflicts and struggles are articulated for the exercise of power over the territory through the control over their water networks.

A number of case studies addressed in the research reveal this tension related to the political dimension of co-production: conflicts, power asymmetries and distrust might arise if in the decision-making processes pursued by organizations some actors with more power act to the exclusion of some members of the community. Lack of transparency, resistances to call assemblies for new elections of leaders and personal returns, corruption result in a number of cases in a reversal of the role of these organizations: from community control and management of land and resources (CPRs), to “oligarchies” that seek to maintain at all costs

the monopoly over resources and territorial control.

The analysis I have carried out in the previous chapter has been oriented to highlight the interdependent relationships that these organizations nurture between network development and territorial reconfiguration. Social protection, community service delivery, electoral lobbying, mortuary dues, issuing certificates of usucapion, and facilitating unauthorized land sales are part of a repertoire of political activities, which are found extensively in the case studies observed. The effects of this clustering of roles are mixed.

On the one hand, these corollary services provide local communities with margins for urban and economic development, opportunities for social cohesion and solidarity.

On the other hand, they bring out some shadows. We have seen how the success of these organizations lies in their complicit action in the regimes of water and land in the current neoliberal political-economic moment. The study conducted by Altman and Lalander (2003) shows how the establishment in the country of the new institutional framework (Popular Participation Law) has institutionalised clientelistic forms in the public procurement system, neutralising the work of the 'watchdogs', i.e. the supervisory committees that are supposed to report any corrupt forms in the system of allocating public funds to OTBs at municipal level. The neutralisation of the watchdogs, according to the authors, has taken place through the mechanism of 'freezing funds' that make complaints and subsequent actions complicated, if not impossible. The authors speak of this law as a mechanism that allowed corruption to be democratised.

The Bolivian case studies have brought out some of the shadows of these co-production practices, in which patronage generate conflict, especially related to the pressures of urbanization on land and resources that fuel social and spatial fragmentation and the systematic exclusion of the poorer inhabitants not only from access to networks, but from political decisions.

9 Conclusions

9.1 Co-production towards the common good

> "The 2000 Water War has been an exceptional case, a kind of message and reference at a global level. People have transformed the economy and the form of water management from the bottom, through these community systems which, with all their difficulties, precariousness and corruption, are not merely technical spaces of water management, but are above all spaces for the organization of life. Because through these systems, communities do not just establish tariffs or ways of expanding pipelines, but forms of social coexistence and collective horizons of life. The issue is that these community systems, the backbone of the Water War, are spaces of life, spaces of governance where the people decide themselves on the management of common goods."
>
> Conversation with Oscar Olivera, December 2020

A large body of scholarly literature oriented towards the analysis of co-production emphasizes how this specific model of service production and delivery has the potential to give space for different roles and responsibilities to the citizenry, fostering the emergence of democratic management models around common resources, such as water.

Community participation, as a policy instrument for the improvement of the effectiveness of public action in situations of particular complexity, has entered urban planning discourses, also informing approaches for the delivery of urban services (housing, water and sanitation, health) in various contexts across the Global North and South. As a process of social, technical and spatial interaction, co-production alludes to an action which allows the policy, plan or the service delivery model to go beyond the concept of the public (Crosta 1998). In other words, the concept of public good, as defined a priori by the state, can be replaced by that of "common good" as a social construct resulting from socio-spatial and socio-technical interactions within the co-production process.

Common good can be the outcome of co-production practices, where, consensus is not the precondition, but derives from a process of bargaining and negotiation between institutions and communities through the sharing and also the conflict, intentional or not, between expert and ordinary knowledge. In line with Nancy and Negri in Parmett (2012), I argue that this arena cannot be free of confrontations and disputes between those forces seeking to emphasise and sustain the radical monopoly[22] exercised by industrial production and the current market forces and those that, on the other hand, tend to oppose alternative visions based on decommodification and re-appropriation from the grassroots.

What emerges from the words of Oscar Olivera at the beginning of this chapter, one of the main leaders of the protesters against the privatization of water in Bolivia, which led to an event known as the Cochabamba Water War in the year 2000, is that community management of water services has a dual value, technical but, above all, social and political. On the one hand, it increases users' awareness of the functioning of the water service cycle and offers opportunities for continuous learning since users, in order to make their technical systems more efficient, tend to improve their management capacities over time. On the other hand, participation in service delivery redefines the role of citizens in the broader policy and decision-making system. Learning and empowerment are thus generally associated with the benefits of co-production.

In the case of Cochabamba, the small-scale water operators proved capable not only of building hundreds of micro-networks and technical systems, but also of developing decision-making models and management strategies to plan and take action at the community level, based on bonds of solidarity and the definition of shared horizons. The same situation, though more nuanced, is evident in Hanoi, where residents' organizations in charge of managing sanitation networks play an important role in the control and management of public spaces, mediation with the authorities, and social cohesion.

These community organisations, which in the past had the appearance of small family aggregations whose exchanges and forms of collaboration were characterised by reciprocity, have been progressively bureaucratised, made into something comprehensible, definable and recognisable within a clear hierarchical structure; and homogenised, i.e. standardised within a codified structure of homogeneous interests (Hamdi 2004). However much I have tried in research to uncover internal

22. By radical monopoly, Illich (1993) refers to the exclusive control, exercised by industrial production, over the satisfaction of needs, excluding the possibility for humans to resort to non-industrial means and activities. An example he gives to explain this phenomenon is that of the infrastructure and transport system, which de facto forces people to be connected to the network (in the first case) or to motorised traffic (in the second one).

fractures within communities to a certain extent I was forced to simplify and group together visions and interests that emerge as representative of the community in the description. Community always appears to be a central element that is often taken for granted as a necessary and ultimate asset for the production of common goods, but which deserves close attention. But who is the community? Who represents it in urban systems that are increasingly fragmented and within which inequalities are pervasive? The small urban communities observed in Cochabamba are far from being cohesive entities. Rather, they appear to be fractured and contested terrains in which struggles for power and control of resources, forms of oppression and everyday violence seem to be institutionalised in systems of self-government that sometimes reverse the means and ends of their way of operating and continue to reproduce forms of environmental depredation. Moreover, their management which does not involve the full water cycle is exacerbating existing ecological pressures. In spite of these limitations, one urges caution in drawing hasty conclusions and automatically de-legitimising these forms of decentralisation of social life: first, limitations and forms of oppression and segregation through networks is also widespread in areas connected to centralised systems; second in spite of their partial successes these organisations appear extremely adaptive to environmental changes.

While the thesis refrains from casting an evaluation on the sustainability of these practices, it seeks to explore the incremental nature of co-production, the adaptive capacity that distinguishes it from centralised models of management and that allows individuals and communities, despite increasing environmental pressures, political and economic transitions to survive in uncertainty and to creatively mobilise available resources to continuously improve their living conditions and ways of dwelling. Adopting an incremental approach to the analysis of co-production practices has not only allowed to navigate the multiple ordinary rationalities through which water and sanitation services are delivered in the South, but it has also raised some challenges that future research could address where one wants to question the role of service coproduction in fostering a transition to built environments and forms of organisation of urban life understood as commons.

9.1.1. CO-PRODUCTION AS A POLICY TOOL OR A POLITICAL ARENA?

" *against policy (a tiny manifesto):*
The notion of “policy” presumes a state or governing apparatus which imposes its will on others. “Policy” is the negation of politics; policy is by definition something concocted by some form of elite, which presumes it knows better than others how their affairs are to be conducted. By participating in policy debates the very best one can achieve is to limit the damage, since the very premise is inimical to the idea of people managing their own affairs."

David Graber, Fragment of an Anarchist Antropology, p.9

Today most governments both in the Global North and South endorse, to a certain extent co-production schemes. Even though they are not always referred to as co-production arrangements, they are increasingly integrated in the planning activity. While interaction and confrontation are considered key elements in democratising decision-making processes, co-production is often mobilised as an operational tool for developing a plan or the design of a policy in a more horizontal manner. The interactive and incremental perspectives help to focus on the mutual learning challenges undertaken in every action for the construction of a public decision, especially those which are co-produced. As mentioned by Crosta (1986, 1998) the central question of the planning process is not the resolution of the problem (problem solving), but its correct formulation (problem setting). Co-production is increasingly supported because it suggests a restoration of the relationship with an original dimension of participation in public policies: the orientation towards common goods (Crosta 1998, Ostrom 1999); the exploratory and hermeneutic vocation (Lanzara 1993); interactive knowledge (Lindblom 1990, Friedman 1987, Crosta 1998).

There is at stake a dialogic process that can be defined as a deliberative dispute. Herein lies the concept of learning which is central in co-production: not so much in incrementally increasing the number of information but in building new tools for grasping life complexity through the relationship with other stakeholders, with infrastructures and urban spaces. Co-production in a certain understanding, based on the relationship between knowledge and power, is based on the transformative theory of social learning. Path that Crosta (1986) undertakes starting from Lindblom and which summarizes in the process of actorship, becoming an actor, that is the interactive process that is building the actor and the action at the same time. Co-production, as a practice of proximity to the recipient, is based on all those "safe rituals of participation", "laboratories", “deliberative encounters” which become opportunities for transformative learning. There is therefore a reversal of the concept of service, which can be placed both in the literature on co-production and that of incremental planning. The distance between participation and public policies is bridged by specifying the service role of the former towards the latter. Through joint action, typical of the mechanisms of co-production, the separation between knowledge and public action dissolves. Already Lindblom (1990) had overturned this idea by formulating the concept of interactive knowledge that materializes during and not before the action. Crosta (1998) makes this procedural dimension of cognitive action explicit with the concept of joint action.

However, what occurs and is found in reality seems far from this ideal type. The application of the concept of co-production to the observation of a multiplicity of cases reveals a twofold trend. On the one hand, the dissolution of arenas of negotiation and participation in those community action contexts caused by a progressive dissolution of community ties attributable to a number of factors, including urbanisation

and population growth in neighbourhoods and the institutionalisation of community organisations that become closer to private service providers. On the other hand, pressures by existing power systems and market interests towards the centralisation of services is occurring in parallel with the multiplication of forms of co-production at the individual level which arise out of necessity and outside any arena of negotiation. Future research could address and depict this tendency in co-production: understanding whether it is getting closer to a policy instrument (even in the negative sense, i.e. within the gaps of policy systems) or to a real area of negotiation and decision-making that can through self-government regulate its own affairs autonomously.

Osborne and Brown (2011) address the transformative potential of co-production. The central issue of their reflection concerns the impact that co-production has on services and their transformation which involves a series of changes that may fall into incremental change and radical change. There are two issues: how radical is the impact of co-production on services? How much can its action lead to an "improvement and incremental change" of the process of service delivery or public policy or rather to a "transformational and step change"? Issue that had also been raised by Lindblom and others, stating that the spectrum of change in incremental practices may be more or less vast.

Public Administration and Management scholarship (starting from Ostrom's theory) considers co-production as a way to better deliver public services through maximised participation of local stakeholders, bearers of the service. According to Osborne et al. (2016) this understanding of co-production has failed to challenge the traditional orthodoxy of dominant discourses on service provision: co-production is generally "added" to the process of service planning to improve existing service delivery models, without rediscussing or redistributing control over the planning process, which remains essentially exercised by service providers or professionals. The attempt to enlarge this concept is pursued by scholarship of Service Management, which sees co-production as an "essential and inalienable" component of service delivery. All of these, just some of the benefits of co-production highlighted by literature, that co-production has effects on a long term. However, no definition questions the existing power structures? In this view, we might expect that immediate benefits in service efficiency might be followed in a more democratic and equal society.

9.1.2 TECHNOLOGY IN CO-PRODUCTION AS AN INTERMEDIATE AND CONVIVIAL TOOL?

" To the threat of a technocratic apocalypse, I oppose a convivial society."

Ivan Illich, La Convivialità (translated by the author)

The state of emergency, of 'exception' in which we live and which in these three years of epidemic has thickened its mesh through the instruments of digital dictatorship, or even transparency, marks a further step in that epochal shift from a biopolitics (understood in the Foucauldian sense) to a psychopolitics (Han 2014).

The increasing atomisation of neoliberal society is totally obscuring the question of the commons and the ongoing privatization of various sectors of the state, including services (water, energy and health). Citizens appear more and more anonymous, controlled and spiritually isolated while technology with its increasingly inhuman features seems to have no limits or control and progresses endlessly while environmental crisis and resource depletion advance (Schumacher 1973).

Technocracy seeks to make man ever more adaptable, to neutralise the discomforts of living the frenetic rhythms of a capitalist society (Gorz). And the paradox is that technology, which on the one hand fuels the crisis, at the same time offers palliative and remedial solutions in a cycle that apparently has neither beginning nor end.

The current planetary crisis is rooted in the failure of modern enterprise that progressively substituted the machine for man, in the belief that the tool could replace the slave. To industrial production, also technocratic and bureaucratic fascism, Illich (1993) contrasts a society that he defines as convivial, which is characterised by a simultaneously individual and communitarian dimension.

"I call convivial society a society in which the modern instrument can be used by the individual integrated with the community, and not reserved for a body of specialists who keep it under their control. Convivial

society in which the possibility prevails for each person to use the tool to realise their own intentions" (translated, p.13).

This model of society is based on new values, rather than technical but ethical ones. The convivial society in this sense gives man the possibility of exercising creative autonomous action with the help of tools that are less controllable by others, where tool means the set of rational means of human action, which include both the device and the codes that the operator uses in his relationship with the device. Several authors have observed how a number of services historically produced by communities (medicine, transport and education) are now subject to monopoly, i.e. only handled by specialists.

This is a form of abuse that makes people less and less involved in their own lives. A reversal of the means-end relationship occurs. "The means to the end pursued by the institution become less and less accessible to an autonomous person, or, more precisely, they become an integral part of a chain of mutually supportive links that must be accepted in its entirety" (p.44). By this Illich does not mean to say that powerful and manipulatable tools must necessarily be abandoned, but that the idea that these tools can be possessed must be abandoned. "The solution, however, is at hand: it lies not in a certain way of appropriating the instrument, but in discovering the character of certain instruments, namely that no one can ever possess them." (p.47). Illich's proposal is to overturn the sense and role of the institutional framework governing the application of technique and the results obtained by science. It will be 'the structure of the instrument' that will decide whether man will move towards a 'new, modern level of craftsmanship, or towards a world of universal functioning'.

Similar to this conception is Schumacher's (1973) definition of *intermediate technology or technology with a human face or self-help technology* that can solve problems and alleviate suffering and poverty but without oppressing man and destroying the environment.

The question here is whether co-production can in any way be assimilated to what it defines as a convivial tool and whether the technology it mobilises comes close to this idea of intermediate technology. In other words, whether this varied socio-technical form guarantees communities a certain margin of autonomy in the management of resources and services, or whether it does not nurture a centralisation of control and use of the technical tool that deprives communities of their own tools.

In Hanoi, the evolution of co-production practices sees the dismantling of the small community water systems still present in peri-urban and rural areas entrusting villages to the technical network and a uniform, extensive and hierarchical system. At the same time, however, it hands over responsibility for service quality to individuals and households. In other words, there is an increase in inequalities in the quality of services provided, since these depend on a whole series of compensatory devices and self-help technologies that in turn depend on the social, spatial and environmental context of reference. The 'limited' and 'incomplete' nature of centralised networks is in turn a limitation in my view for the conviviality of the technological tool employed by individual co-production, in terms of equity and socio-spatial justice.

Marked inequalities are also found in Cochabamba, where the infrastructural landscape is dictated by the coexistence of heterogeneous and independent socio-technical networks. In fact, the variability of the micro-networks managed by community organisations appears in terms of the types of infrastructure and technologies employed, the type and accessibility of the resource, the cost and quality of the service. Heterogeneity, or fragmentation, is not only found on a broad territorial scale, leading to the coexistence of more fortunate and less fortunate areas, such as the North Zone and the South Zone, but is internal to the mi-cro-networks themselves. Phenomena of exclusion occur in both cases and have precisely to do with dynamics of control over technological devices and resources. The self-technologies mobilised by co-production certainly have the characteristic of being adaptive, flexible and easily manipulated by users. These devices are cost-effective compared to the sophisticated, highly capital-intensive technologies mobilised by centralised networks. They are simple equipment, fitting smoothly in unsophisticated environments, suitable for cheap maintenance and repair, more adaptable to market fluctuations and environmental changes. However for these to truly be valued as part of a convivial vision of society, the gaze must be shifted from the purely technical question to the question of power and control over resources.

9.1.3 INSTITUTIONALIZED CO-PRODUCTION AS LEGITIMIZATION OF POWER ASYMMETRIES?

"Participation is thus reduced to speaking, and learning is reduced to knowing and the transformation of done-to into doers, spectators and victims into activists, fragmented group into renewed bodies, old resignation into new beginnings, are lost from our view."

John Forester, 1999, p. 115

A number of authors point out the risk that in co-production those acts of participation, called deliberative rituals by Forester (2009), become "obsolete routines" (Lanzara, 1993). In the *Deliberative Practicioner*, John Forester (1999) raises the problem of lack of attention to learning, which not all policies are capable of activating. This misunderstanding stems from a flattening of the concept of empowerment, which dominates the co-production discussion, to “being heard” and reducing learning to the simple inclusion of local knowledge alongside expert knowledge. It means that some actors with greater power will conduct opportunistic behaviours, in order to take advantage from the process and pursuit largely personal goals. The division between policy maker and policy taker, provider and user decays in co-production, and its dissolution materializes in the figure of *everyday maker* (Bang 2005, Crosta 2003). The everyday-maker solves the dichotomy between policy taker and policy maker and is opposed to the figure of the expert citizen, generally part of an elite (Bang 2005). Every-day makers, unlike expert citizens, are not an extended arm of the state, intervene more occasionally, pose questions in a concrete way and move following "small political tactics"

to obtain positive largely personal returns. Expert citizens, on the contrary, "exclude certain conventional democratic values and practices in favour of those of success and influence". This is an aspect of co-production that deserves careful studies, since it was already highlighted by a number of authors endorsing a critical perspective on co-production. Indeed, some empirical studies mainly in the Global South suggest that co-production can rather take the shape of forms of co-optation, as vehicles for the institutionalisation of inequalities and that be subjected to elite-captures (Cornwall 2004, Jaglin 2002). Therefore, both incremental and co-production discourse engage to the characteristics and motivations of the actors involved in co-production, suggesting that power dynamics within organizations might reinforce opportunistic behaviours and therefore make the “deliberative dispute” made of bargaining and negotiations, be distorted in favour of those with more power.

Is then co-production promoting spatial justice or is it allowing power asymmetries to be institutionalised?

In the literature, co-production is not only found to improve service delivery but also to impact on relationships between users (communities) and providers (governments). For the the citizens co-producers, it represents an opportunity to strengthen a series of relationships and to build resilience necessary for an invigorated ability to find answers to the community’ needs in the long term (Albrechts 2013). In this perspective, co-production allows the communities and territories they represent to become catalysts for change. Co-production would improve service effectiveness, namely guaranteeing greater accountability, higher productivity, reduced costs of services and threat to all forms of opportunistic behaviors and corruption (Ostrom 1996). Its success would encourage citizens to develop horizontal relationships ultimately building of social capital (Putnam 1993) and to empower communities (Ostrom 1996). Drawing on Lindblom’ incremental models, co-production would contribute to make politics a process of social interaction that would increase knowledge by integrating the “ordinary” and “expert” one (Mitlin 2008); fundamentally transform relations between users and providers and ultimately produce a more equitable service delivery. Theories of co-production and of incrementalism share the assumption that “small, incremental steps” if framed in participatory and interactive processes, can drive broader changes on a long term.

However, co-production is often narrated in the literature in a deterministic and prescriptive way: the integration of co-production sche-

mes in policy making improves the delivery of services (means-end approach) and impacts on society (long-termism).

This problem is central to co-production, especially in forms of institutionalised co-production of urban governance in the Global South. As the case studies have shown, the cases of co-productions are often the current photograph of an incremental process that over time has led to self-help practices, to be institutionalized and therefore regulated and absorbed by the bureaucratic apparatus. The problem of the "depoliticization of co-production" therefore arises against that of the “autonomy of civil society”, what Galuzska (2019) calls the contrast between institutionalization and flexibility.

The creation of ever more extensive and hierarchised systems and networks favours an exacerbation of inequalities between different territories and within the same territories. With the loosening of those processes of social cohesion and mutual support resulting from a shared management of resources and equally equal distribution of risk, differences have in fact worsened. The progressive extension of centralised networks means that the population has less and less control over the management processes of water, a common good. Co-production, appears to transfer costs and responsibilities to the citizen as an atom, a single individual, depriving the community of the shared instruments of resource management. In fact, the institutionalisation of co-production throws an increasingly scarce resource down to the private forces of the market. What is the benefit for the community? What benefit for the water resource?

Furthermore, a second question that emerges is linked to the relationship, often blurred between co-production mechanisms and the state. The absence of clear legal frameworks, or their incremental changes, often leaves co-production in the "whims" of the bureaucrats who can overturn co-production schemes once the government opts for broader political changes. In no watchdogs are found to supervise the decision-making processes and guarantee that the interests of the different parties are equally defended in the incremental bargaining process, the co-production model might not necessarily bring to the expected outcomes.

Co-production practices thus can bring mixed results. They may represent opportunities to truly democratize and re-politicize conventional service delivery, but they can also lead to a depoliticization of the service production and delivery process, fostering the emergence of

instrumental and patronage dynamics in the use of power that undermine their potential role as democratic alternatives to the private and the Leviathan.

9.1.4 WATER AS A PRACTICE

> "H_2O is a social creation of modern times, a resource that is scarce and that calls for technical management. It is an observed fluid that has lost the ability to mirror the water of dreams."
>
> Ivan Illich, H_2O. Waters of Forgetfulness, p. 76

The co-production of water and sanitation services is potentially a guarantor of the dual intrinsic value of the "fluid element" it manages. If, on the one hand, water is a common resource that, through the use of technical tools is domesticated and transformed into a service, it is, at the same time, a form and space of life, around which multiple grass-roots practices are articulated to allow this transformation.

The combination of the notions of resource and practice has already been theorized by Huron (2017) in reference to urban commons and by Ranzato and Moretto (2017) in relation to the role of the co-produced services of water, energy, and waste in informing a transition to sustainable urban commons. First, the consideration of water as a natural resource opens up possibilities for individual and/or collective management of a common pool of resources (Ostrom 1999). Second, water understood as a practice brings with it the potential to create new political imaginaries based on alternative governance arrangements in which citizens are directly included in decisions about urban transformations (Susser and

Tonnelat 2013, Becker et al. 2017).

With the term Savage Thought, the anthropologist Levi-Strauss referred to 'thought' before its formalisation as a rational category, based on a system of values and operational procedures regulated by sequential logic and the causal means-end relationship. Although they are nothing more than faint traces of pre-capitalist models, and in all the limitations I have not omitted to mention, the organisational forms examined, based on individual ingenuity and moral economies of exchange and reciprocity, show us the infinite possibilities of adaptability to one's environment. Through the recovery of the scraps between the scarce resources at one's disposal and their creative use, new possibilities are created not only for survival but can lead to constant improvement.

The theme of design and planning as a process of incremental learning and the way of proceeding by trial and error suggest a conception of the city as a repertoire of shapes, spaces and resources to which it is possible to relate assuming the attitude of the bricoleur. Koetter and Rowe (1981 p.156) argue that the idea of a total control, typical of the rational-comprehensive planning, "has broken against the complexity of the concrete phenomena of production, transformation and use of the territory". Co-production activities feed this complexity. Users interact with urban space and infrastructures with the attitude of the bricoleur, that is, "by working with what is available", or by the art of "muddling through", thus adopting a trial-error and inclusive approach made of stratifications, hybridizations and sometimes conflicts. Co-production is able to grasp and enhance the repertoire of scraps (resources) that are available, enhancing them for their unicity and developing their generative potential. As the bricoleur "[…] addresses himself to a collection of oddments left over from human endeavours" (Levi Strauss 1962, p.12), co-production proceeds with analogous jumps, rejecting a serial logic.

The rule of the game is to adapt to changing conditions of the "equipment" available, namely resources whether land, water, financial or social resources. It could therefore be said that co-production way of proceeding is incremental and retrospective: its design capacity derives from a renewed and creative use of available resources. This conception of the design discipline embraces a conception of the city as an experimental and open process, continuously rewoven by the interactions of subjects with a multitude of changing resources.

9.1.5 ADVANCING INCREMENTALISM IN THE PLANNING CULTURE

Although the thesis thoroughly illuminates the incremental mode of reconfiguration in water infrastructure and built environments further investigation could more systematically address the actor dimension of co-production. A deeper exploration into a strand of literature known as historical institutionalism could help highlighting modes of change in the institutional domain and in decision-making processes, integrating the "organization" dimension in the taxonomy of practices (Chapter 6). Indeed, historical institutionalism offers a lens to analyze incrementalism within organizations, framing these adaptations within a wider narrative of institutional development and persistence. It underscores the influence of historical legacies, institutional arrangements, and the distribution of power among actors on the pace and direction of change. Although this literature is marginal in this research work, in Chapter 7 and Chapter 8 It is emphasized how incremental changes, though potentially minor in the short term, have contributed to significant shifts in institutional structures and to the evolution practices over time, thus influencing the trajectory of organizational and societal evolution through the reconfiguration of wss coproduction arrangements.

Incrementalism in planning culture refers to an approach to planning and decision-making that emphasizes gradual, step-by-step development that is locally driven and performed in short-time frames, rather than comprehensive, large-scale plans executed in a single phase and from a top-down level. While comprehensive synoptic planning models generally operate within a 30-50 years' time-frame (long term planning), the incremental development processes analyzed in this research move within much tighter time frames (3-5 years). Yet significant changes and consistent reconfigurations are found, particularly in rapidly urbanizing areas, where incremental development allows for a more flexible, responsive, and learning-oriented approach to urban change, making it possible to navigate the complexities and uncertainties of fast-paced urban development effectively.

The research has highlighted some dominant characteristics of the incremental way of proceeding by the actors who coproduce the city, allowing for a reconceptualization of planning activity, which is proposed here through three images. Planning as Muddling Through refers to the decision-making proces-

ses and related actions performed by the various communities or individuals who coproduce. These socio-technical practices reveal how coproducers simplify choices by comparing a limited number of possibilities, finding ad hoc solutions to manage moments of crisis and disruption. Planning is intended in this sense as a continuous decision-making and action process, generated through material improvisation and mutual adjustment in response to contingent dynamics of disruption that coproduction feeds and at the same time addresses. Planning as Negative Capability, which Lanzara (1993) defines as the ability to dwell in uncertainties, doubts, without being impatient to reach facts and reasons, indicates a type of action that arises from emptiness, from the loss of meaning given by indeterminacy. It is not meant negatively, as a lack of competence to interpret or act upon reality, but as a cognitive sensitivity that allows confronting the complexity of reality, grasping its multiple dimensions and meanings, and the hidden conditions of possibility. Planning in this sense is configured as a constructive and exploratory activity that thrives on situations of discontinuity, asynchrony, and disruption. Planning as Bricolage emphasized the creativity of bottom-up action performed by the coproducers, as opposed to the experts and technicians upheld by classical planning that follow a rational-comprehensive logic. The different actors indeed show an extraordinary ability to adapt project choices and technical equipment to the available conditions, in a universe that is closed but at the same time open to infinite possibilities of experimentation and continuously woven by interactions with a multitude of changing resources (Lévi-Strauss 1962). In this sense, planning is configured as a practice and rationality capable of capturing and valorizing the heritage of available scraps (resources), enhancing their uniqueness and developing their generative potential.

The cities subject of the thesis appear as unstable laboratories, where innovation and experimentation coexist with insecurity and interruptions. Incremental planning, in the analysis of coproduction of water and sanitation services, allows for the emergence of more adaptable and flexible socio-technical strategies which succeed in accommodating complexity, responding to breakages and disruption, and responding to changing environmental conditions in rapidly growing urban environments. These practices carry out a relevant potential for improving knowledge and effectiveness of the planning discipline. First, as generally executing plans in smaller, manageable phases, they tend to minimize risks while facilitating the testing of assumptions and the assessment of

interventions on a smaller scale before committing to full-scale implementation, thereby limiting potential adverse effects. Moreover, their benefits are often associated with learning and feedback mechanisms. By evaluating the results of each step and integrating feedback, planners can refine future decisions and actions, ultimately improving the effectiveness of their strategies.

The current social and ecological crisis has sparked the urgency to experiment with new ways of inhabiting the planet through words and deeds, and emphasizing interspecies coexistence, thereby adopting structural changes that address the root causes of the current crisis we are dwelling. Rethinking our energy needs, land and resource consumption is now one of the main challenges in response to the consequences of the trajectory of the Capitalocene, which has established "capitalism as world-ecology", not only underlying processes of planetary urbanization but also enabling various ecologies to strike back. As we find ourselves shifting our attention to new imaginaries of inhabiting, we should ensure that socio-ecological transition is a global goal and that it occurs under the principles of equity, equality and ecology. I remain skeptical that those who determine global policies and hold wealth and power, continuing to fuel the capitalist development system, will be the ones to champion significant reforms (they also seem to proceed incrementally). I remain fundamentally aligned with David Graeber and other advocates of anarchist thinking, who consider revolution not as a sudden overthrow but as an incremental, step-by-step process emerging from grassroots movement, emphasizing gradual change initiated from the bottom up, rather than abrupt transformations imposed from the top down. Focusing on local actions, community involvement, and the empowerment of individuals, the incremental approach, as embraced by the research, suggests that profound social and political changes may be achieved through a series of small, deliberate and “silent” steps over a long term. It reflects a belief in the power of collective action and the importance of constructing alternatives within the existing system, aiming for a societal transformation that is both inclusive and participatory.

While beneficial in many contexts for its adaptability and flexibility, incrementalism encounters certain limitations. Notably incrementalism pace and scale may not align with the urgent, broad actions needed to address complex, large-scale challenges (i.e. climate change or deep socio-economic inequalities). The approach's focus on small, manageable steps may indeed struggle against the systemic and transformatio-

nal changes required across energy, infrastructure, and societal behaviors to address the current socio-ecological crisis. To navigate these challenges, integrating incremental planning within a broader strategic approach, as proposed by Lindblom with the concept of disjointed incrementalism, may offer a more nuanced and effective pathway for addressing the complex dynamics of an increasingly urbanizing world in the face of a global crisis, ensuring adaptability within the demand for more radical shifts.

Learning from the incremental city: requisite variety of fragments of anarchy to engage complexity in the time of uncertainty

Two days before he was hospitalised and from there taken to the Rimini hospital hospice, ending up in total solitude in the cold and sterile death rooms arranged by the national health system, I had visited him in his room at the elderly home in Pennabilli.

There, in that small room overlooking the concrete square with off-white walls and tiled floor, Mario had reconstructed his life during the three years of his illness. The room was full of stuff. With so much care he had made it his own that one almost no longer had the perception of being in a public facility for the elderly. But one only had to step out of the microcosm of his room and walk through the bare corridors laced with the smell of thawed food mixed with floor disinfectant to immediately return to the impersonal reality of the place he had been forced to move to because of his condition.

Plants, dried flowers, seeds and spices of various origins, drawings, origami entirely covered the walls of his room. Between one object and another, he had hung several photographs of insects, plants and flowers that he had taken while walking for about ten years with a Canon camera with a macro lens in the woods of the Marecchia Valley. His passion for insects and biodiversity, whose visible reduction over the years worried him greatly, was constantly reflected in his craftsman's work. Above his cupboard and inside self-built cabinets made from wooden boxes salvaged from the shelter kitchens he stored a small selection of his rich library. Texts by Barry Commoner, Rachel Carson, Ivan Illich, Peter Kropotkin placed among manuals of mostly oriental provenance that told of ancient forging techniques, sand and cuttlebone casting and other now-forgotten methods of metalworking. Mario had always decided to work without the use of machinery. All the tools he used to produce his unique and wonderful metal objects came from the work of his hands: chisels, hacksaws, knives, pliers.

The anarchist thought to which he felt close was so embodied in his work as a craftsman and in his life that even in the period before his death, in his desire to remain independent and autonomous he constantly worked to self-produce supports to help him compensate for the progressive reduction in mobility of his weakened body. With pieces of cardboard, he had made his cart into a portable cabinet in which he stored various everyday objects on different levels. When he was no longer able to stand up with ease, he made various tongs and extendable hooks out of recycled material so that he could take things from the room. By putting together various plastic straws into one long straw, he drank from the glass placed on the bedside table next to the bed. By then joining a branch of turkey oak to various pieces of cloth he had attached to the wall, he had created a support that allowed him, by levering, to raise his back and sit on the bed.

On that last day when I saw him conscious, we talked about the war in Ukraine that had just broken out and as usual during our conversations we soon gave in to the resignation of a totally doomed global economic, political and environmental system. Will the problem of gas, grain and resources for which we are totally dependent on third countries perhaps bring us back to autarky? I asked.

He was silent for a few seconds, then, prying with that improvised support he had built himself, he sat down and looking at me, with his usual thoughtful and frowning look, said: no, Federica, I believe the issue is autonomy.

Mario, who was able to turn this concept of autonomy into a way of life right up to his last breaths, has left me in the midst of thoughts and questions that I hope in time I will be able to address by entering into the readings he has passed on to me. For almost a year I had not even been able to reopen my thesis, and as the time limit, I had given myself to grapple with its incompleteness approached, I found myself more confused than before. As much as I repeated to myself that this was not the time to start leafing through the books that he had left me because they would have suggested new paths that would surely have made it even more difficult to complete the work, I could not resist from entering the

space of his library. Getting in touch with his spiritual legacy by going through some of his most cherished authors on the one hand seemed to me a way to get to know better a friend who had unfortunately been around too little in my life. At the same time, it helped me to question my own point of view, to better define it, to ask myself further questions and to develop critical thinking with respect to the observation of those practices that for years have led me to wander through the dense alleys of Hanoi's villages and the deserted red lands strewn with skeletons under construction in the suburbs of Cochabamba. The main dilemma that has been my companion over these years, and I would say the last one I have been able to face, albeit certain that I would never be completely rid of it, has to do with the same term and theoretical reference that this thesis takes on to investigate certain practices and processes in the Vietnamese and Bolivian context: co-production. The question of language resonated in these years of research, especially in this last period of writing, in an increasingly nagging way. In other words, I could not fully accept that the practices I was investigating in various parts of the world fell under the concept of co-production. The same was true for other terms I used in my thesis, such as: north-south, formal informal, planned and unplanned, spontaneous and rational... Expressions that I wrote down, crossed out, revised dozens of times during the writing phase and then, exhausted and overcome by resignation, used them in the belief that a new alphabetisation is necessary when discussing certain phenomena using allegedly arbitrary, not to say inadequate, categories.

I would like to inform the reader, at this concluding stage of the work, that such terminologies, widely used by both the reader and myself, should be better analysed, deconstructed and revisited but that, unfortunately, the time and in-depth study required is beyond the scope of this work.

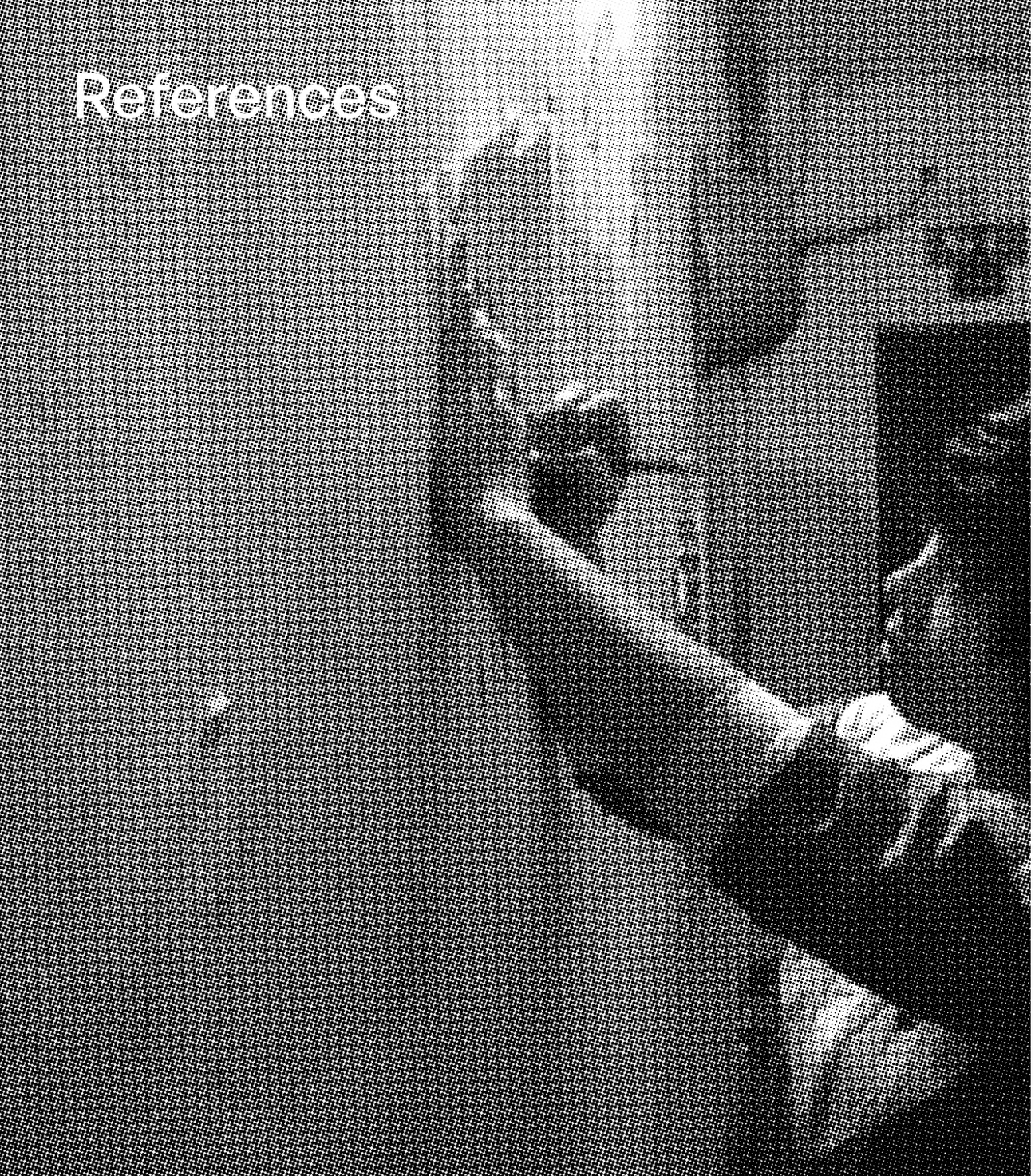
I wonder whether, and to what extent, co-production is capable of becoming a convivial instrument and democratisation of politics or rather a more inclusive governance tool and model of policy making in the hands of the political and decision-making system itself. Where bottom-up practices, forms of self-organisation and collective action are institutionalised (or rather appropriated) and its activists thus take their place in the comfortable seats of a system that often does not foster equality, is oppressive towards human beings and brutal towards the environment, they risk being emptied of their own meaning and end up feeding the system they want to oppose instead.

Therefore, I wonder whether talking about co-production, where a radical restructuring of economic and political systems and decision-making mechanisms is not seriously considered, does not represent a mere utterance that masks yet another form of collective slumber with respect to pressing issues that continue to be politically avoided.

How can we not agree with Graeber and Illich, when they claim that part of the scientific world is co-responsible for this human drift on a planetary scale, which progressively takes away capacities and autonomy from the individual and communities in order to leave the processes of building the societies of the future increasingly unreachable from below, well controlled and guarded in the hands of bureaucrats, technocrats and specialists?

I hope to one day also agree with Illich that 'the advent of techno-bureaucratic fascism is not written in the years' and with Graeber's optimism encapsulated in the phrase 'another world is possible' and to witness with my own eyes new forms of government through community. Both authors show glimmers of confidence in a political reversal. While for Illich this will take place through what he calls a 'detonator', an unforeseeable crisis or catastrophe that will weaken to the point of annihilating the population's trust in current institutions, for Graeber it will rather take place in the form of the gradual emergence of new forms of organisation, parallel to the political systems that will at some point make the 'stupidity' of current forms of power apparent.

Yet I feel closer to Weil's (2010) thought that the only possible form of political reversal cannot occur without extensive cooperation between individuals who hold power and those who do not, but that this is unlikely to arise within a society increasingly fuelled by rivalries and characterised by inequalities. Well, tormented by these questions and the resulting frustrations, I confess that for some time I had doubts about revising the work in its entirety and bringing a different point of view to it, experimenting with a different language that I might have been able to wear more comfortably. Instead, with the exception of some parts of the text that have been revised and this concluding afterword, I opted to keep the text in its structure and perspective of observation that I had built up, step by step, over the years.



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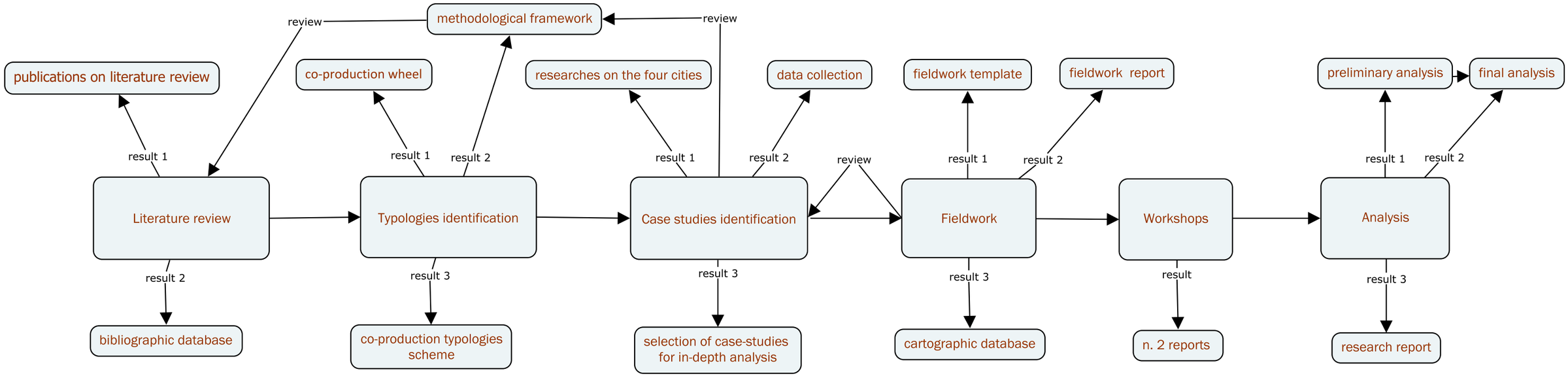
Annexes

1. Research project roadmap



2. Actor-Flow-Area with variable description

	Dimensions, variable and sub-variable description
ACTOR	The actor field is an essential part when looking at alternative and hybrid service provisions. Drawing on Yu et al. framework for analysing decentralized stormwater systems, the actor dimension can be further explicited by highlighting the role of the users and the official providers in the service delivery. Other stakeholder can be involved as intermidiaries, ranging from private actors to the multiple forms of citizens' organisations (local associations, NGOs, social movements, etc.). Moreover, the relationships between all these agents assume diverse configurations and characteristics, that we will try to address in the variable here named "interactions". **Users** • Users' scale of involvement (Moretto and Ranzato 2016): individual, group and collective (Joshi and Moore 2004) • Number of users (Ostrom 2009) • End-users motivation / willingness (Van Eijk and Steen 2014; Van Eijk et al. 2017): necessity, incentives, capacities • Socio-economic conditions of users (Ostrom, 2009): economic, social, demographic • Norms and social capital (Ostrom, 2006): forms of collaboration, community values related to reciprocity and trust **Providers** • Responsible agency and type (Moretto and Ranzato 2016): public, private • Forms of government: regime types (Ostrom, 2009), decentralization types and governance systems **Intermidiaries** • Kind of actors involved: CBOs, middle-income groups, "mediators" such as semi-professional civil society organisations (for example, the "federation of urban poor", such as SDI – Slum Dwellers International), non-profit entities or non-governmental organisations (see, for instance, McDonald and Ruiters, 2012; McGranahan, 2013; Moretto, Ranzato, 2016). **Interactions** • Level of institutionalization (Joshi and Moore 2004; Moretto and Ranzato 2016) and nature of relationships: formal or informal, contractual or semi-contractual (Batley, 2006); long-term or punctual collaborations (Joshi and Moore, 2004; Pestoff, 2012); interdependent, supplementary or complementary relationships (Pestoff, 2012); collective coproduction (Bovaird et al. 2015). • Level of intervention: planning, design, management, delivery, etc. (Bovaird, Leoffler, 2012).
FLOW	With respect to the flow field, the water, energy, waste, and transport (the latter to a reduced extent) services deal with flows of metabolised materials. To produce services, environmental resources like water or energy are processed and delivered to the user. Waste products are collected from the user and, if possible, recycled at a later stage. In metabolic terms, distribution and collection are just two of the phases of the overall circulatory processes for the materials involved in service provision. Ostrom (1996) describes more polycentric circulatory processes and infrastructure (e.g. the feeder line of the condominium and the trunk line of the urban street). We want to observe, as far as possible, these complex circulatory processes by first focusing on the service delivery, intended as the way a resource in processed by making use of a particular technology. Those variables are explicited below: **Resources** • Variety of environmental resources mobilised by service delivery: such as local rainwater, local waste, etc (the waste product collected and those discharged by the service may or not coincide, as the material collected could be further processed/transformed before its final discharge, Moretto and Ranzato, 2016). • Relation flows-citizens: extent to which citizens operate in the flow's circulatory processes by collecting, separating, purifying, reusing, or recycling water and waste water (Allen et al., 2016; Moretto, Ranzato, 2016). • Short cycles/closed loops of resources (Moretto and Ranzato 2016): resource availability; reusing and recycling; quality and regenerative capacity of natural resources

Technology

- Scale of technology: condominial systems or non-networked solutions, such as wells or public toilet blocks (Ostrom, 1996; Jaglin, 2012; Allen et al., 2016).
- Short cycles/closed loops of resources (Moretto and Ranzato 2016): resource availability; reusing and recycling; quality and regenerative capacity of natural resources
- Technical complexity (Yu, C., Farrelly, and Brown 2011): level of expertise, the number of actors and/or the size of an organisation needed to run it
- Connectedness (Yu, C., Farrelly, and Brown 2011): Combined vs. separate systems
- Infrastructure portfolio (Moretto and Ranzato 2016): Taxonomy of devices; technology availability; device's interface operability; maintenance operability

Service

- Spatial forms and scale of service: articulation between conventional networked and centralized systems, and coproduced SERVICES, creating diverse service constellations (Monstaadt, Schramm, 2013, Coutard, Ruthgerford, 2015).
- Spatial level of coproduction: household, settlement, city (Moretto, Ranzato, 2016); risks of urban fragmentation at the city level, or at the local one ("micro-fragmentations", Moretto, 2010).

The field area concerns the relation between the service delivered and the space. Water, energy, and waste services have a crucial spatial connotation, both in terms of 'spatialisation' and 'territorialisation' (Dubresson and Jaglin 2005), because of the link with flows of resources, the presence of specific actors, and their interactions. Service provision can take place at different spatial scales with consequences for service technical options, the physical characteristics of the territory, and the related social forms of organisation. From the elementary level (like the household) up to more collective levels (like the block, the district, or the settlement), service delivery and spatial scales influence each other in a variety of ways. In our project, the area dimension is will take into account the characteristics of the land as well as the spatial organization of the settlement:

Land

- Land tenure and use (Allen 2010): legal or illegal; zoning; masterplans and future development of the area as well and pressures from speculation.
- Environmental risk (Winayanti and Lang 2004) and public health risk (Yu, Farrelly and Brown 2011): flood prone or landslide risk areas; contaminated sites; presence of waterborne or vectorborne diseases.
- Location (Schramm 2011): central, urban, peri-urban.

Settlement

- Morphology (Yatmo and Atmodiwirjo 2012): topology, topography, characteristics of the housing typologies and relationship between private and public space.
- Extension: Surface, density, age and number of inhabitants
- Multifonctionality: presence of collective services, facilities and shared spaces

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3. Survey form used for data collection in Hanoi and Cochabamba

BẢNG CÂU HỎI KHẢO SÁT
QUESTIONNAIRE SHEET

Ngày phỏng vấn/ Date of interview: _____
Họ tên người được phỏng vấn/ Full name of the interviewed: _____
Tuổi/Age: _____ | Giới tính/Sex: Nam/M Nữ/F
Nghề nghiệp/ Occupation _____ | Địa chỉ/ Address _____
Khoang cach tu nha den noi lam/ Distance house-job (km): _____

THÔNG TIN CHUNG VỀ HỘ GIA ĐÌNH
Household attribution

1 Số người trong gia đình: _____
No. of people living in the house:

2 Thu nhập hàng tháng của hộ gia đình:
Monthly income of the family:
- ☐ <1.000.000 đồng
- ☐ 1.000.000 - 2.000.000 đồng
- ☐ 2.000.000 - 3.000.000 đồng
- ☐ 3.000.000 - 4.000.000 đồng
- ☐ 4.000.000 - 5.000.000 đồng
- ☐ >5.000.000 đồng

3 Anh/chi co tham gia vao to chuc, doan the nao o day
Are you part of community groups?
☐ hoi phu nu nguoi cao tuoi women's union
☐ hoi elder people union
☐ khac/ Others _____
☐ hoi lam nong nghiep tap the agriculture cooperatives
☐ to dan pho resident's association

4 Cac hoi nay co tham gia vao cac hoat dong cai tao khong gian cong cong khong
Is any of this community groups engaged in the management of common areas?
- ☐ khong gian cong cong — Collective management of public space
- ☐ dat nong nghiep, khong gian mat nuoc, be ca — Collective management of agriculture land and/or fish pond
- ☐ he thong duong ong nuoc — Collective management of piped water network
- ☐ he thong cong, thoat nuoc nua, be phot — Collective management of sanitation facilities (drainage, sewerage, septic tank)
- ☐ khac — Others (please specify) _____

Thong tin ve nha o / Housing information

5 Hinh thuc so huu nha
House tenure:
☐ Nhà tự xây/own built
☐ Nha tu nhan/property
☐ Nhà thuê/rent

6 dien tich nha _____ Mq house:
7 dien tich dat _____ Mq land:

8 Loại nhà ở:
Type of house:
☐ nha rieng/ Individual House
☐ nha o chung giua nhieu ho gia dinh/ Multifamiliar House
☐ Can ho trong khu tap the/ Apartment in Collective Block
☐ Can ho trong chung cu/ Apartment in Tower

9 nha cua anh chi co so huu / Does your house have
☐ dat ruong / Farm Land
☐ cua tiem /Shops
☐ ao ca/ Fish ponds

10 Co dung chung cac cong trinh phu voi cac ho khac khong
Do you share facilities with other households?
☐ bep Kitchen
☐ toa let Toilet
☐ vuon Garden
☐ cua tiem Shop
☐ khu phoi phong quan ao Laundry
☐ khac Others _____

11 Năm xây nhà/Year of construction: _____
11.1 so nam sinh song trong nha/ Number of years living in the house: _____

Encuesta n.
QUESTIONNAIRE SHEET

Fecha de entrevista/ Date of interview _____GEORREFERENCIA (Poner punto en mapa SIG)
Nombre completo del entrevistado/ Full name of the interviewed: _____
Años/Age _____ Sexo/Sex Hombre/M Mujer/F
Ocupación/Occupation _____ Dirección/ Address _____
N° Teléfono / Phone number _____
Distancia casa-trabajo o actividad principal (km)/ Distance house-job (km): _____
OTB/Barrio/ OTB/neighbourhood _____

Características del hogar
Household attribution

1 No. de personas que viven en la casa: _____ No. familias que viven en la casa: _____
No. of people living in the house: No. of families living in the house:

2 ¿En tu barrio que organizaciones comunitarias hay más allá de la OTB y el operador de agua? _____
Are you part of community groups? _____

3 ¿Alguno de estas organizaciones se dedica a la gestión colectiva/comunitaria?
- ☐ Gestión colectiva del espacio público y el equipamiento — Collective management of public space and services
- ☐ Gestión colectiva de tierras agrícolas y / o estanques — Collective management of agriculture land and/or fish pond
- ☐ Gestión colectiva del suelo urbano, urbanización — Collective management of land, urbanization
- ☐ Gestión colectiva de instalaciones de saneamiento (drenaje, alcantarillado, tanque séptico) — Collective management of sanitation facilities
- ☐ Otros (transporte, basura, electricidad…) — Others (please specify) _____

Información de la vivienda
Housing information

4 Construccion de la casa: / House contruction:
☐ construida por su familia /own built

5 M2 casa Mq house: _____
6 M2 lote Mq land: _____
7 No. de pisos N. of floors _____

8 Tenencia de casa / House tenure:
☐ Propiedad/property
☐ Alquilar/rent
☐ Anticretico/uso gratuito
☐ Otro/other _____

9 Tipo de casa: / Type of house:
☐ Individual/ Individual House
☐ Colectiva/ Multifamiliar House
☐ Departamento en condominio / Apartment in Collective Block
☐ Departamento en edificio/ Apartment in Tower

10 La casa tiene…/ Does your house have
☐ Tierra agricola / Farm Land
☐ Comercio /Shops
☐ Servicios /Services
☐ Otros/ Other _____

¿Compartes instalaciones con otras familias en la misma casa? Do you share facilities with other households?
☐ Cocina Kitchen
☐ Baño Toilet
☐ Jardin Garden
☐ Garaje Garage
☐ Lavanderia Laundry
☐ Otros Others _____

10 Año de construcción de la casa /Year of construction: _____
Número de años que vive en la casa/ Number of years living in the house: _____
Año que se creó el barrio/Year of neigborhood creation
Cantidad de años viviendo en el barrio/ Number of years living in the area: _____
Número de casas que estaban en el barrio cuando llego por primera vez / Number of houses when arrived: _____

4. Urban typologies systematisation in Hanoi and Cochabamba

Name of the case study	Old Quartier	French Quartier	Kim Lien KTT	Nguyen Cong Tru KTT
Interviews done (nb)	2	2	4	2
Surveys	20	20	20	20
Type of location (urban/periurban/rural)	urban	urban	urban	urban
Distance from the centre	0	2	5,5	3,5
Housing typology	-a. Individual Tube house -b. Apartment in KTT	-a. Individual Tube house -b. Apartment in French Villa	-a. Apartment in collective blocks -b. Individual Tube House	-a. Apartment in collective blocks -b. Individual Tube House
Type of development (formal/informal; private/public/cooperative)	-a.Informal/Private -b. Formal/Public	- Informal/Private a.Informal/Private -b. Colonial	-a. Informalized/Public b.Informal/Private	-a. Informalized /Public b.Informal/Private
Nb of inhabitants and area			(1999) 0,34 km² pop. 14.098 density 41.465 p/ km².	

Name of the case study	Old Quartier	French Quartier	Kim Lien KTT	Nguyen Cong Tru KTT
Information about water coproduction	-a. Municipal water network + Complementary strategies for water supply (filters, booster pumps, tanks) co-management -b. Water is shared between the residents but different price is set between original residents, and later inhabitants or renters co-management, co-design	-a/b. Municipal water network + Complementary strategies for water supply (filters, booster pumps, tanks)	-a. Municipal water network + Complementary strategies for water supply (filters, booster pumps, tanks). However different technologies and price for those living in houses which are extensions of original blocks -b. Municipal water network + Complementary strategies for water supply (filters, booster pumps, tanks)	-a. Municipal water network + Complementary strategies for water supply (filters, booster pumps, tanks) -b. Municipal water network + Complementary strategies for water supply (filters, booster pumps, tanks)
Information about sanitation coproduction	-a. Individual septic tanks connected to public drainage co-design, co-management	-a/b. Individual septic tanks connected to public drainage co-design, co-management	-a. Collective septic tanks connected to public drainage co-management (TPD collect money) -b. Individual septic tanks connected to public drainage -secondary and tertiary drainage system managed by TDP co-design, co-management	-a. Collective septic tanks connected to public drainage co-management (TPD collect money) -b. Individual septic tanks connected to public drainage co-design, co-management -secondary and tertiary drainage system managed by TDP co-design, co-management

5. Case study table for Hanoi case studies

City	Study Area	Settlement Types	Settlement Origin	Settlement Location	Settlement Density	Settlement Planning	Distance to city centre (km)	Connectedness (water supply): Combined - Separated	Connectedness (sanitation): Combined - Separated
Hanoi	36-Streets	Core Settlement	Historical	Nearby the city centre	High-density	Spontaneous	0	Combined	Combined
	Co Nhue	Village Settlement	Historical	Enclosed in urban agglomeration	High-density	Spontaneous	8	Combined	Combined
	French District	Core Settlement	Historical	Nearby the city centre	High-density	Spontaneous	1	Combined	Combined
	Kiêu Kị	Village Settlement	Historical	Dispersed	Middle-density	Spontaneous	12	Combined	Separated
	Kim Lien	Collective blocks	Historical	Enclosed in urban agglomeration	Middle-density	Government subsidized	4	Combined	Combined
	Lang To	Village Settlement	Historical	Enclosed in urban agglomeration	Middle-density	Spontaneous	11	Separated	Separated
	Linh Dam	Apartment Tower	Consolidating	Enclosed in urban agglomeration	High-density	Government subsidized	8	Combined	Combined
	Nguyen Cong Tru/ Pho Hue	Collective blocks	Historical	Enclosed in urban agglomeration	Middle-density	Government subsidized	2	Combined	Combined
	Nhi Khe	Village Settlement	Historical	Dispersed	Low-density	Spontaneous	15	Separated	Separated
	Phu Nghia	Village Settlement	Historical	Dispersed	Middle-density	Spontaneous	23	Combined	Combined
	Phuc Xa/ Phuc Tan	Slum	Consolidating	Nearby the city centre	High-density	Spontaneous	1	Combined	Separated
	Times City	Apartment Tower	Recent	Enclosed in urban agglomeration	High-density	Real estate	5	Combined	Separated
	Trieu Khuc	Village Settlement	Historical	Enclosed in urban agglomeration	High-density	Spontaneous	8	Combined	Combined
	Van Phu/ Phu La	Village Settlement	Historical	Enclosed in urban agglomeration	High-density	Spontaneous	12	Combined	Separated
	Co Loa	Village Settlement	Historical	Dispersed	Low-density	Spontaneous	9	Combined	Separated
Cochabamba	Callajchullpa	Peripheral settlement	Historical	Dispersed	Low-density	Spontaneous	11	Separated	Separated
	Chacacollo	Peripheral settlement	Historical	Enclosed in urban agglomeration	Middle-density	Spontaneous	5	Separated	Separated
	El Palmar	Peripheral settlement	Consolidating	Enclosed in urban agglomeration	Middle-density	Spontaneous	3	Separated	Separated
	Kami	Peripheral settlement	Historical	Enclosed in urban agglomeration	Middle-density	Spontaneous	4	Separated	Combined
	La Paz	Peripheral settlement	Historical	Dispersed	Middle-density	Spontaneous	9	Separated	Combined
	Las Peñas	Slum	Recent	Enclosed in urban agglomeration	Middle-density	Spontaneous	8	Separated	Separated
	Lava Lava Baja	Peripheral settlement	Consolidating	Dispersed	Low-density	Spontaneous	11	Separated	Separated
	Padre Berta	Peripheral settlement	Consolidating	Enclosed in urban agglomeration	Middle-density	Spontaneous	6	Separated	Separated
	Parque Pirai	Collective private housing	Historical	Nearby the city centre	Middle-density	Government subsidized	3	Combined	Combined
	San Jorge	Village Settlement	Historical	Enclosed in urban agglomeration	Middle-density	Spontaneous	18	Separated	Separated
	Santa Vera Cruz	Peripheral settlement	Historical	Dispersed	Low-density	Spontaneous	5	Separated	Combined
	Serena Calicanto	Collective private housing	Historical	Enclosed in urban agglomeration	Middle-density	Government subsidized	10	Separated	Separated
	Villa Exaltación	Peripheral settlement	Historical	Nearby the city centre	Middle-density	Spontaneous	5	Combined	Combined
	Villa Israel	Peripheral settlement	Consolidating	Enclosed in urban agglomeration	Middle-density	Spontaneous	11	Separated	Combined
	Villa Moscu	Peripheral settlement	Historical	Nearby the city centre	Middle-density	Spontaneous	3	Combined	Combined

6. Interview form example from Cochabamba

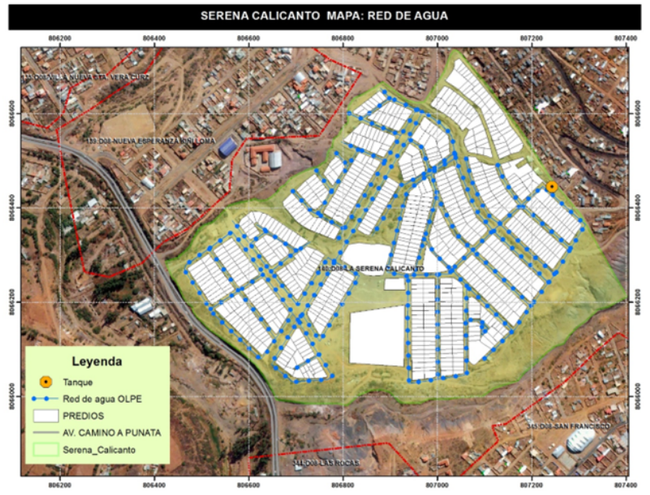
OTB SERENA CALICANTO
BARRIO INFO.
¿Cuántos lotes forman parte de Vila Calicanto?
Se puede identificar alrededor de 800 lotes
¿Cuántas personas viven?
Actualmente viven más de 750 familias que gozan de tofo los servicios básicos y 100 familias que no en total son 850 familias según el dirigente con 3156 Hab
¿Cuándo se fundó el barrio? ¿Quién vive principalmente en la zona?

En 1995 se dio las primeras construcciones con el proyecto de ASICA-SUR que se dio en Serena Calicanto, un 80 % de toda la población que habita en la OTB son mineros de Huanuni, donde hay profesionales, comerciantes y el 18 de noviembre de 2002 consiguió la personería jurídica a la OTB, mas tarde en el 2008 se dio inicio a la construcción de tanque de agua para la población de la OTB con una inversión 356000 Bs. El 80 % perteneciente de la Cooperación Europea y el 20 % de la Alcaldía de Cochabamba.
El 9 de agosto de 2009 la alcaldía de Cochabamba otorga la personería jurídica del funcionamiento y administración del tanque de agua y su distribución (que tiene una superficie de 4x15m2) a la OTB Serena Calicanto.
Donde los primeros habitantes fueron Don Martin Medina Pastor Vargas y Anselmo Vargas actual plomerop de Agua potanble en 2002 se entregaron las viviendas donde aun no contanban con ningun servicio, donde tramitaron de 50 personas a tramitar lo primero Luz Electrica por que antes commo dos años de luz utilisaban velas el agua les traia carros sisternas, el mensiona que estos financiamientos se dieron en la Epoca del Goni donde las viviedas eran solo 150 y luego cuando la empresa construe las viviendaqs para verder lo qalargan a 750 viviendas y asi basn consiguienso otras gente para llenar las viviendas. Cuenta Daon Anselmo Vargas.
AGUA.
¿Cuáles son las características de las infraestructuras hídricas en el área? ¿De dónde proviene el agua? ¿Qué compañías / utilidades lo proporcionan? ¿Cuáles son las principales características de la infraestructura del agua (puntos de admisión, distribución, almacenamiento)? Si hay sistemas de almacenamiento y estaciones de bombeo, ¿qué capacidad? ¿Dimensión? ¿Número?

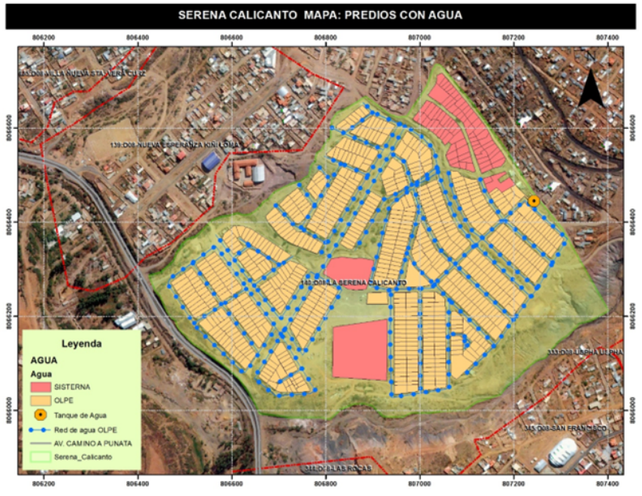
El sistema del agua potable consiste en almacenar en cisternas al tanque que se encuentra en el este de la OTB en un altura aproximada mente 120m. Que se almacena 75.000 litros de agua.
Cada cisterna de agua compra la OTB con 170 Bs. Al día 5 cisternas de agua, al semana 25 cisternas menos los domingo ya que este día no esta en funcionamiento todo el sistema de distribución del agua potable, a si llegando a un total por mes de 100 cisternas que consume la OTB

El consumo del agua potable por familia mensual es aproximadamente de 5 m3, que cada m3 es de 17 Bs. En 5 m3 un total de 85 Bs. Mensual, comparando con el agua potable de SEMAPA es totalmente en desfavorable ya que los precios de agua de las OTB son muy elevados para ser exacto mas 7 Bs. Por metro cúbico y de mala calidad. No obstante hay familias que consumen mas de los 5 m3.

En el 2015 un pequeño OTB (21 DE MAYO) se unen con tan solo dos manzanos los cuales asta la fecha no tienen acceso al agua potable de la OTB Serena Calicanto, para los cueles se hace traer en cisternas aguas comprtados de semapa el cual el turril sale a 4 o 5 bs lo que normalmente el turril cueta 7bs.



Si hay pozos, ¿a qué profundidad?
Se excavaron pozos, con ayuda de la cooperación europea pero el agua de la zona no sirve para el consumo tiene metales pesados, como plomo y yerro que no sirve ni lavar los utensilios.
¿Cuál es el volumen de agua empleado en el área?
En el tanque se almacenan 75.000 litros al día traídos en cisterna que se compra del Semapa, con una cobertura de 86%
¿Existe algún sistema común de purificación / tratamiento para el agua potable, o las torres / hogares tratan el agua por sí mismos?
El agua se compra de Semapa, agua ya tratada y también se trata en casa haciendo hervir por si mismos.
¿Cómo se gestiona la infraestructura del agua en la zona? ¿Quién está a cargo del mantenimiento de la infraestructura?
Mediante cobro mensual, donde tienen un plomero que se encarga de manejar la administración de agua don Anselmo Vargas.
¿Cuántos lotes están conectados a la red OTB?
33 manzanos tienen conexión a agua potable y dos no tiene acceso, son los manzanos que fueron apropiándose de las área verdes se Serena Calicanto, y recién tramitaron papeles para pertenecer al barrio los cuales a un no tienen todo los servicios Básicos pero sin embargo tienen una cobertura de 86%



-Cuanto pagas por el agua? (custo de connecion y de agua (m3)

Se paga 17 bs donde las familias consumen de 8 hasta 10m3

SANEAMIENTO

¿Cómo es el sistema de alcantarillado?
Tiene cobertura de un 85% con dos cámaras sépticas que mensualmente se paga 9bs del servicio, que se hace limpieza dos veces al año que se contrata cisternas, y se paga 1500bs

¿Hay fosas sépticas colectivas debajo del edificio, o el agua negra fluye directamente al sistema de alcantarillado?
El agua fluye directo a la red de alcantarillado, menos de la parte donde no tienen conexión tiene pozos sépticos.

-¿A dónde fluyen las aguas residuales?

A la cámara séptica de la OTB que se hace limpieza dos veces al año. Uno de los cámaras ya no está en funcionamiento sin embargo varios de los vecinos todavía no tiene conectados al nuevo, el cual actualmente está en disfuncionamiento y el cual está desembocando al Rio.

¿Cómo se gestiona la infraestructura de saneamiento en el área?

El gestionado por la OTB y la mesa directiva que gestiona el agua potable.
¿Cuánto cuesta la alcantarilla?
9bs mensual

HISTORIA DE TRANSFORMACION
-¿Cuál es la historia de esta área?

El barrio se fundó hace 20 años donde hay mineros de Huanuni, profesionales donde se compró legalmente donde financio el proyecto europeo de Delicia popular, donde los FONBIS les dieron a viviendas a 20 años de pagar que salió por familia 21000 y cuando las viviendas fueron entregadas no estaban terminados faltaban puertas y ventanas que los mismos vecinos se ayudaron para comprar y poner las ventanas y puertas que les faltaban a las viviendas y así empezando de ahí se fueron organizando para los servicios básicos.
¿Cuándo se desarrolló?

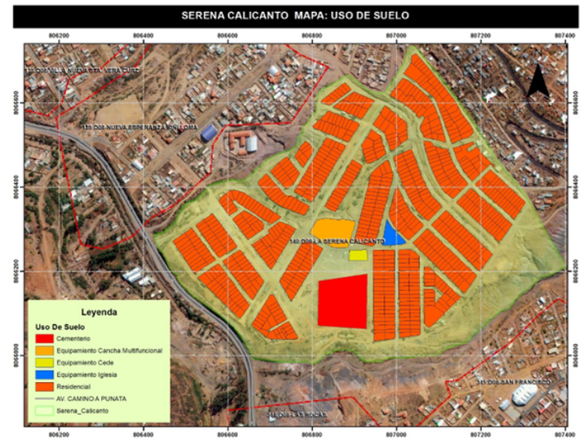
Gracias a la organización que empezaron con 50 personas.
¿Qué cambios en el paisaje de la zona después de la densificación del entorno construido?

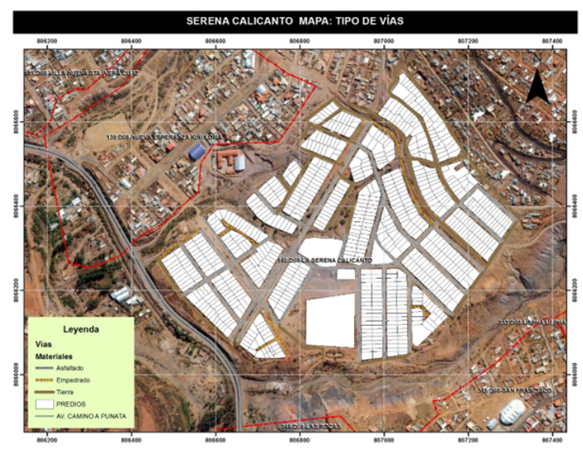
La zona ha desarrollado a partir del año 2015 donde las calles eran de tierra los niños que tenían que ir a la colegio iban con bolsitas en los pies pero en estos tres últimos a los el barrio ha desarrollado porque el Dirigente ha hecho buenas gestiones con el gobierno municipal de cercado, sin embargo el agua y la red de alcantarillado son financiamientos internacionales y aporte propio de los vecinos.

¿Qué actores son y han sido responsables de la gestión de la infraestructura en el área a lo largo de los años?
Siempre hemos tenido comité de agua hace más de 5 años está la actual comité de agua que está a cargo como Precedente de Agua Don Jesús vicepresidente Aldiel Rosio, secretario de actas doña Marina Geres, Vocal Juvenal Castellano, Secretaria María Luz Cariaza. Plomero don Anselmo Vargas.

¿Cuándo se construyó el sistema OTB? ¿Cuándo se construyó el sistema de alcantarillado?
El sistema de red de alcantarillado se construye con el apoyo del gobierno municipal, 1500 cuesta la descargas de las cámaras sépticas desde arriba al norte son cañerías de 5 y abajo ya tienen cañerías de 6 3.000000 millones a puesto el gobierno el cual no alcanzo en las acometidas se pusieron todo los vecinos hablando con el supervisor, como vecinos se compraron silletas los empedrados que han destruido los vecinos se propusieron a arreglar para que la empresa que se los a realizado el proyecto, y así cada vecino puso de su dinero para hacer terminar la red de alcantarillado como 150bs.y ayudo a arreglar los empedrados.

MAPAS DE USO DE SUELO Y MATERIAL DE VIAS

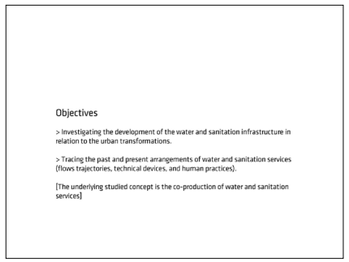


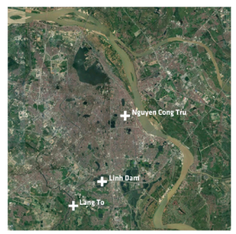


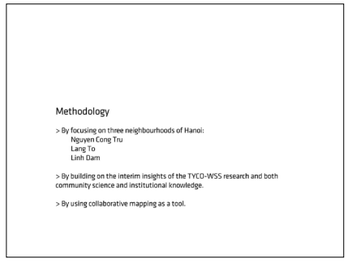
EN CONCLUSIÓN

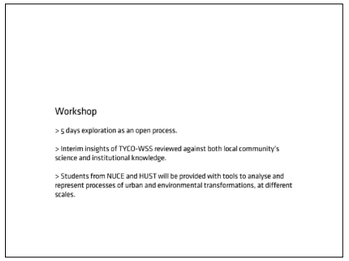
La OTB Serena Calicanto si bien administra tanto el sistema de agua potable como la red alcantarillado, que cada uno de los servicios tiene distintos costos mensuales, por ejemplo los ingresos del cobro mensual de alcantarillado no son disponibles en nada mas que en los accesorios de gabinete del comité de agua potable y accesorios de instalación de agua potable, realizando cálculos del los 730 familias de la OTB,100 familias no cuentan ningún de los dos servicios agua a 14 % , y 630 familias cuentan con los dos servicios que administra la OTB, que equivale a 86 % sin embargo las 630 familias pagan mensualmente 9 Bs. Del servicio de alcantarillado lo cual en un año llegaría a 68040 Bs. En dos años llega 136080 Bs. Esto es suficiente recurso para cubrir la instalación de los dos manzanos que no tienen al acceso a ninguno de estés servicios que brinda la OTB, esto es un indicador que no administran bien los servicios de esta OTB. Siem embargo siempre hay intereses seegun los diregentes eso se ba reparaciónes y las cdescargas que se hace. Que de gual manera cuesta.

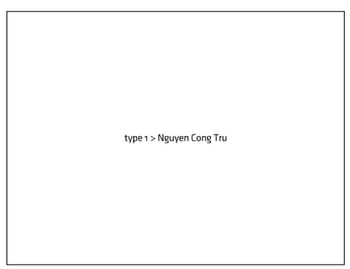
7. Presentation before the focus group with institutional stakeholders in Hanoi

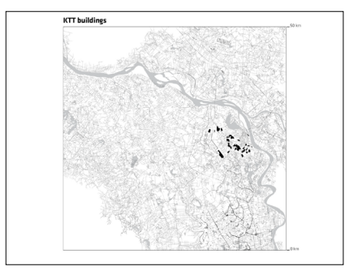


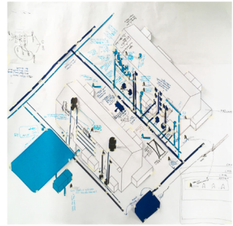












Representativeness
Drinking water
> Is an individual drinking collection a spread-diffuse solution? When have they been installed?

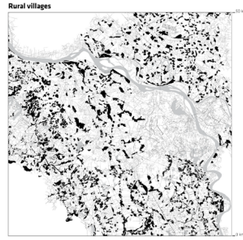
Waste water
> Do we find this kind of scheme (septic tank-sewage branches managed by the To Dan Pho) in all the soviet block?

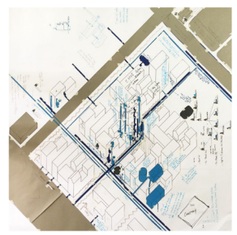
Reasons
> Why did you move from a collective drinking water collection to an individual system?
_Change in policy/infrastructural terms (economic and technical)
_Urban development/population increase

Consequences
> What does it mean in economic terms?
> What such a change means in the management?
> What is the benefit for the environment?
> What is the benefit for the human health?

type 2 > Lang To

Rural villages





Representativeness
Drinking water
> Is a mini-network with a local pump a spread-diffuse solution? When have they been built?
> Is a local coop managing these mini-networks in all the villages? Is always a coop of famers that built and manages the system?
> Did a local organization (coop) supported by a development cooperation developed these mini-networks in all the villages?
> Is rainwater collected in many of the villages we find in the urban area of Hanoi? Can you provide an estimation?

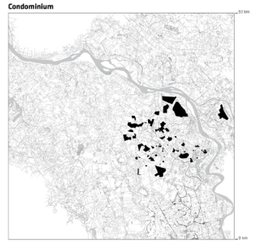
Waste water
> Do we find this kind of scheme (septic tank-drainage managed by the subvillage- bodies of water) a diffuse situation?

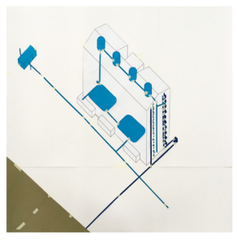
Reasons
> Why did you move from an individual water supply to a semi-centralised system?
_ Pollution (here and elsewhere?)
_ Change in policy/infrastructural terms (economic and technical)
_ Urban development/population increase

Consequences
> What does it mean in economic terms?
> What such a change means in the management?
> What is the benefit for the environment?
> What is the benefit for the human health?

type 3 > Linh Dam

Condominium





Representativeness
Drinking water
> Is an individual drinking collection a spread-diffuse solution? When have they been installed?

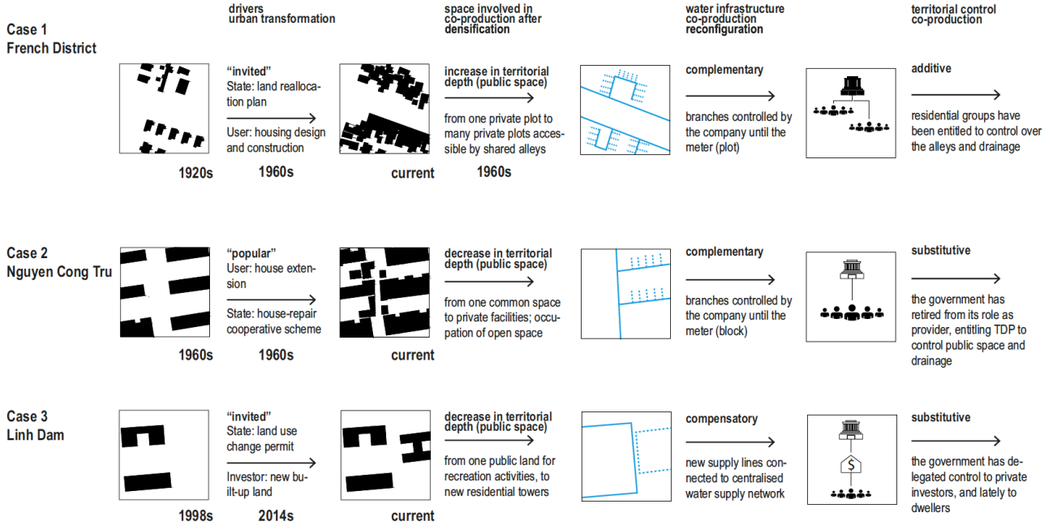
Waste water
> Do we find this kind of scheme (septic tank-sewage branches managed by the To Dan Pho) in all the soviet block?

Reasons
> Why did you move from a collective drinking water collection to an individual system?
_Change in policy/infrastructural terms (economic and technical)
_Urban development/population increase

Consequences
> What does it mean in economic terms?
> What such a change means in the management?
> What is the benefit for the environment?
> What is the benefit for the human health?

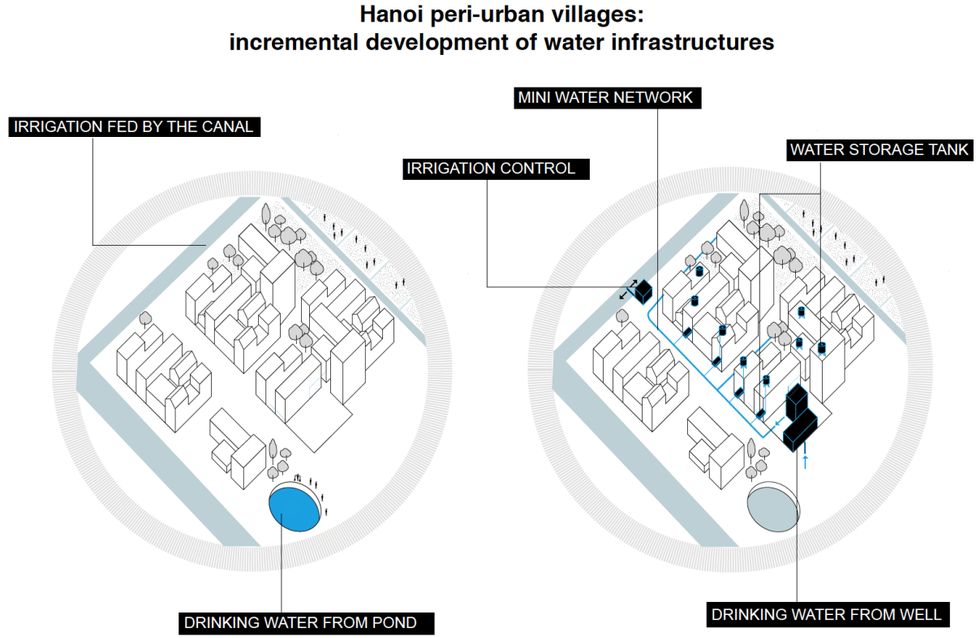
8. Examples of spatial reconfigurations in Hanoi

Hanoi examples of reconfiguration of the built environment and water and sanitation infrastructures



9. Densification in Nguyen Cong Tru neighbourhood in Hanoi

10. Map of Lang To village in Hanoi



11. Adaptation of water infrastructure in Lang To village