



# UNBUNDLING THE URBAN SANITATION CRISIS: A TERRITORIAL HISTORY OF THE DEVELOPMENT OF URBAN SANITATION

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Andri Brugger is a doctoral candidate at the Université de Neuchâtel in the department of sociology. Andri pursues his PhD as part of the U-STASIS research project, which is funded by Swiss Network for International Studies (SNIS). The research project aims to understand both the way access to safe sanitation is currently being provided in the metropolitan areas of Dar-es Salaam (Tanzania) and Dhaka (Bangladesh) as well as the dominant political and economic bargains that shape the sanitation sector at the global level. Through scrutinizing the multi-scalar aspect of providing access to safe sanitation the research aims to contribute to achieving the Sustainable Development Goal (SDG) 6.2. The U-STASIS project is a collaboration between the Université de Neuchâtel, Eawag Sandec, the Institute of Development Studies at the University of Sussex, the International Water Management Institute (IWMI), Borda Africa, and the International Centre for Diarrhoeal Disease Research, Bangladesh. More information on the project can be found on the [SNIS website](#) and [YouTube](#) channel.

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## **Abstract**

A territorial political economy (TPE) framework can be used to expand scientific conceptualisations of the ongoing sanitation crisis, namely, the collective failure to provide access to safe sanitation for more than two billion people worldwide. The provision of safe sanitation is the most important health achievement of the past 200 years. In these times of global health crisis (viz. the COVID-19 pandemic), the importance of public health to prosperous societies is particularly evident. In this paper, the brief history of urban sanitation over the past 200 years is examined, identifying the stable social, political and economic arrangements that enabled fast increases in access to safe sanitation. Times of progress are contrasted with periods of stagnation, such as the one that is currently being experienced in fast-growing cities across the globe. It is found that the rationale for creating access to safe sanitation has shifted from fighting global and universal health threats through local public arrangements in the 19th century to multi-local and private health needs today, addressed by global and universal arrangements in the last 40 years. In parallel, responsibility for providing services has shifted from the local public sector to spatially disconnected businesses, with the public sector as regulator. The presented analysis highlights how the declining systemic relevance of sanitation for securing urban development is morphing into deepening spatial segregation. It is argued that the prominent solutions that are proposed to accelerate progress towards Sustainable Development Goal 6.2 (SDG6.2) risk deepening inequalities through reinforcing spatial disparities. Due to the often temporary, emergency or ephemeral nature of alternative solutions promoted to accelerate access to safe sanitation for all, slums are solidified as sites of persistent precarity. This reduces the pressure on cities and nations to achieve fundamental transformations towards hygienic living conditions for all.

## **Key-words**

Sustainable Development Goals

Sanitation

Urban development

Governance

Urban water management

## **Acknowledgments**

This publication has been (co-) funded by the Swiss Network for International Studies.

## 1. Introduction

In a time dominated by a pandemic (COVID-19), the importance of public health for prosperous societies is particularly evident. The widespread introduction of sanitation through systems of infrastructure and institutions for the safe disposal and treatment of wastewater is the most important health achievement of the past 200 years (Mara, Lane, Scott, & Trouba, 2010). Yet, despite progress, universal access to safe sanitation remains one of the most persistent development challenges. Over 60 percent of the world's population is exposed to water moderately contaminated with faecal matter, with 10 percent of the population being exposed to severely contaminated water. The risks of water pollution are greatest in the rapidly growing cities of the global South, where 95 percent of urban growth is projected to occur. However, most cities in the global South are struggling to provide adequate investment in basic infrastructure, particularly for safe sanitation, to accompany their demographic and spatial expansion (Herrera, 2019; Joint Monitoring Program, 2019).

The sanitation crisis is not new. Since the Water and Sanitation Decade in the 1980s, progress on access to safe sanitation has remained slow. The Millennium Development Goal 7.3 (MDG7.3) to halve the number of people without access to toilets and latrines was officially achieved; however, this success is highly misleading, due to the wide range of unsanitary options that were included in measuring access to improved sanitation. Without massive acceleration, Sustainable Development Goal 6.2 (SDG6.2), the globally adopted goal to provide safe sanitation for all, and SDG6.3 to halve the amount of non-treated wastewater by 2030, again will be missed. An average funding gap of 60 percent between identified needs and available funding to provide access to safe sanitation for all as agreed upon in SDG6.2 has been reported by governments. Moreover, investment needs in most countries are three times higher than current investment levels (Herrera, 2019; World Health Organization, 2017).

Against the backdrop of the persistent crisis, the dominant infrastructure for safe urban sanitation, consisting of vast sewer networks which are connected to centralised wastewater treatment plants (WWTPs), and the institutions that govern them have been increasingly questioned to be the optimal solution to all sanitation challenges across the world (Hoffmann et al., 2020). It has been argued that rather than top-down planning of centralised network infrastructure, cities in the global South need inclusive planning tools and a decentralised sanitation system which can solve problems at the scale where they occur. For densely populated urban slums in particular, alternatives such as container-based sanitation (CBS) and safe faecal sludge management (FSM), that do not depend on vast sewer networks, are considered by sanitation experts and development specialists to be viable solutions. However, CBS systems serve no more than 70,000 and FSM only about 3 million people per day worldwide (Berendes, Sumner, & Brown, 2017; World Bank, 2019). Common explanations for the failure to scale up adapted sanitation solutions are inadequate institutional frameworks, lack of recognition by governments and failures in the process of innovation (Klinger, Gueye, Sherpa, & Strande, 2019).

The patterns of contemporary urbanisation in the global South, with rapidly growing slums and a silent public health crisis, are strikingly similar to those in Europe and the United States at the dawn of industrialisation. Quite to the contrary, however, the response to it differs in several respects. While during the 19th century, city authorities in the global North built large-scale publicly owned sewer systems based on a sunk-cost attitude, with the primary goal of ridding cities of the burden of water-borne disease (Bisaga & Norman, 2015). Contemporary sanitation systems are predominantly provided based on the principles of willingness to pay, the polluter pays principle and cost-covering tariffs. This contrast raises the research question: what is different today that is preventing a similarly thorough response to the urban sanitation crisis, despite more sophisticated technologies and higher urban prosperity?

To answer the research question, this paper analyses the evolution of the urban sanitation sector over the last 200 years from an territorial political economy (TPE) perspective. By explicitly adding the territorial approach (Crevoisier, 2011) to the international political economy theory (Strange, 1988, 1996), the spatio-temporal nature of sanitation developments and the implications for collective action in the context of the globalisation of technologies, environmental issues, business and finance can be identified. The paper generates structured insights into the dynamics influencing the construction of sanitation as a public issue, the sanitation solutions implemented, and analyses how the costs and benefits, and the risks and opportunities of providing access to safe sanitation are distributed between public and private spheres across spaces and over time.

The paper is organised as follows: Section 2 reviews the existing literature on the urban sanitation crisis in light of Sustainable Development Goals (SDGs). Section 3 introduces IPE theory and adds the territorial approach to introduce a territorial political economy framework relevant to analysis of the urban sanitation sector. Section 4 charts the history of sanitation over the past 200 years along four ideal-type phases and outlines the emergent fifth phase under the era of the SDGs. Section 5 discusses the ongoing sanitation crisis and the challenges to the achievement of SDG6.2 considering the history of sanitation.

## 2. Literature review

The literature addressing the provision of access to safe sanitation under SDG6.2 can be divided into three broad realms. The first focuses on the innovation of adequate tools and technologies for urban sanitation, the second studies the advances in governing access to urban water and sanitation infrastructure and services, and the third highlights the struggles of vulnerable groups through analysis of the political ecology of water and sanitation.

### 2.1. Sanitation technologies

Studies from an engineering and planning perspective to achieve SDG6.2 predominantly focus on innovative technologies and planning processes for the provision of sanitation services in informal settlements. The prevailing centralised nature of sanitation infrastructure is criticised as teleological and essentialist, as it does not reflect urban realities around the globe and is ultimately unable to reach urban slums. Rather than top-down planning and centralised sanitation systems, it is argued that cities in the global South need inclusive planning tools and a decentralised sanitation system that solves problems at the scales that they occur (see, for example, Gambrill, Gilsdorf, and Kotwal (2020); Schertenleib et al. (2021)). By emphasising the need for technologies and planning tools that are feasible in informal urban contexts, these approaches have quickly become teleological in themselves, precipitously accepting the existence and sheer unmanageability of rapidly growing megacities and neglecting the broader political implications of spatially differentiated sanitation.

Continuing with the core assumption that radical technological change is needed to provide universal access to safe sanitation, work from sustainability transition studies and innovation research explores the lack of innovative potential of the water and sanitation sector. Central to the explanation of inertia in transition research is the concept of socio-technical regimes as dominant institutional rationalities, depicting persisting structural patterns between actors, institutions and technologies (Köhler et al., 2019). Early work focused on historical examples to understand the rapid expansions of sewers in late 19th-century Europe (Geels, 2006). Recent work tries to understand why innovations in the field of sanitation fail to scale up (van Welie, Cherunya, Truffer, & Murphy, 2018; van Welie & Romijn, 2018). Ongoing theoretical debates in the field suggest incorporating the increasing importance of international structures (Fuenfschilling & Binz, 2018) and to place socio-technical regimes in their contested social relations, providing the sort of understanding of power and structure that is absent in much of conventional socio-technical regime conceptualisations (Brand, 2012; Haas, 2019). In sum, however, innovation and transition studies remain descriptive approaches that fail to explain why certain regimes become dominant while others do not.

### 2.2. Water and sanitation governance

The governance literature is primarily concerned with drinking water and, to a much lesser extent, the provision of sanitation infrastructures and services, examining how different policies and institutional arrangements affect the effectiveness of service delivery. These studies take a predominantly neo-institutionalist perspective, based on the assumption that the institutional design affects the performance of rational actors through the regulations and incentives that they embody (Hassenforder & Barone, 2018). Studies on water governance predominantly address the questions of (a) scale, (b) participation and representation and (c) allocation mechanisms (Woodhouse & Muller, 2017).

Studies of multilevel water governance approach water-related processes at the basin level, i.e., the area where water is collected by the natural landscape and drained by a river and its tributaries. The multiple and often competing uses of water that coexist and are governed by different institutional arrangements give water governance an inherent

spatial dimension. The focus on multilevel governance can be used to show how hydro-logic and institutional processes from different scales intersect and partially overlap in the management of a watershed. The synergies and contradictions between institutional arrangements and their varying political legitimacy have been studied in order to understand how they affect the allocation of water to different uses and users, as well as its affordability, availability and quality (see, for example, Cash et al. (2006); Gupta and Pahl-Wostl (2013); Moss and Newig (2010)).

Studies in participation and representation of various actor groups have examined how the integration of different stakeholders affects the legitimacy of the policy-making process and the effectiveness of the resulting institutional arrangement, and how this integration can be optimised by relying on mutual learning and co-creation among the actors involved (see, for example, Gerlak, Heikkila, and Newig (2020); Jones (2011); Morinville and Harris (2014); Norström et al. (2020)).

In addition to the emphasis on scale and participation, an important area in the governance literature is the focus on allocation mechanisms. This work examines the processes and effects of liberalisation, privatisation or re-regulation of the water sector to determine whether markets are equitable and efficient allocation mechanisms for allocating scarce water resources, often with contradictory findings (see, for example Finger and Allouche (2002); Krause (2009); Lieberherr and Fuenfschilling (2016); O'Donnell and Garrick (2019)). To understand the effectiveness of service delivery, governance studies examine the material and political interests at play. This work includes, amongst other things, the assessment of willingness to pay (Alam et al., 2020), the reasons and paths of corruption in water utilities (Davis, 2004), the various economies of scale related to networked infrastructure (Mercadier, Cont, & Ferro, 2016), and transaction cost as well as efficiency effects related to public or private provision of water and sanitation services (Dagdeviren & Robertson, 2016).

In sum, studies of water governance tend to perpetuate a narrow techno-bureaucratic episteme of water scarcity, focusing primarily on national technical policy arenas and simplistic technical or bureaucratic fixes to conflicts, while underrating the wider political contestation and the territorial dimension beyond the biophysical surroundings (Hudson & Leftwich, 2014; Ioris, 2012a; Kashwan, MacLean, & Garcia-Lopez, 2019).

### *2.3. The political ecology of water provision and sanitation*

Urban political ecology, in contrast, focuses on people living in vulnerable situations who are denied access to safe sanitation. Political ecology, as an explicitly normative intellectual project, highlights the struggles of marginalised populations. Rooted in critical social theory and a post-positivist understanding of nature, political ecology posits that the production of knowledge about nature and the use of natural resources are inseparable from social relations of power (Bridge, McCarthy, & Perreault, 2015). Thus, these studies start with the main proposition that sanitation is a socio-ecological process which is inherently uneven, in terms of costs and benefits in social, economic, environmental or cultural terms (Gandy, 2006b).

Work from political urban ecology prioritises access to resources over the disposal of wastes. As a result, access to water and conflicts surrounding water scarcity have been widely studied (see, for example, Bakker (2007, 2017); Ioris (2012a, 2012b, 2016); Rodríguez-Labajos and Martínez-Alier (2015); Swyngedouw, Kaika, and Castro (2002); Truelove (2011). However, in the study of safe sanitation the importance of waste is marginalised (Karpouzoglou & Zimmer, 2016; Véron, 2006). The few studies on sanitation have analysed how sanitation systems in specific cities are historically contingent and laden with power conflicts (see, for example, Gandy (2006a); Karpouzoglou and Zimmer (2016); Sanchez (2019); Schramm (2016)). Most political ecology studies on water and sanitation have focused on a particular city. However, two notable exceptions

have provided comparative accounts. Swyngedouw et al. (2002) traced the development of urban water provision in Amsterdam, Athens, London, Seville and Tel Aviv, finding that there are four distinct phases of socio-environmental relations in urban water management. On the other hand, according to Gandy's (2006b) study of Lagos and Mumbai, sanitation is a struggle over urban citizenship and inclusion, as much as technical and managerial challenges. Apart from these two exceptions, however, the (urban) political ecology of water and sanitation suffers from what Angelo & Wachsmuth (2015) have termed a methodological cityism. This is the overwhelming analytical and empirical focus on single cities, neglecting both, the larger landscape in which the cities are embedded as well as the global processes of urbanisation. While studies in (urban) political ecology have been generally aware of the more global processes in which the provision of sanitation infrastructure and services is increasingly embedded, none of them has taken up the challenge of theorising the interdependency between global and local processes and their territorial articulation.

### **3. Theoretical foundations and analytical framework: territorial political economy**

From the literature reviewed, three major gaps have emerged. First, sanitation is, except for in the technological literature, treated as an appendage or outcome of water supply, rather than as a distinct process of locating and disposing of waste. Second, the wider political contestations and territorial articulations of (un)safe sanitation tend to be neglected. Third, political and economic discourses and constraints at the global scale and how they interact with national- and local-level sanitation governance are inadequately addressed. The research gaps serve as motivation to study whether political contestation and the interlinkages between global and local political economy dynamics can (at least partially) explain the slow progress towards achieving SDG 6.2. To do so, this paper deploys a territorial political economy framework that integrates the IPE of Susan Strange (1988, 1996) with the territorial approach of Crevoisier (2011).

#### **3.1. Bargains**

Key to the IPE framework is the analysis of the bargain between public authorities and market mechanisms in the deliberation over public issues. A bargain, then, first encompasses the degree to which an issue is perceived as a public or private responsibility. Further, a bargain is characterised by the social, political and economic arrangements that emerge to address the issue. Once implemented, those arrangements translate into structural power. IPE highlights four dimensions through which structural power in these arrangements takes shape. These dimensions are, namely, *security*, *knowledge*, *production* and *finance*. Finally, the analysis of the bargain describes its distributional outcomes in terms of costs and benefits, and risks and opportunities (Strange, 1988).

Adding the territorial dimension to the analysis allows identification of the spatio-temporal nature of sanitation developments and the implications for collective action in local milieus in the context of the globalising competition over quality of life (Crevoisier, 2011). In territorial terms, sanitation infrastructure and services, and the presence of waterborne pollution and disease, are the place-specific materialisation of bargains. They make visible how risks and opportunities, and costs and benefits for (un)safe sanitation are distributed across the scale of societal cohesion. Territory in this sense is understood as the subject of various historically contingent intentions and appropriations that mark it and thus becomes the matrix in which structural powers operate and on which they imprint (Crevoisier, 2004). The following section introduces the four dimensions of structural power in detail, using the empirical case of providing access to safe sanitation to show how the territorial approach enables operationalisation of the abstract theoretical frameworks of structural power.



### 3.2. Dimensions of structural power: security, knowledge, production and finance

The *security* dimension is the deliberation surrounding what is a hazard and the threshold at which it becomes a risk to the functioning of society, so that it needs to be eliminated or reduced by public authorities. While hazards occur naturally, risks are socially constructed by humans (Davoudi, 2014). The higher the perceived risk, the higher the willingness to pay to be protected (Strange, 1988). Orthodox IPE predominantly limits the security to the absence of violence and war, making the state the main provider of security. However, public health has an explicit security dimension as well. According to the World Health Organization, health security includes the protection against, control of and response to public health threats (World Health Organization, 2007). Similarly, the availability of adequate quantities of water of acceptable quality has a security dimension, amongst others, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability (UN Water, 2013). Recognising that public health is a security concern; that sanitation systems are the most important medical achievement of the past 200 years; and that the lack of wastewater treatment threaten health security, the orthodox IPE understanding of security that predominantly relates security to the absence of direct physical violence and war must be expanded to include the protection against individual and public health threats.

The *knowledge* dimension focuses on the possibility of determining what is considered to be legitimate knowledge, as well as who can create, disseminate and use that knowledge. Regarding sanitation, the knowledge dimension describes the deliberation over the causes of the public issue and subsequently the realm of legitimate solutions to address the identified problems. Thus, regarding sanitation, this concerns the deliberation over causes and threats posed by unsafe sanitation, optimal technologies and management schemes, and the expertise applied to evaluate the performance of sanitation systems in a certain space and at a certain point in time.

The ability to decide what gets produced, by whom and who can consume it is addressed in the *production* dimension. Regarding the sanitation system, this comprises the technology choices, operational business models, maintenance arrangements, and the relative importance and rewards that they give to the owner of land, labour, capital and technology. In territorial terms, sanitation systems predominantly depend on place-based, custom-built and continuous technologies such as septic tanks, sewers and treatment plants. They are, in general, land and capital intensive. Few parts in the sanitation system, predominantly pumping and advanced treatment stages, are solved by technologies produced and traded in global markets.

The *finance* dimension describes the sum of the arrangements governing the availability of capital and credit, particularly who provides funding for what, to whom and under which conditions. As investments in sanitation infrastructure are rarely carried by municipalities', cities' or even national governments' current revenues alone, this dimension scrutinises the different financing models that enable credit generation for specific sanitation systems. Highlighting the territorial dimension, where credit is generated spatially as well as socially can be traced, i.e., by public, private or third-sector entities. Further, the finance dimension scrutinises how the revenue generation to cover interest is structured, i.e., via general taxes, tariffs, cost-covering tariffs, or via a mixture.

## 4. A territorial political economy analysis of the history of urban sanitation

This section describes the evolution of sanitation over the past 200 years, tracing the development of access to safe sanitation across various scales from local to global (see Table 1). The section follows the waves of urbanisation, as this is where sanitation challenges emerge prominently. Most studies regarding the evolution of urban water and sanitation systems highlight four phases (see, for example, Swyngedouw et al. (2002)). The presented analysis supports these phases by and large, while adding an emergent fifth phase for the era of the SDGs. Each phase operates under a different bargain and has a distinct approach to sanitation. The bargains are analysed along the four dimensions of structural power, the role of authority and market, and the – territorial – distribution of costs and benefits, and risks and opportunities. Combined with the relative performance of each phase, the analysis helps to identify the nature of bargains that are more likely to advance access to safe sanitation and thus gives insights into how to accelerate progress towards achieving SDG6.2.

### 4.1. Phase I: Pre-industrial period

The first phase of sanitation history covers the period before the industrial revolution, when cities rarely housed more than 100,000 people. Without knowledge of bacterial transmission of disease at the time, faeces were perceived less as a threat to human health but more as a valuable fertiliser, similar to manure. Buckets and cesspools were used to dispose of faeces. Emptying the containers was the job of particular social classes, euphemistically called night-soil men, as they collected faeces at night and sold them to farmers as fertiliser. The acquisition of sanitary infrastructure and the organisation of services were private tasks, and the level of service was strongly linked to the wealth of individual households (De Feo et al., 2014; Ferguson, 2014b; Illi, 1992; Lofrano & Brown, 2010).

### 4.2. Bargain I: Local market

The brief history of urban sanitation commences with a bargain operating at the local scale of the home or neighbourhood, in which market mechanisms organise sanitation. This *local market* bargain was strongly influenced by the mercantilist economic liberalism of the early 19th century, under which the authority of the aristocracy was gradually replaced by the entrepreneurial bourgeoisie. Entrepreneurial freedom and individual accumulation of material wealth were considered development in itself. Accordingly, the organisation of sanitation was seen primarily as a private matter. The management and governance of sanitation occurred at the individual household scale and were a private, not a public, responsibility.

Households invested in sanitation infrastructure, such as cesspools, and bore the **cost** for the service from night-soil men based on their ability and willingness to pay. As a result, the **benefits** of sanitation were visible mainly in private spaces. The **opportunities** under the *local market* bargain lay with the service providing night-soil men and with farmers close to cities. The **risks**, on the other hand, lay with households that could not afford to invest in cesspools and pay the night-soil men (Ferguson, 2014a). The **spatial organisation** of the city at the beginning of the 19th century was only weakly articulated. Due to the uncontrolled and rapid population growth during industrialisation, different socio-economic groups often literally lived on top of each other. This spatial overlap of rich and poor citizens, and of clean and polluted spaces, resulted in vertical segregation of the city, which was exacerbated by the private organisation of sanitation.

**Table 1:** Global development patterns of the sanitation sector over the past 200 years. Phases 1-5 describe periods in which a type of sanitation became established and was stable. The phases differ both in terms of the technical systems primarily used and in terms of the social arrangements that were necessary to maintain these relatively stable constellations. Source: Author.

		<b>Local Market</b>	<b>City Health</b>	<b>National Environment</b>	<b>Global Privatization</b>	<b>Global Market</b>
<b>Phase &amp; rough time</b>		I: until ~1860s	II: ~1860s – ~1950s	III: ~1950s – ~1990s	IV: ~1990–ongoing	V: ~2008–ongoing
<b>Territorial form</b>		Pre- and early industrial centres	Cities of industrialization and centres of colonial trade	Urbanizing and industrializing nations in global North and East Asia	Cities and nations across the globe, with access to safe sanitation in place	Cities and informal settlements, without access to safe sanitation
<b>Dimensions of structural power</b>	<b>Security</b>	Irrelevant	Decisive	Decisive	Decreasing relevance	Low relevance
	<b>Knowledge</b>	Experience and religion based, not scientific	Medical science and civil engineering	Natural science and environmental engineering	Environmental science and neoliberal economics	Interdisciplinarity, toolbox engineering and business/entrepreneurship economics
	<b>Production</b>	Buckets and local entrepreneurs	Sewers and public utilities	Sewers, WWTPs and public utilities	Sewers, WWTPs and private utilities	CBS, FSM and social entrepreneurs
	<b>Finance</b>	Private investors	Municipal bonds	National bonds and MDB credits	MDB credit, full cost recovery tariffs	Private investors / impact investors
<b>Bargain</b>	<b>Costs</b>	Households	Municipal public authorities	National and municipal public authorities	Public authorities & Households	Households, charities, philanthropies
	<b>Benefits</b>	Private realm	Urban population	National population	Affluent urban population	Private realm and neighbourhood
	<b>Risks</b>	Diseases, pandemics	Water pollution, ecosystem collapse	Public debt, wasting water	Decaying infrastructure, no expansion	Diseases, pollution, social differentiation
	<b>Opportunities</b>	Fertilizer & business	Sewerage construction, increased labour productivity, interests on municipal bonds	WWTP development and construction (e.g., technology, consulting services)	Monopoly rents for private operation	Resource recovery and reuse & private businesses

### 4.3 Phase II: Sanitary revolution

Water was a central resource to early industrialisation. It served as the dominant means of transport, a main source of energy and as input to all production processes. As a result, all early industrial centres of Europe and the United States grew close to large rivers (Gandy, 1998). The share of the urban population doubled and tripled across Europe due to the massive increase in demand for labour to operate the growing factories between 1830 and 1880. This period of urbanisation was unplanned, informal and resulted in congested cities with deteriorating living conditions for the new urban working classes. Many struggled to survive and were unable to pay for the services of the night-soil men. Thus, an increasing proportion of faeces ended up in the streets and open drains, from where the occasional rain drained it into rivers. The constant pollution and the high population density created an environment which facilitated the spread of diseases, resulting in life expectancies between 35 and 40 years. During the 19th century, cholera spread across the globe in five different pandemic waves, with mortality rates between 2,200 and 8,900 deaths per 100,000 inhabitants of the affected cities<sup>1</sup> (Abellan, 2017; Daude, Eliot, & Bonnet, 2008; Phelps et al., 2018). The spread of cholera was facilitated by the intensifying commercial relations between the expanding empires of the time. This enabled the water-borne disease to spread from until-then isolated countries, affecting the rapidly urbanising centres most severely. While cholera predominantly spread fastest amongst the urban poor, the better-off were not immune to the disease. Thus, the entire city desperately needed a solution to the recurring cholera pandemics (Rosner, 2020).

During the first three cholera waves, *scientific knowledge* on the sources and paths of transmission for the disease was sparse. As a result, different, often xenophobic, explanations competed. For a long time, the miasma theory, which proposed that cholera was transmitted through the air by bad breath, was prominent in explaining the rapid spread of the disease. It was only after the doctor and physician John Snow famously stopped the cholera outbreak in London's Broad Street, by taking off the handle of a contaminated water pump, that faeces-polluted water was slowly beginning to be established as the cause for cholera. During the Hamburg cholera outbreak of 1892, 50 years later, there was a stand-off between the miasmatic theories and the contagionist arguments of Robert Koch who blamed the contamination of the water supply for the spread of cholera and called on the German authorities to take decisive action. Aside from the scientific debates over the transmission of cholera, social reformers such as Edwin Chadwick used the statistical methods of emerging empirical science to establish the causal relationship between poverty, burden of disease and the physical environment. He argued for strategic city-wide action to collectively eradicate poverty, disease and pollution with coordinated social (for example, public health services) and technological (for example, sewer systems) innovations (Halliday, 2019).

Unhealthy sanitary conditions were recognised as a *public security risk* only after the nightmare and devastation of cholera in London, Paris, Berlin and other cities started to imperil the riches of the wealthy created by industrialisation and the functioning of the industrial society itself. Now, sanitation was being addressed more systematically, which allowed political, economic and technical spheres to be considered in relation to one another. As a result, the improvement of urban drainage systems to direct wastewater streams, the provision of unpolluted water for drinking and cleaning, and the control of the rivers to prevent flooding were central measures to curb pandemics and secure the development of industrial cities (Rosner, 2020). With the increasing priority of public health and the emergence of hygiene discourses as well as the discovery of cheap

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<sup>1</sup> As a comparison, the COVID-19 pandemic has a mortality rate in the range of 200–500 deaths per 100,000 citizens (<https://g.co/kgs/w3uVja>).

natural and synthetic fertilisers, water containing faeces was no longer perceived as a manure in demand but as a harmful threat to society that needed to be controlled and eliminated by public authorities (Gandy, 2006a; Sedlak, 2014).

Large-scale sewer networks and the embankment of rivers were the core *measures produced* to limit human contact with wastewater and increase the control over water in the city in general (Halliday, 2019). As a consequence, slums, which were often located in close proximity to rivers, had to be resettled. Towards the end of the 19th century the understanding that sanitary dwellings which are affordable and close to factories improve the productivity of labour and the prosperity of the entire city was firmly established (Stilwell, 2015). In cities across Europe and the United States, widespread urban upgrading and resettlement were facilitated by public housing programmes (Bisaga & Norman, 2015; Halliday, 2019, p. 139). This resulted in a new urban form which was characterised by horizontal, rather than vertical, segregation of the urban population (Gandy, 2006a). In this new urban form, the construction of sanitation infrastructure and the provision of services were the responsibility of public utilities (Hall, Lobina, & Terhorst, 2013). With the recognition that public health and the productivity of the city's industrial labour force is embedded in social conditions, the establishment of national health systems integrated in emerging social welfare states was an institutional innovation to respond to the cholera pandemics (Rosner, 2020).

The proportion of cities that had established public utilities for the management of water and sanitation systems rose from 50 percent to 90 percent between 1850 and 1900. The provision of sanitation at scale through public utilities in the 19th century was made possible by the invention of new *financial instruments* such as municipal bonds. Municipal bonds enabled the realisation of large engineering projects without increasing the tax burden on the general population. In addition, cross-subsidies from profitable publicly organised sectors such as gas or water supply were used to finance investment as well as operation and maintenance in the loss-making sanitation sector (Abellan, 2017; Gandy, 2006b; Szreter, 2002).

### 4.3. *The city health bargain in phase II*

The transition from the first phase to the second was strongly marked by social upheavals. In the passage from mercantilism to the Industrial Revolution, the urban labour force became essential for the survival of cities, which increased its systemic importance. Under these conditions the health of the urban working class, who were the basis of wealth accumulation, drastically deteriorated through the frequent cholera outbreaks and other water-borne diseases. This threatened the success of the liberal economy in general and the survival of the cities in particular. Health was no longer perceived as a purely individual responsibility, but as a threat to society. In general, there was an increase in recognition that individual responsibility and entrepreneurship were insufficient solutions to increasingly public health challenges.

Against this backdrop, the *city health* bargain, which characterised phase II, moved decision making from private household to the municipality. The pressure from organising workers and the growing recognition that individual health depends on public health strengthened city authorities and the general capability of collective action. The ensuring of urban development through the provision of public goods, such as sanitation infrastructure but also health care in general, to the entire population by city authorities through the newly established municipal utilities is at the heart of this *city health* bargain. With public actors, such as municipal authorities and utilities, in charge, the rapid and widespread implementation of sewers was facilitated by the development of eminent domain and property taxation, both measures that allow public interests to prevail over private ones (Gandy, 2006a). As a sign of their growing role and strong legitimacy, cities boasted of their public infrastructure, which is still visible today in the often very elaborate

designs of rather functional infrastructure such as pumping stations and water reservoirs (Kaika & Swyngedouw, 2000).

In sum, sanitation was strategically approached as a public issue with economic, social and infrastructural dimensions at the scale of the developing cities. At the core of the bargain was providing security through improving public health. As a result, **benefits** accrued to all citizens, labourers and the elites alike. Entrepreneurs and the bourgeoisie were willing to carry the **cost** through subscribing to municipal bonds and accepting higher taxes as they saw the direct benefit for their own health, which they could no longer effectively protect with private means. The prosperity of their businesses also benefited through the increased productivity of the labour force. Companies and, later, with the growing middle class towards the end of this period, private individuals suddenly became shareholders in public infrastructure and financial beneficiaries of public infrastructure projects by earning interest from the bonds signed (Crow, 2007).

With rapidly decreasing health **risks** and increasing public services, **opportunities** for the entire urban population to successfully and independently shape their lives were increasing. This made the city the epicentre of innovation and societal progress. Risks were externalised by transporting faeces outside the city and discharging them into water bodies.

In the *city health* bargain, the dominant actors in the security, finance and production dimensions overlap at the scale of the city. This spatial aggregation of structural power results in reinforcing dynamics, which stabilise the *city health* bargain for a relatively long period of time and characteristically reshape the design of the city into what has been termed the modern infrastructure ideal (Monstadt & Schramm, 2017). City-wide sanitation networks, extensive public housing projects and resettlement of urban slums led to cities that became increasingly spatially differentiated. In these cities, sanitation infrastructure was a strong driver for social inclusion and equality through reducing spatial differentiation (Halliday, 2019). In stark contrast to industrial cities, the colonial centres across the global South, from and to which cholera spread along trade routes, protected against the spread of diseases through spatial and racial segregation of the urban population through so-called cordons sanitaires. Segregation was preferred over the high investments in sewers and public health services, amongst other reasons, because the security, production and finance dimensions did not intersect in the same ways as in the industrial cities. Also, the urban working class was both of less systemic relevance to the flourishing of the city and in most cases completely deprived of any rights. If sewers were built, these were only in areas inhabited by settlers to provide a European lifestyle and to manifest the power of the colonizers (Beverley, 2011; Gandy, 2006b; Njoh, 2009).

#### *4.4. Phase III: Managing the human–nature interface*

During the public health revolution of the 19th century, sewer networks were expanded in anticipation of continued rapid urbanisation, laying the groundwork for formalised urban growth during the 20th century. With decreasing rates of urbanisation, larger public housing projects and smaller dwellings were continuously connected to the already existing trunk sewer lines. The living standards and hygienic practices emerging at the turn of the 20th century resulted in the relocation of cleaning activities into the household and thus in a rapid increase in the demand for fresh water. Consequently, engineering activities over the first half of the 20th century were predominantly concerned with improving water purification and distribution networks (Halliday, 2019). In contrast, the direct discharge of sewage into rivers was still the dominant practice. As it was observed that rivers cleaned themselves over certain distances, the concept that dilution is the solution to pollution was firmly established. As a result, only limited experimentation with wastewater treatment was carried out until after the middle of the 20th century (Sedlak, 2014). Fordism was the guiding model for production, trade and consumption in the early

20th century. Thus, the resulting shift from manufactory to modern industry, the growing middle class and the associated mass production and mass consumption increasingly patterned industrial cities and societies (Antonio & Bonanno, 2000). Accelerated industrial production and agricultural intensification, as well as the introduction of chemical detergents, along with the increasing amount of wastewater discharge from ongoing urbanisation, dramatically increased the amount and variety of water pollution towards the middle of the 20th century.

For the first half of the 20th century, polluted water was seen as an unpleasant side effect of industrial transformation. Moreover, respected leaders in the *knowledge dimension* did not see wastewater treatment as a necessary part of the water system. The purification of drinking water was seen as the cheaper and more efficient solution to control the spread of water-borne diseases. However, recurring ecological disasters in the 1950s and 1960s, i.e. foaming rivers, mysterious mass deaths of fish and so-called dead lakes, made the deteriorating conditions of water ecosystems unmistakable (Sedlak, 2014). The ecological crisis of water ecosystems was highlighted by the growing field of natural sciences. In addition, the apparent deleterious effects of humans on their natural environment provided the impetus for systemic approaches in the natural and environmental sciences. The establishment of research institutes devoted to specific realms of the environment was a distinct strategy to improve water quality through the effective management of the human–nature systems, predominantly through integrating a systemic approach in the development of new environmental regulation and technologies (Mieg & Frischknecht, 2014). On a global scale, the most prominent proponents of system approaches have united in the Club of Rome think tank to promote the interdisciplinary approach in science and policy alike (Colombo, 2001).

*Public security concern* was raised by farmers, fishermen and emerging middle-class environmentalist movements to highlight the crisis in the water ecosystem. This grew into a new consciousness of the environment, stressing that rivers do more than turn turbines, float boats and carry off sewage. The fear of toxic and dysfunctional water ecosystems created and translated into a dominant public perception that sanitation infrastructure had to protect both the public health of citizens and the national water ecosystems (Kline, 2011; Sedlak, 2014).

The development of end-of-pipe solutions in the form of WWTPs situated at the main sewer outlets was the *dominant solution produced* to protect water ecosystems for three main reasons. First, the volume of pollutants released from industries and households to environments was minimised effectively. Second, the central location enabled the simplification of the complex human–nature relationship to a single interface which could be closely monitored. Third, few changes in production processes and consumption patterns were needed (Mengist, 2020). The introduction of wastewater treatment enlarged the sanitation system. The WWTPs encouraged the formation of new industries for treatment technologies and engineering consultancy, while the constant monitoring of water quality and the operation of WWTPs added further responsibilities and costs to the public budget (Federer, 2015).

The surge in wastewater treatment rates across Europe from below 10 percent in 1950 to above 80 percent in 1990 would not have been possible without changes in the *finance dimension* that enable substantial public investment (Hall et al., 2013; OECD, 2019b). The World Bank and the European Investment Bank were formed to support states in achieving public objectives, including the provision of basic services to the entire population through public utilities (Engen & Prizzon, 2018). These multilateral development banks (MDBs) in combination with national development banks enabled nations and cities to take turns in constructing basic infrastructure, which they were unable to afford from their running budgets (Clifton, Díaz-Fuentes, & Gómez, 2018). The 1960s saw a surge of regional MDBs as a reaction to the lack of attention that developing countries

received from the World Bank and the European Investment Bank. They provided the investment structures as well as the international collaboration needed for globalising large-scale sewer networks and centralised wastewater treatment (Ben-Artzi, 2016; Engen & Prizzon, 2018).

#### 4.5. *The national environment bargain in phase III*

The transition from the second to the third phase was triggered, amongst other things, by the accelerating changes in human–environment relationships. What had long been the solution to public health challenges related to wastewater increasingly became an ecosystem health crisis, as nature could not keep up with cleaning up the increasing volume and diversity of wastewater.

Against the backdrop of environmental degradation spreading beyond the territory of city boundaries and affecting entire water basins, a new bargain was needed that was adequate to the novel spatial dimension of water pollution. National authorities emerged as the dominant forces in environmental planning. This was reflected, for example, in the establishment of ministries of the environment and public research institutes. Given the interconnectedness of sanitation issues, national environmental authorities' role in urban, environment and sanitation planning steadily increased (Federer, 2015).

The *national environment* bargain, which characterised phase III, is strongly influenced by Keynesian economic ideals of the mid 20th century, under which the extension of public services and the promotion of full employment through public policies are seen as the main tasks of governments to stimulate development. In the case of water management, this resulted in the logic of “more water – more cleaning” (Finger & Allouche, 2002). Consequently, sanitation, now including wastewater treatment, was approached as a strategic tool to develop the nation, for example, by providing the same levels of service to all citizens. This was seen as a public, not a private responsibility. With public actors, such as the newly created national environmental protection agencies and strengthened public utilities, leading the way, rapid and widespread implementation of wastewater treatment was further facilitated by the creation and enforcement of water protection regulations and constant water quality monitoring. Both measures allowed the environment to have a voice in public discourse.

The **costs** of expanding sanitation infrastructure and improving wastewater treatment were financed by national governments through tax increases and the issuance of bonds. In addition, the emerging MDBs facilitated infrastructure investments by providing concessional loans, which were ultimately also financed from public budgets. Over an extended period of time, successful companies and the growing middle class were willing to help governments meet these costs by investing in bonds and paying high taxes. They saw the immediate **benefits** of wastewater treatment for the natural environment they were surrounded by and which was becoming increasingly popular for recreational activities that were recognised as important for healthy and productive living.

The expansion of the sanitation sector to treat almost 100 per cent of wastewater opened up a range of **opportunities** in science, technical consultancy and construction. As a result, the third phase saw the emergence of more private companies specialising in the design and construction of environmental infrastructure such as wastewater treatment plants. At the same time, public authorities drastically increased their spending not only on investments but also on operation, maintenance and renewal of wastewater infrastructure, which brought with it the **risks** of indebtedness (Finger & Allouche, 2002).

Widespread government investment in sanitation, which placed a high priority on protecting public health and the environment, aimed to provide the same infrastructure to all citizens. As a result, treatment rates in global North countries rose above 80 percent. This led to a sharp decline in the contribution of sanitation and water pollution to the



**spatial differentiation** of populations, regardless of urban or rural areas. In contrast, spatial segregation remained the dominant strategy to protect colonial elites from the risks of polluted water until the end of colonisation. In many examples, spatial segregation was also adopted by postcolonial elites as a strategy of domination. As a result, expansion of sewer networks and implementation of WWTPs were slow and concentrated in business districts and wealthier residential areas. This created spatial legacies of inequality (Njoh, 2012).

#### 4.6. Phase IV: Privatisation and new public management

By the mid-20th century, providing basic infrastructure for the entire population had become a strategic national interest (Swyngedouw et al., 2002). Many states in the Global North provided almost all of their citizens with sewerage networks and sewage treatment plants, often without regard to financial and ecological efficiency or acute need. Furthermore, (former) colonial centres were equipped with the same infrastructure to provide the colonial elites with a European lifestyle. As a result, a globally dominant “gold standard” for providing sanitation was firmly established. Technologically, it was comprised of household devices such as water closets which were connected to vast sewer networks and custom-built, large-scale WWTPs. Administratively, it was organised through public utilities in full charge of providing sanitation services from planning sewer networks to the operation of WWTPs. Financially, public subsidies at the national and credit generation at the international scale were critical for investment and operation and management alike (Nilsson, 2016). The comprehensive public provision of sanitation effectively reduced the threats from polluted water to people and the environment. However, it came at the cost of growing public debts.

With the neoliberal revolution in the *knowledge dimension* setting in during the 1980s, increasing budget deficits became associated with the idea that governments had become overloaded and ungovernable. Subsequently, the role of government in the production of public goods through infrastructure was increasingly challenged. The lack of competition and the absence of market mechanisms in determining prices for public services were identified as two of the main causes of inefficient and therefore loss-making public service provision. As a corrective measure, the role of the public sector was rolled back and the role of the private sector was pushed forward through a comprehensive liberalisation and tax-cutting agenda, and the introduction of new public management principles (Harvey, 2007).

Due to the progress made in rolling out sewerage networks and WWTPs, sanitation and the threats from water pollution were perceived less as a *public security issue* that had to be prevented at any cost. Rather, the steady growth of the world’s population and the accelerated industrialisation of agriculture led to increasing concerns about water scarcity (Kaika, 2003). Environmental concerns about the lavish use of water together with the growing acceptance of economic expertise and market prices for the efficient allocation of scarce resources resulted in the declaration of water as an economic good at the Rio Summit in 1992 (Finger & Allouche, 2002).

With respect to *production*, the sanitation sector had changed only incrementally between phases III and IV. Moreover, the design of sanitation infrastructure had been copied through blueprint designs for major cities across the globe (Hoffmann et al., 2020). Besides the strong path dependencies built into the sewer networks, the introduction of economic expertise that came with the neoliberal turn shifted the focus from expansion of networks and service provision to the economically efficient management of utilities. The repeated rounds of governance reforms that introduced market logics into the water and wastewater sector were primarily guided by the idea of unbundling the natural monopolies of public basic service provision to allow for competition. In this process the state was transformed from a service-provider into a regulator. The operational units of

the administration were transformed into utilities that function like commercial entities and which face citizens as customers. The separation of utilities from the state apparatus enabled the participation of the private sector in various forms of public–private partnerships, from management contracts to build–own–operate–transfer models, to concession and – in some instances – full divestiture. The privatisation of the water and sanitation sector has been accompanied by the rapid growth of multinational private utilities, such as Suez, Veolia and Berlin Wasser, which often specialise in taking over basic service provisioning from governments (Bakker, 2003; Finger & Allouche, 2002).

In contrast to the incremental technological improvements, phase IV brought radical changes in the *finance dimension*, i.e. in how investments in sanitation infrastructure are organised and in the ways that the operation and management costs are covered. Regarding investment, infrastructure was perceived as a new asset class for private investors. The limited public funding available was increasingly used to leverage private investment (Laboul & Schwartz, 2018). The new public management paradigm reorganised the provision of sanitation services along three principles: first, that any household or company has a willingness to pay for sanitation services; second, that polluters pay for the services they receive through tariffs that depend on their demand; and third, that these tariffs should not only account for the service but also for full cost recovery of the infrastructure investments. To realign public utilities accordingly, an increasing share of public funds in sanitation has been devoted to institutional reforms aimed at utility management. This is especially visible in the structuring of credits from MDBs, where governance reforms focusing on unbundling have become a quasi-requirement to access credit (Andrews, 2013; World Bank, 1994). During liberalisation and privatisation of the water and sanitation sector, the maintenance of the existing wastewater infrastructure was neglected or at least minimised. As a result, massive infrastructure debts accumulated in the cities of the global North in the form of unrealised investments in the maintenance and renewal of the sewer networks and WWTPs (Tscheikner-Gratl et al., 2020).

#### *4.7. The global privatization bargain in phase IV*

The transition from the third to the fourth phase was triggered partly by growing concerns with national debt, which was perceived to threaten the development of nations. The public health and environmental pollution situations were seemingly under control. However, the increasing tasks of the state, such as wastewater treatment, public expenditures in the form of infrastructure investments and operating costs, rose permanently. The transition from phase I to phase II was driven by a collective security threat closely linked to sanitation. In contrast, the transition from phase III to phase IV was triggered by the global revival of liberal ideologies, which hardly emanated from the sanitation sector but from a newly emerging worry about the state as the problem rather than the solution to public issues. This reversal from a Keynesian to a neoliberal approach to public issues fundamentally transformed the provision of basic services, including sanitation. As the problem pressure, the health of the population and the water-ecosystems, was seemingly under control, supporters of neoliberal ideologies successfully criticised the growth of administrations and the growth of financial deficits, as well as the emerging cases of mismanagement in the sanitation sector. In particular, the superiority of the market over public authorities in ensuring the welfare of society in general and in the optimal provision of basic services was successfully propagated. This translated into a dominance of economic expertise in the knowledge dimension and a focus on lowering taxes, and removing resources from the government in order to take its tasks to the market as far as possible (Harvey, 2007).

The transition into the fourth phase involved an abrupt shift back from public authorities to markets as the dominant forces determining the provision of sanitation services. The *global privatization* bargain which emerged operates at the global scale and puts the management of utilities at the forefront of the discourse in the sanitation sector. At the

heart of the *global privatization* bargain is the joint focus on financial efficiency and individual responsibility which conflate with the desires of environmental protection. This is visible in the commodification of environmental services and their subsequent allocation through market mechanisms as the silver bullet. As a result, it is generally perceived as imperative that private actors, predominantly public sector multinational corporations, or at least corporate public utilities, are responsible for basic services. In the case of sanitation this resulted in three major changes in the role of public authorities: first, from the provider of sanitation infrastructure and services to the regulator of (private) service providers; second, from the infrastructure investor to enabler of private investment opportunities by ensuring returns and de-risking; and third, from managing the monopolies associated with network infrastructure to deliberately unbundling them to create markets for as many components as possible (Bakker, 2014; Finger & Allouche, 2002).

However, the initial **cost** of infrastructure investments, if not already made, largely remained the responsibility of public budgets. In contrast, the **benefits** of improved water supply and sanitation were shifted to the more affluent segments of the population, where the return on investment is more likely.

Unbundling opened up new **opportunities** for the private sector to enter monopoly markets, usually backed by public guarantees. As tariffs in water supply and sanitation are particularly politically sensitive, the focus on operational efficiency and a positive balance sheet for utilities puts at **risk** maintenance expenditures and renewal investments that have no immediate economic benefit but are important for the longer-term functioning of the system. These risks remain with the local authorities, who are ultimately the owners of the infrastructure (Hall et al., 2013).

Governments with large investment needs for basic infrastructure, in particular the emerging economies of the global South, were increasingly dependent on credit from MDBs. In contrast to phase III, in which MDB lending was mainly to shareholder governments, the relationship between MDBs and borrowers changed in phase IV where borrowers generally are not shareholders. With neoliberal governments as main shareholders of large MDBs, the banks became a main lever to transport the *global privatization* bargain to borrowing governments by the means of structural adjustment programmes. The MDBs increasingly used their hegemonic position to also dominate the knowledge dimension by rolling out the new public management paradigm as *de facto* conditionality for creditworthiness. Through the subsequent commodification and financialisation of human–environment relationships, sewers and WWTPs became an asset class for investors and sanitation a service that is offered to consumers (Bigger & Webber, 2020).

With power shifting from the security dimension at the local and national scales to the finance dimension at the global scale, sanitation is increasingly provided when cities and nations can articulate their demand on the global markets to attract investments in basic infrastructure. As a result, regions, cities and neighbourhoods are served according to anticipated returns on investments rather than the burden on the public health and local water ecosystems. In the global North, this leads to an increase in **spatial differentiation** within and between cities among those who can afford to live in a beautiful and safe urban environment and those who cannot (Pauli, 2020). Regarding the global South, the fast-growing informal settlements continue to be left behind, as they neither offer investment security nor promise lucrative service arrangements.

#### 4.8. Phase V: Enabling the sanitation economy

When the Sustainable Development Goals were adopted in 2015, the *global privatization* bargain was firmly in place. However, this bargain has not provided a solution to access to safe sanitation for two billion people who live predominantly in informal settlements in the urban areas of the Global South. Rather, these settlements are predominantly served informally by subaltern sections of the urban population, often direct successors of the

so-called sweeper class established under colonial rule. They operate similar to the night soil men of the 20th century, but instead of selling faeces as fertilizers to farmers, they dump the wastewater into the nearby open environments. This results in deteriorating public health conditions and constant pollution of the environment, the persistent sanitation crisis (Zaqout, Cawood, Evans, & Barrington, 2020). As it is precisely this context that is crucial for achieving SDG 6.2, the description of phase V focuses on the emerging sanitation sector that seeks to provide access to safe sanitation in rapidly urbanizing areas of the global south.

Building on and continuing the dominance of economic expertise in the *knowledge dimension*, Phase V is characterized by entrepreneurial know-how as decisive for realizing access to safe sanitation in informal urban areas of the global south (Fischer, Kokko, & McConville, 2021; Otoo & Drechsel, 2019; World Bank, 2019). Furthermore, private actors such as philanthropic foundations and charitable NGOs are in more dominant positions in the knowledge production and dissemination process. The Bill and Melinda Gates Foundation (BMGF), for example, is playing a leading role in positioning the emerging sanitation economy as an attractive business opportunity for entrepreneurs. Tellingly, the organisation lists sanitation in its portfolio not under global health but under global growth and opportunity. BMGF is funding the development of disruptive sanitation technologies through the “re-invent the toilet challenge”; spearheading standardisation processes for sanitation systems which function without sewers; and advocating for the paradigm shift towards a sanitation economy that is said to be necessary for achieving SDG6.2 (Bill & Melinda Gates Foundation, 2018; Bill and Melinda Gates Foundation et al., 2017). In parallel to business know-how, environmental science is dominating the sanitation sector by demanding that a deeper understanding of resource cycles is applied. Thus, it is no longer enough to remove hazardous wastewater and clean it. Rather, the resources it contains must be efficiently returned to the material cycle in order to minimize the ecological impact of urban societies (Hoffmann et al., 2020; Orner & Mihelcic, 2018; Rodriguez, Serrano, Delgado, Nolasco, & Saltiel, 2020). In sum, sanitation and development specialists regard incremental changes to centralised sanitation systems as insufficient for the wastewater management of the 21st century in general and to solve the urban sanitation crisis in the global South in particular (Gambrill et al., 2020). Rather, they posit that sanitation systems need to be made fit for purpose, through re-imagining wastes as resources, solving sanitation challenges at the scales at which they occur, and changing from supply led provision by public authorities to a demand led provision organized by market mechanisms. Focus should be as much on waste removal as on generating profitable outputs such as potable water, recycled nutrients, compost and energy to close resource cycles and make the sanitation sector profitable (Bill & Melinda Gates Foundation, 2018).

The provision of access to safe sanitation is no longer perceived primarily as a public *security* issue. Rather, in the face of a global water scarcity crisis, exacerbated by the effects of global climate change, centralized water-based sanitation systems have evolved from protectors of local water ecosystems to threats to water security itself. (Hoffmann et al., 2020; Robins, 2019; Sithole & Morales, 2020). In parallel but in the opposite territorial direction, the public health threat of waterborne diseases has changed. Since the 1970s, cholera epidemics have occurred repeatedly in the cities of the global South. In contrast to the pandemics of the 19th century, cholera today rarely spreads beyond the population and neighbourhoods where it broke out (Mutreja et al., 2011). More broadly, waterborne diseases are increasingly being replaced – at least in the public perception – by viral airborne diseases such as MERS, SARS, Ebola and most recently COVID19 as the main threat to global public health security (Campbell-Verduyn et al., 2020) .

Phase V differs crucially from Phase IV in that the logic of unbundling is expanded to the technological level and becomes the overarching paradigm in the *production dimension*. As the centralized gold standard of sewers and WWTPs is conceived as inadequate against the backdrop of the changes in the knowledge and security dimension, the concept of the *sanitation service chain* is becoming the dominant blueprint along which sanitation systems are designed, implemented, and evaluated in the context of informal settlements. According to this logic, sanitation is divided into the components of collection, containment, discharge, transport, treatment, safe disposal and reprocessing of wastewater. Thereby, each step can be carried out by different and interchangeable actors with specific technologies. Unlike in networked sewer systems where a single utility is in charge of the entire process, here the optimal configuration of actors makes the service chain work. CBS (see Russel et al., 2019), safe FSM (see Berendes et al., 2017) are two ideal typical configuration of the sanitation service chains, which are most widely promoted as alternatives to sewerage. In the context of the desired (circular) sanitation economy to achieve SDG6.2, developing technologies for safe sanitation is only half the equation. With the increasing dominance of economic and business expertise in the knowledge dimension, the focus is on innovating, testing and producing optimal business models that enable the sanitation sector to function safely without government subsidies has become the second half of the equation (Mallory et al., 2020). Organisations such as for example the Toilet Board Coalition specialize in the development of feasible business models for a (circular) sanitation to reap commercial and societal benefits faster at scale by enabling the for-profit provision of sanitation as a service while generating marketable outputs (Beevor, Magarinos-Ruchat, Hicks, & Lane, 2017). The promise of modular technologies along the sanitation service chain lies in scaling units rather than networks to make sanitation infrastructure more flexible in terms of management and service delivery and more efficient in terms of closing resource loops (Heiberg, Binz, & Truffer, 2021). The concept of "scaling units" refers not only to scaling sanitation within an informal settlement, but also to scaling the production of standardised modules and business models to manage sanitation service chains on a global scale. This makes the concept attractive to multinational actors, such as Veolia that is actively seeking "sustainable economic models" that they can apply globally and expand their operations to previously unserved areas (Couder & Kibutu, 2020). In summary, the sanitation service chain, modular technologies and the (circular) sanitation economy have become the dominant solutions in the production dimension. However, they do not actively challenge the dominant gold standard of large sewerage networks and centralised sanitation facilities. Indeed, they explicitly are positioned as partial solution for informal and hard to reach areas in the quest for city-wide and inclusive sanitation. In this regard, they complement centralised sanitation systems which remain the firmly established gold standard in densely populated formalized urban areas (Gambrill et al., 2020; Schrecongost, Pedi, Rosenboom, Shrestha, & Ban, 2020).

Sanitation experts and development economists agree that the public sector alone cannot raise enough funds to ensure universal access to safe sanitation. To bridge the gap, new financing instruments to increase private investment are being tested and advocated (UN Water, 2018). These include blended finance, which combines private loans with official development assistance on the one hand, and social impact investments by philanthropic organisations on the other. The former is mainly used for the expansion of sewer systems to wealthier areas of the emerging middle class, while the latter is preferred for non-sewered sanitation systems in informal settlements (OECD, 2019a). In general, the long lifespan of sanitation infrastructure and political risks are the main barriers to attract private investment to finance sewer infrastructure. Private participation focuses rather on service delivery, while financing sunk investments and subsidising wastewater treatment is covered by public funds (Goksu, Trémolet, Kolker, & Kingdom, 2017). However, the most important change in the finance dimension in Phase V is the

orientation of sanitation towards service delivery. The public sector assumes the regulating and enabling role, while the private sector is in charge of execution. Thus, technological progress shifts towards service technologies in which both capital and operation costs are recovered through user fees. Following the logic of making markets work for the poor (M4P), the sanitation service chain is organised through a combination of private entrepreneurs with different business models and sanitation technologies. While collection and transport are financed by user fees, the sale of recovered resources is expected to finance sanitation. To this end, microfinance promotion and sanitation marketing campaigns aim to increase poor households' purchasing power and willingness to pay for sanitation, while impact investors and social enterprises seek out sanitation technologies and business models (Bill & Melinda Gates Foundation, 2015; Gambrill et al., 2020). Comparing the capital and operating costs of FSM and sewer-based wastewater systems, studies show that FSM capital costs are up to ten times lower in comparison, while operating costs are similar. However, because sewer-based wastewater systems are still heavily subsidised, effective costs do not reflect the difference. Households pay up to ten times more in fees for FSM and bear not 5% but 70-80% of the total cost of providing safe sanitation (Dodane, Mbeguere, Sow, & Strande, 2012; McConville, Kvarnström, Maiteki, & Niwagaba, 2019). Considering the socio-economic situation of the population groups that are predominantly served by FSM systems, it must be noted that in FSM-served areas, expenditure on sanitation accounts for a disproportionate share of household budgets.

#### 4.9. *The global market bargain in phase V*

As we have seen, the transition to the fifth phase is characterized by the extension of the *global privatization* bargain to the urban slums in the global South and to the level of technological design of the sanitation system. In contrast to cities of the global North, hardly any infrastructural path dependencies exist in the informal settlements of the cities of the global South. Therefore, they offer the opportunity to organise basic services through market mechanisms before infrastructural networks with their natural monopoly characteristics emerge. The transition was triggered, among other things, by the acceleration and informalisation of urbanisation in the Global South, and facilitated by the austerity programmes under the neoliberal doctrine of structural adjustment that accompanied MDB loans in Phase IV. This has resulted in governments in the Global South being so indebted that they are virtually unable to obtain loans or issue bonds due to their weak credit ratings and are increasingly withdrawing from the provision of basic services. (Bigger & Webber, 2020).

Against the backdrop of informalisation and the retreat of the state from managing urbanisation in the global South and in the face of hyped liberalisation of basic services and infrastructure in the global North, the unbundling logic of the *global privatization* bargain dominates in slums and previously unserved areas. At the heart of the emerging *global market* bargain is the intensified focus on individual responsibility and entrepreneurialism to ensure sufficient demand for and supply of sanitation services to expand safe sanitation. This reinforces the dominant role of market mechanisms over public authorities in providing access to safe sanitation for all by 2030. The role of public authorities is pushed further back and is limited to regulating, enabling and guaranteeing the functioning of the sanitation economy. This ultimately turns poverty reduction from a responsibility of public authorities into a business case.

The **costs** of extending access to safe sanitation to informal settlements under the *global market* bargain are primarily borne by (poor) households. First, centralized sanitation remains heavily subsidised, while the contribution of public budgets to FSM is negligible and limited to treatment. Second, the principles of new public management, willingness to pay, polluter pays and full cost recovery, are more thoroughly applied in expanding access to safe sanitation in informal settlements than in expanding sewerage networks

(Dodane et al., 2012). As a result, the **benefits** of sanitation are increasingly visible in private spaces, while public spaces are characterised by constant pollution.

To enable a completely private organisation of the sanitation sector, wastewater is re-imagined as a resource. Dismantling the societal consensus established under the *public health* bargain that highly valued security, the **risks** of unsafe sanitation are turned into the **opportunities** of resource recovery. The aim of the sanitation system is decisively reoriented from a collective duty of eliminating harmful wastes to the private opportunity to recover energy, nutrients and water. While the risks associated with unsuccessful experiments with new sanitation technologies and business models remain with slum dwellers, global start-ups as well as multinational corporations reap the benefits from technological development and project-based commercialisation of poverty alleviation.

The progressive unbundling of the sanitation system to the technological level and into distinct economic units translates the decreasing spatial coherence between the dominant actors and mechanisms in the dimensions of structural power into increasing spatial differentiation of the city through sanitation systems. This reproduces a territorial pattern of (non-)presence of the state, namely the withdrawal or even non-entry of the state into low-income and informal settlements and second by providing different sanitation services to different socio-economic groups.

## 5. Synthesis

By reviewing and analysing the brief history of urban sanitation from a territorial political economy perspective, this article has highlighted how the provision sanitation has been and continues to be shaped by the dominant bargains and their arrangements in the four dimensions of structural power. The following paragraphs discuss the changes in each dimension of structural power over the sanitation history to identify patterns under which access to safe sanitation rapidly increased.

### 5.1. Changes in the dimensions of structural power over time

Urban sanitation infrastructure has been of different relevance to the security dimension of urban societies. Only under the *city health* and the *national environment* bargain, sanitation was addressed predominantly from a security perspective. In these phases, the main objective was the protection of public health, until the protection of water ecosystems was gradually established as an equal security objective. Continuing with the knowledge dimension, it has become apparent how the deliberation over pressing challenges in the sanitation sector is closely connected to questions of legitimacy and truth of threats to the security of society. Under the *city health* bargain and *national environment* bargain, medical expertise respectively environmental science was dominant for planning and evaluating urban sanitation infrastructure. Both were able to demonstrate the threat of the inadequate sanitation system to the safety of society. The emerging *global market* bargain exemplarily illustrates the interconnectedness of the security and knowledge dimension. The promoted (circular) sanitation economy is based on the proposition that wastewater and faeces should no longer be predominantly approached as harmful wastes but as a soup of precious resource that must be sustainably managed. Consequently, solutions which forefront human health while lavishly using resources are delegitimised. The analysis of the finance dimension has shown how all of the described bargains are based on their distinct financial instruments. While the invention of municipal bonds and multilateral banks has enabled to take the sunk investment needed to scale sewer networks and WWTPs in phase II and III, public private partnerships and blended finance so far have failed to achieve the same for accelerating access to safe sanitation during phase IV and V.

The description of the production dimension has highlighted the type of sanitation system that was produced under each bargain and the relative importance and rewards they give to the use of land, labour, capital and technology. In territorial terms, the dominant sanitation systems in the *city health*, *national environment* and *global privatization* bargains all predominantly depended on place-based, custom built, and continuous technologies such as sewers and WWTPs. Few parts in these sanitation systems, predominantly pumping units and technologies used in advanced treatment stages, are produced and traded in global markets. In brief, conventional sanitation systems are land and capital intensive, while they depend less on labour and technology as inputs. As a result of their place-based nature, dominant multinational corporations in the realm of sanitation have specialize in the design and operation of sanitation infrastructure, while the construction of the systems is often handled by local contractors. Under the emerging *global market* bargain, the arrangements in the production dimension are less capital and land intensive but depend more on technology and labour as inputs.

### 5.2. The changing security dimension of cities

While the analysis of the dimensions of structural power across time helps to explain the stable bargains that formed the basis for increasing access to safe sanitation in the past, one open issue remains. Contemporary metropolitan areas in the global South increasingly house more than 10 million inhabitants. This is roughly 10 times more than European cities at the dawn of the sanitary revolution. An extreme case is Dhaka, which houses over 20 million and where less than 2% of the wastewater is treated before it



discharges into the environment (Furlong, 2016). Nevertheless, the city is flourishing and is often presented as a development miracle (Ganguly, 2020). This begs the question: Why is untreated sewerage no longer a security threat to the development of a megacity?

First off, the lack of safe sanitation is still a security issue, waterborne diseases such as cholera are still real health hazards and the polluted water ecosystems are at the brink of collapse – but these crises do no longer affect the entire city or the entire society more or less equally as it was the case in the *city health* and *national environment* bargains. What was the cordon sanitaire in colonial times has been perfected into the territorial organization of booming megacities in the global south.

The urbanisation process has become much more spatially distinct. Cities are no less congested than in the 19th century. Poverty and wealth still overlap territorially, but the spaces they occupy no longer necessarily touch. In today's megacities, the growing dominance of neatly sealed private spaces, such as, for example, cars, is an expression of the fact that public space can be traversed in private bubbles. Likewise, gated communities have become the norm across the metropolis of the 21st century, again segregating and protecting the private from the public, not least in the realm of pollution and hygiene. Thus, being exposed to polluted public space becomes increasingly a private not a public issue.

Second, the threats posed by polluted water to public health have become less daunting due to the triumph of conventional medicine in the knowledge dimension. As a result, mortality from many water-borne diseases has decreased dramatically. While the infection with cholera came close to a death sentence in the times of the *city health* bargain, today many treatments for cholera exist, which have become affordable and available in global South megacities. An example is vaccination against cholera, which is being sought as a viable public health alternative or supplement to sanitation (Khan et al., 2018). Similarly to medicine, the availability of cooked or packaged food and bottled water has become affordable and available to large proportions of urban populations. In sum, progress in the knowledge and production dimension outside the sanitation sector have resulted in the possibility to consume security in the form of medicine and safe or even health enhancing diets.

Third, the systemic importance of the urban working poor in the production dimension outside the sanitation sector has declined dramatically since early industrialisation. In the *city health* bargain era, local urban labour was relatively scarce and thus of systemic importance for competition between cities in the race for industrialisation. In today's megacities, slum dwellers are part of a global reserve army of labour and are interchangeable at short notice due to the high degree of flexibility in production. Workers' health and productivity is thus of less systemic importance in the now global competition between companies.

Taken together, changes in the knowledge-, finance- and production dimensions have altered the importance, role and form of sanitation infrastructure in protecting urban development from a must-have public infrastructure into a nice-to-have addition to private health strategies. Just like under the *city health* bargain, cholera still spreads fastest amongst the urban poor, and as under the *national environment* bargain water ecosystems are at the brink of collapse, but unlike 200 or 70 years ago, the better off are now immune to the disease, creating an environment in which neither the entire global nor the entire local urban population is desperately needing a 'solution' to the persistent sanitation crisis.

## 6. Conclusion

The brief history of urban sanitation and its analysis from a territorial political economy perspective illustrate how the development of the sanitation sector over the last 200

years has been shaped by and shaped the dominant social constructions of (waste)water as a threat of systemic relevance at different scales of societal organisation. The changing (e)valuation of faeces either as a useful resource under the *local market* bargain and increasingly under the emerging *global market* bargain or as a harmful waste under the *city health* and *national environment* bargains. Adding the territorial lens, the analysis shows how the scales at which sanitation systems operates are directly linked to the scales at which (waste)water is perceived as a (collective) threat or an individual responsibility.

Two patterns can be recognised. First, the more sanitation challenges are perceived as a threat to society as a whole, the greater the role of public authorities and the public sector. Subsequently, public sector interventions are linked to the scale at which unsafe sanitation is perceived as a collective security threat. To protect entire societies, more egalitarian and inclusive sanitation solutions are provided. This was the case under the *city health* and *national environment* bargains, which showed the most rapid increase in access to safe sanitation. In such bargains, the effectiveness of the sanitation system is evaluated against the perceived threat and how effectively it protects societies from them, rather than based on cost–benefit or net present value calculations.

Conversely, when the focus on public security disappears, whether due to lack of knowledge as during the *local market* bargain or lack of a collective experience with threat as under the *global market* bargain, individual responsibility and market mechanisms are given a stronger role. In such bargains, the efficiency of the sanitation system is evaluated primarily based on financial criteria. The role of public authorities is at best to fix market failures. This results in a situation where collective threats remain with the public until they are perceived at the scale of societal cohesion, while the benefits accrue to private operators that have an interest at keeping sanitation an individual challenge to which they can offer solutions.

Based on the analysis presented, it is concluded that under both current *global privatization* and emerging *global market* bargains, it is unlikely that significant progress will be made towards achieving SDG 6.2. The lack of a collectively perceived threats from unsafe sanitation at the city, nation and global scale, combined with the general preference for markets in allocating access to basic services, results in low public priority and little willingness to invest in public solutions for the persistent sanitation crisis. This is visible in the prominent solutions proposed to achieve SDG6.2, which predominantly target private actors and the household scale. Such approaches are at high risk to only marginally improves access to safe sanitation and, more worryingly, only for those with the willingness and the ability to pay.

The research presented and its findings are timely. In the current debate about “building back better” after the COVID-19 pandemic and in the face of climate breakdown, the question of the role of the public sector for global health in particular, but also for the provision of public goods in general, is debated more controversially than it has been for a long time. The findings support voices that call for a stronger mandate for public authorities to address societal challenges by generating investment pathways based on clear and targeted strategies (Mazzucato, 2021). By this, top-down interventions through particular technological solutions by big governments are not advocated. Indeed, it must be acknowledged how the globally hegemonic discourse on sanitation policy under SDG6.2 risks leaving not only the decision on how to provide access to safe sanitation, but also whether to provide it, to the market. Thus, rather than innovating sanitation systems that depend on articulated demand at the scales where sanitation challenges are perceived to currently occur, progress towards SDG6.2 will accelerate if the (collective) threat of unsafe sanitation can be articulated at the scale of social organisation, demanding strategic and public investment at city, national and global scales.

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## Electronic reference

Brugger, Andri. « Unbundling the urban sanitation crisis: a territorial history of the development of urban sanitation in-frastructures », Working Paper series MAPS [online], 2 | 2021, [https://www.unine.ch/files/live/sites/maps/files/shared/documents/wp/WP\\_2\\_2021\\_Brugger.pdf](https://www.unine.ch/files/live/sites/maps/files/shared/documents/wp/WP_2_2021_Brugger.pdf).

**ISSN : 1662-744X**

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