

– TOWARD THE NETWORKED CITY? Translating Technological ideals and Planning Models in Water and Sanitation Systems in Dar es Salaam

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ABSTRACT

One of the most influential ideals for constructing and managing cities and infrastructures worldwide is that of the ‘networked city’. This ideal refers to the technological design and morphology of cities integrated and ordered by infrastructure networks and to a specific model in the operation, use and planning of infrastructures. Engineers, planners and public health officials have aspired to align with this circulating ideal of urban modernity, hygiene and rationalization of nature in (re)producing cities worldwide. Like many cities in the global South, Dar es Salaam cannot be characterized by universal access to centralized water and sewerage networks. While formal institutions, planning documents and strategies reflect significations, as well as organizational and planning models of a networked city, its urban environments are shaped by hybrid arrangements manifesting unequal access to water and sanitation services. We build on postcolonial critique in urban studies and science and technology studies to inquire into this contradiction by addressing the translation of the ideal of the networked city in Dar es Salaam. Our objective is to uncover the negotiations over the translation of this hegemonic model, and to delineate the scope of creativity in reinventing alternative urban modernities that defy simplistic notions of technology transfer.

Introduction

Water and sanitation systems are critical preconditions for cities. These socio-technical systems have enabled the functioning and growth of cities by importing water resources for domestic and commercial use, by discharging city waste, by helping to control many forms of pollution, by protecting public health and safety, and by ordering public space (cf. Kaika, 2005; Kooy and Bakker, 2008; Melosi, 2008). One of the most powerful ideals that has influenced the construction and the planning of both cities and their water and sanitation systems worldwide since the nineteenth century is that of the networked city. Engineers, planners and public health officials worldwide have thus aspired to align with this circulating ideal of urban modernity, hygiene, universalization and rationalization of space in (re)producing cities (cf., e.g., Dupuy, 2008; Coutard and Rutherford, 2016). Since colonial times, this globally circulating ideal has also been transferred to cities in sub-Saharan Africa. It has considerably shaped the planning institutions and strategies of local governments as well as the engineering cultures and investments of urban utility companies. However, the transfer of the networked city model has been challenged by patterns of rapid urbanization in sub-Saharan Africa, which differ greatly from those of industrial countries in that they represent a ‘poverty-driven process and not an industrialization-induced socio-economic transition’ (UN-Habitat, 2010: 7). Contrary to the modernist ideal of a unitary, orderly city integrated by universal networks, these cities are characterized by an unequal provision of

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infrastructure services, low access rates of the urban poor to networked services (*ibid.*: 31), a diversity of service providers and differentiated services.

Academic debates, having been focused on deviance from hegemonic models, have long framed African cities as deficient, chaotic, decaying or ‘off the map’ of global interconnection (Robinson, 2002). Instead of presenting dystopian narratives about the status quo of African cities and notions of African exceptionalism, postcolonial critique argues that African cities should be regarded as ‘ordinary cities’ (Robinson, 2002: 533, 546) by emphasizing the global connection of African cities and the dynamic ways in which they actually work.¹ This shift in perspective does not solely entail the critical study of colonial legacies and the ongoing transfer of hegemonic planning models to African cities (see also Watson, 2009; Silva, 2015), but also the distinctive and place-based patterns of modernity, creativity and urbanity. Compared to the burgeoning debate on urban development and planning in Africa over the past decade, postcolonial studies of urban infrastructure in Africa are still rare (exceptions include Gandy, 2006; Rakodi, 2008; Silver, 2015; Jaglin, 2016). Instead, deficit analyses or problem-solving approaches dominate current debates on urban water supply and sanitation (see e.g. Hardoy *et al.*, 2001; Pastore, 2015). Studies that critically address the colonial legacies of urban infrastructure in Africa, their capability to adapt to circulating technological and urban ideals and models, along with their room for manoeuvring and local creativity have, however, not yet attracted much scholarly attention.

This article thus contributes to postcolonial studies on urban technology and to debates on the circulation and translation of urban planning ideals and models through the lens of urban water and sanitation infrastructure. By drawing on debates on the networked city and by conceptualizing the translation of this travelling urban and technological ideal, we explore how place-based processes of adaptation and creativity shape the provision of water and sanitation services in urban Africa. In doing so, we provide a more nuanced and critical view of (1) the considerable efforts made in African cities to translate and to re-contextualize circulating technological and urban ideals and models, and (2) the consequences of diffused ideas and technologies. More specifically, we take the city of Dar es Salaam, Tanzania’s rapidly growing economic and political centre, as our empirical case. By inquiring into urban plans and policies, as well as into current interventions in the water and sanitation domains, we demonstrate that formal institutions, planning documents and strategies have reflected aspirations to build a ‘networked city’ since the colonial period. However, within the urban realm, the provision of infrastructure services can be characterized as unstable, uneven and contested (Brennan and Burton, 2007; Kjellén and Kyessi, 2012; UN-Habitat, 2014: 23). Until today, only an urban minority has household access to water pipes or sewerage networks, and the distribution of and access to water and sanitation services is highly uneven. Our article uses this observation as a starting point to examine the contested processes of adaptation and creativity in translating this globally circulating ideal in Dar es Salaam. We look specifically at the extension of Dar es Salaam’s water distribution network and the low priority of network extensions in the domain of sanitation to explore how the hegemonic model of the networked city has been translated.

Our article is structured as follows: the second and third sections explicate our conceptual framework by outlining the model of the networked city and by elucidating our understanding of the translation of the circulation of ideas and technologies. The fourth section draws on various studies and policy documents to discuss how planning and policy documents since colonial times have reflected the transfer of the ideal of the networked city. This is then contrasted with the study of the contested topologies of urban water and sanitation systems that occur in the process of translation. The fifth section inquires into the processes and mechanisms of the translation of the networked

1 See also Robinson (2002), Watson (2009), Myers (2011) and Silva (2015).

city ideal in each domain. We conclude by expounding the various translation experiences in Dar es Salaam's water and sanitation systems and by critically reflecting on the consequences of the translation of ideas and technologies. The content of this article is based on empirical research conducted during 2013 and 2014, which included a series of 29 semi-structured in-depth interviews with representatives of local and state governments, international organizations, local utility companies, NGOs, academics, local stakeholders and residents. In addition, ethnographic field studies and the assessment of grey literature, websites, official city and state documents, secondary literature and newspaper articles have played a crucial role.

The ideal of the networked city

One of the key features in the (re)construction of 'modern' cities worldwide is their networked character. Technical networks have been crucial as the foundation, the medium and the structural outcome of modern cities, and as sites for economic production and social, technological and environmental transformation (Graham and Marvin, 2001; Kaika, 2005; Melosi, 2008; Coutard and Rutherford, 2016). In their early work, Tarr and Dupuy (1988) describe how the development of infrastructure networks has influenced the construction and management of cities in Europe and North America since the nineteenth century. Since then, technical networks have been considered the most efficient means of supplying urban services, and solutions to problems created by networks reside within the networks themselves (for example, in their expansion or universalization, more centralized management and increased technical sophistication) (Coutard and Rutherford, 2016: 3). The modernist ideal of a 'networked city' can be characterized as an ensemble of interrelated components: (1) the technological design and topology of cities integrated, ordered and confined by universal infrastructure networks that organize the exchange of goods, ideas, waste, power and people within and between urban territories, and that define the boundaries of an urban territory; (2) the notion that urban monopolists provide for ubiquitous and standardized infrastructure services (or for 'public utilities'); (3) the notion of passive customers that are not actively engaged in the production of infrastructure services; (4) the assumption that the provision of infrastructure services is closely attached to, or highly regulated by, the state; and (5) the concept of urban planning effectively regulating land use and guaranteeing the universal provision of critical services (Dupuy, 2008; Monstadt and Schramm, 2013; Coutard and Rutherford, 2016).

While most studies focus on the (re)construction of networked cities in Europe and North America (Graham and Marvin, 2001; Monstadt, 2009), the transfer of the networked city model to the global South in the colonial and postcolonial era has not attracted much scholarly attention. Although this hegemonic ideal has, until today, continued to influence the planning of cities in the global South politically and ideologically and has long been regarded as attainable by international funding agencies and national and local governments, the ideal of urban space rationalized and ordered by large centralized networks and public institutions remains an anomaly. Rather, through massive colonial interventions in urban expansion and restructuring, the colonizer's transfer of this ideal to cities in the global South has reinforced a system of spatial apartheid via the exclusive provision of networked infrastructure in Europeanized urban quarters. Or, as Kooy and Bakker (2008: 385) put it, in the pursuit of 'civilizing' or 'developing' cities, colonial governments have translated the classification of urban citizenship into differentiated urban spaces that were rationalized and reiterated through networked infrastructure. In addition, post-independence ambitions to modernize, hygienize and order cities have further cemented these divisions, as network expansion was confined to areas of the city inhabited by 'modern' and 'developed' urban residents (*ibid.*), while lower income groups have often been disconnected from centralized networks and pay more for the provision of services

(Gandy, 2006; Jaglin, 2008). Moreover, the model of public utility companies that are closely regulated by state institutions and have a monopoly in providing infrastructure services rarely applies. Instead, a large variety of private entrepreneurs or civil-society organizations co-provide infrastructure services in a continuum between formality and informality where the infrastructure services of traditional service providers are inaccessible or unaffordable (see also Budds and McGranahan, 2003; Mitlin, 2008; Jaglin, 2016).

Over the past few decades, a burgeoning literature has shown that not only does a centralized topology and universal coverage of technical networks not exist in urban areas in Africa, but it is also infeasible. Various studies point to the high costs of building and maintaining such infrastructures, their deficiencies regarding sustainable resource uses, their high degree of inflexibility in adapting to rapidly changing urban conditions and the complexity of operating them professionally (see e.g. van Vliet *et al.*, 2010). Since the 1970s, the ideal of 'appropriate technology' has emerged in response to the diagnosis of an 'economic and infrastructure crisis' in the global South. This ideal has been driven by the assumption that decentralized solutions provide environmental and economic advantages compared to centralized networks, such as lower costs, higher flexibility and adaptability to rapidly changing urban environments, and options for resource recovery, efficiency and local income (*ibid.*; see also UNDP/BMZ, 1999). Today, many academics, international NGOs, development agencies and engineering firms favour decentralized approaches to water supply and sanitation as the solution to the infrastructure crisis in Africa (*cf.* UN-Habitat, 2014). However, the resulting transfer of more decentralized solutions to African cities has proven difficult and has hitherto failed to substantially improve the splintered access to vital services for urban populations (*cf.* van Vliet *et al.*, 2010).

Although the networked city ideal does not conform to the realities of the urban fabric in the global South and is increasingly contested, its legacies remain persistent in infrastructure planning across the global South. State officials, administrators and urban planners still often consider the implementation of this ideal as a goal of planning and investment efforts. We can thus observe considerable tensions between the ongoing persistence of the ideal in legislation, formal plans and investment strategies and the urban realities in the global South. In order to conceptualize these tensions, we analyse debates on globally circulating urban ideals, models and technologies, and the ways in which these travelling ideals and technologies are actually being translated in specific localities.

Translating urban and technological ideals and models

Over the past decade, planning studies and postcolonial urban studies have explored how planning ideas and practices travel from one place to another and what happens in the process of transfer (see e.g. Healey and Upton, 2010). An increasing number of scholars have studied the circulation and the 'mobilities' of urban policies. This work emphasizes the way policies and urban models are constructed, mobilized and 'placed', and how they derive their legitimacy from territorially embedded narratives of policy success.² While the phenomenon of how policies become mobile and how they travel among cities in the global North has been well documented, the circulation of policies to (and across) cities in the global South and the ways in which they are appropriated locally has attracted far less attention.

However, some African urban studies have addressed the circulation and transfer of planning models within the context of colonization (see e.g. Njoh, 2003; Beckmans, 2013), in which colonial powers used and developed the planning ideas, standards and engineering technologies that had been invented to meet European requirements (Rakodi, 2008: 6). As postcolonial critique shows, former imperial powers have

2 See, for example, McCann and Ward (2011), Baker and Temenos (2015) and Grubbauer (2015).

continued their presence in the postcolonial era through models of professional training, international consultancy, preconceptions and practices of international development agencies and international travel and education by Africans (*ibid.*; Watson, 2009; Silva, 2015). Until today, the governments of many African nations apply colonial spatial plans and land management tools, and follow the corresponding ideas of spatial order (Njoh, 2003; Silva, 2015). However, planning models and practices that originate from a specific context and cannot be applied easily in another, have to be translated into the particular circumstances of a different locale (Beeckmans, 2013; Healey, 2013). Accordingly, various studies take into account the perpetual resistance of African cities to adapting to these hegemonic ideals in urban planning and thus focus on the contestations and contradictions that potentially occur in the course of their transfer (Watson, 2003; Silva, 2015). These studies contribute greatly to understanding African cities for their multiple urban relationships and their place-based practices. However, empirical accounts that systematically address how exogenous urban ideals and planning practices ‘become “localized”, that is, drawn down, adapted and inserted into struggles over discourse formation and institutionalization’ (Healey, 2013: 1520) are still the exception (see e.g. Beeckmans, 2013). Moreover, the sociotechnical dimensions of mobile policies and place-based experiences of translating infrastructural models and ideals have rarely been embraced.

In particular, science and technology studies (STS) draws more attention to the translation experiences and the localization of travelling technological ideas. Some earlier studies have conceptualized the ways in which technological and scientific innovations in the development of urban infrastructure in Europe and Northern America flow from one place to another. For example, work on circulation and appropriation elaborates the parallel processes of homogenization and differentiation in the historical development of urban technological innovations throughout Europe (Hård and Misa, 2008). On the one hand, the circulation of artefacts, people and ideas acts as ‘an engine of homogenization’ for urban technology (*ibid.*: 10). On the other hand, the transfer of technologies and ideas requires that they are modified and appropriated to suit the specifics of a particular locale (*ibid.*: 12). Moreover, recent work in actor–network theory (e.g. Latour, 2005; Callon *et al.*, 2009) explores processes of ‘translation’ that are triggered by flows of ideas, ‘scientific’ knowledge and technologies, and the struggles that ensue when ideas or technologies are drawn into new situations.

While STS has rarely ventured into analyses in the global South, an emerging debate in STS or in ‘postcolonial technoscience’ has called for a more critical engagement with the present effects—intellectual, social and material—on former colonies of centuries of European technology transfer (Anderson, 2002: 644; Arnold, 2006), for an analysis of alternative sociotechnical modernities, and for the ‘recognition of hybridities, borderlands and in-between conditions’ (Anderson, 2002: 643). An emerging strand in this debate is the exploration of processes of ‘translation’ involved in flows of technologies or technological models since colonial times. These studies argue that once technological ideals and models travel, they are de-territorialized from their original setting and re-territorialized in new settings. The workings of these models presuppose techniques in how to deal with a standardized model in place-based contexts (Behrends *et al.*, 2014): ‘These techniques consist of embodied knowledge that does not travel with the objectified model but needs to be reinvented at the new sites through experimental practice and experience’ (*ibid.* 2). The term ‘translation’ thus captures these dynamics of reinvention and, at the same time, the preservation of meaning that enables the circulation of ideas and models that are usually inscribed into artefacts and sociotechnical arrangements (Rottenburg, 2009: 26). When circulating ideals and models enter a new place with a different ontological and epistemic background, and different social practices, institutional setups and technical

infrastructures, they need to adjust to these new circumstances in order to connect to them (Behrends *et al.*, 2014: 3). This ‘editing process’ (Sahlin and Wedlin, 2008: 226) creates a new reality in the local context so that the two ends fit each other, and thus a local version of ideals and models is produced.

In order to capture the broad range and diverse outcomes of translation processes in our case study, we can analytically distinguish between different forms of translation (*cf.* Behrends *et al.*, 2014: 9): *adaptation*, or the alteration of existing planning legislation and technologies to conform with circulating ideals; *appropriation*, or the adjustment of the circulating ideal to accommodate available urban technologies, urban morphologies and planning practices; *hybridization*, or the creation of something new by combining elements of the new ideals, models or technologies with existing ones; and the *refusal* of circulating ideals through the rejection of, or resistance to, the new and the persistence of that which already exists. The concept of translation thus provides an analytical framework to explore the scope of local creativity in transcending technological models, and the reinvention of alternative urban modernities that defy simplistic notions of a linear technology transfer. From this perspective, the hybrid sociotechnical constellations of urban infrastructure in Africa are no longer to be interpreted as deviant cases of European models, but as contextually creative translations to particular contexts of a rapidly urbanizing society.

The transfer of water and sanitation ideals to Dar es Salaam

Dar es Salaam was founded in 1857 under the name Mzizima(zi) (‘healthy town’) and renamed Dar es Salaam (‘house of peace’, probably derived from the Arab ‘Bandar as-Salaam’ or ‘harbour of peace’) by the Sultan of Zanzibar. In 1887, imperial Germany conquered the regions that are now known as Tanzania (apart from Zanzibar) and incorporated them into German East Africa. In 1920, the post-first world war accords placed the regions under British mandate until they attained independence from colonial rule in 1961. After independence, a socialist model of economic development and a one-party system were introduced. The country faced considerable economic downturn in the late 1970s and was increasingly pressurized by the International Monetary Fund. Since the 1980s, Tanzania’s government has undertaken major economic and political reforms, initiating both economic and demographic growth in Dar es Salaam (*cf.* Brennan and Burton, 2007).

Today, Dar es Salaam is the most important city for business and government in the United Republic of Tanzania. The harbour city presents itself as the gateway to East and Central Africa and as a major hub for international trade. Over the past decades, Dar es Salaam has grown massively, from a town of about 50,000 inhabitants in 1950 into a sprawling metropolis. Between 1980 and 2015, Dar es Salaam’s population more than quintupled from 836,000 to 4.4 million, a number projected to rise to 7.3 million by 2025 (UN-Habitat, 2014: 25). With its projected annual growth rate of almost 6.6%, the city today is one of the three most rapidly growing cities on the African continent. It has taken over the lead from Nairobi as eastern Africa’s largest city. Urban and demographic growth in Dar es Salaam has mostly taken place in the form of low-density development (see Figure 1) and beyond the scope of urban and infrastructure plans. Although previously projected urban growth occurs in ‘finger-like’ stretches along its major road, electricity and water networks, over 80% of Dar es Salaam’s population live in unplanned areas, where access to safe drinking water and sanitation services is limited (UN-Habitat, 2010: 17).

In the subsections that follow we demonstrate that problems of water provision and sanitation in Dar es Salaam and the aspirations of planners, public health officials and engineers to build a networked city date back to the colonial era. A historical review illustrates that the ideal of the networked city has been transferred to

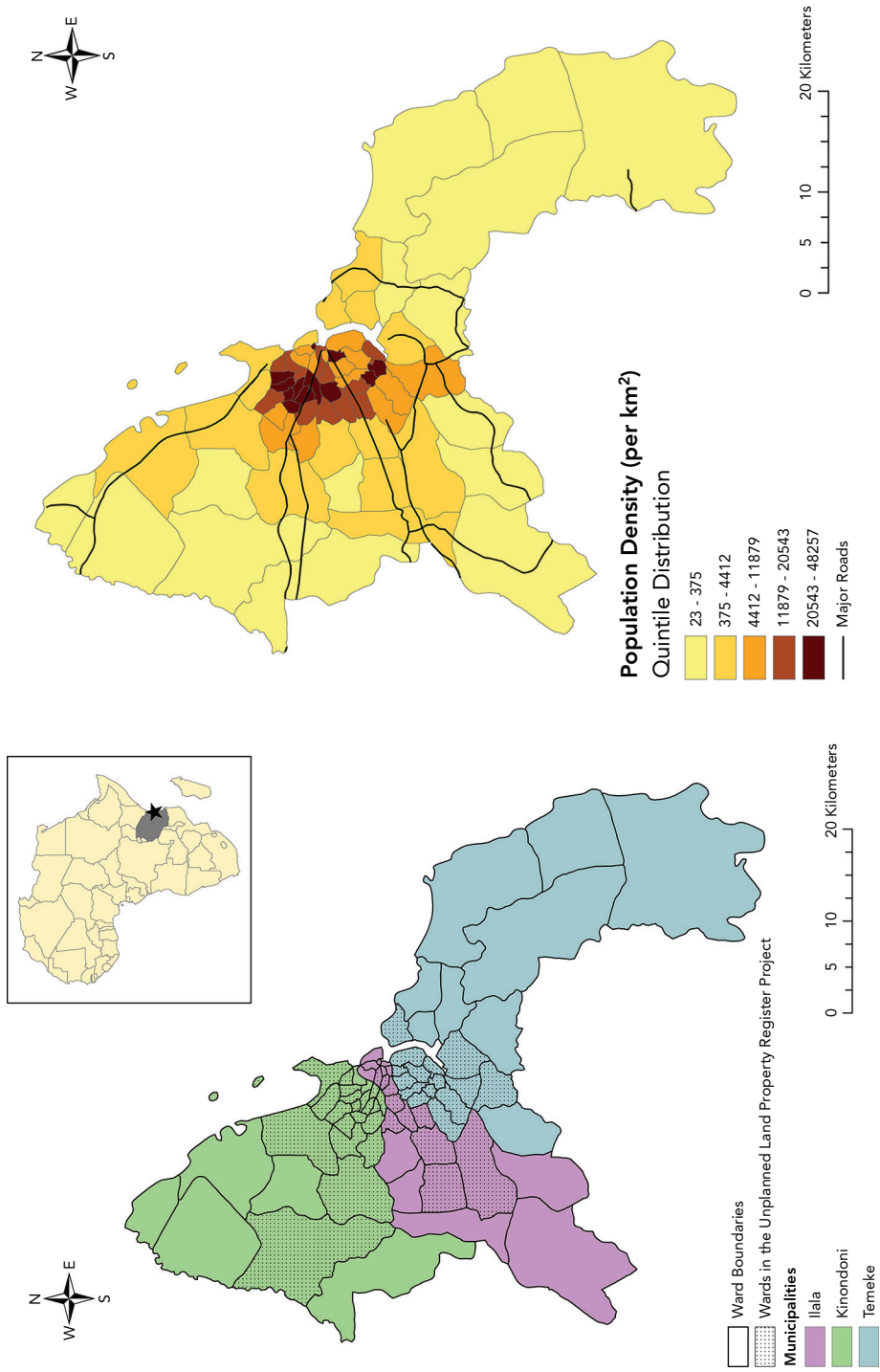


FIGURE 1 Territorial structures and population density in Dar es Salaam, 2008 (source: Penrose et al., 2010)

Dar es Salaam since colonial times, and that the way in which it was translated has considerably shaped urban and infrastructure planning until today. We then investigate the contemporary topology of urban water and sanitation infrastructures.

- Networking Dar es Salaam: history of water and sanitation policy and planning
 German colonialists used initial water supplies from shallow wells within the city and the first planned water supply system in 1891 (Kjellén, 2006: 144) as a starting point for developing plans for centrally networked systems of water supply and waste water disposal (*ibid.*). However, implementation was confined to the areas of the German colonizers by means of a system of building ordinances and zoning regulations and a *cordon sanitaire* between the African and European quarters to limit the range of disease vectors (*cf.* Kironde, 2007). The result was a racially segregated city in three concentric zones, each governed by different building and infrastructural standards (Smiley, 2009: 180 *et seq.*). The central zone housed the administrative and residential buildings for the European colonial elites. These not only manifested European-style building regulations but were also adapted to the infrastructural standards of a networked city (for example, every building was to have a flush toilet). The second zone was predominantly home to Asians and Arabs and allowed for mixed construction using only sturdy materials. In the third zone—the African villages—native-style buildings were permitted, which were rarely connected to any water and sanitation networks. The allocation of resources between the three zones—a system that was later adopted by the British colonizers—remained fundamentally skewed, with African ‘villages’ receiving the smallest investment in infrastructure. In the mid-1940s, the zone for native-style buildings had no water-borne sewerage systems, and water was only available from 16 public kiosks, 14 of which were located in Kariakoo, a quarter that had increasingly been populated by Asians (Smiley, 2009: 185). In the 1950s, a significant plan for the expansion of a unitary combined sewerage network was designed and implemented under British mandate (Kironde, 2007), based on which most of the city’s currently existing water and sanitation networks were built (SID, 2008). Although planning officials generally recognized the need for increased development of the African quarters to improve living conditions and to achieve ‘stabilization’ of the increasingly insurgent African population (Brennan and Burton, 2007: 65), they refused to set actual timetables for investments. Colonial urban planners’ translation of the ideal of the networked city thus consolidated a system of spatial and infrastructural apartheid. While its adaptation was confined to the ‘modern’ European quarters and partly to the Asian quarters, the African ‘villages’ were at best supplied with minimal services.

Only since independence have public plans officially promoted the goal of universalized networks. The new socialist government launched ambitious investment plans and initiated a ‘free water for all’ policy in 1969, according to which only those urban residents whose houses or yards had domestic connections would pay (Rugemalila and Gibbs, 2015). In 1979, the Dar es Salaam Master Plan highlighted the failures of the then-existing sewerage system and proposed the complete removal of pit latrines and decentralized sanitation (Smiley, 2013: 136). However, amplified by the severe economic downturns from the 1970s onwards and by demographic growth in the sprawling metropolis, funding for maintenance, repairs and network extensions remained inadequate, and the universalization of networked systems was not realized (*ibid.*). The turn toward structural adjustment policies at the end of the 1980s and privatization of the water and sanitation sector in the mid-1990s could not resolve the lack of basic services (Kinusi and Lupala, 2009). On the contrary, the structural adjustments impeded the government’s financial capability to service basic needs.

After the political and economic liberalization of the mid-1990s, Dar es Salaam witnessed substantial demographic and economic growth, accompanied by a massive expansion of unplanned squatter developments, which remained largely excluded

from the water and sanitation networks (Brennan and Burton, 2007). The existing networks suffered from chronic under-investment, which led to substantial losses through leakages, free-riding through non-metered connections and illegal usages, the development of an unofficial distribution system and inadequate revenue collection (Kjellén, 2006; World Bank, 2012). In an attempt to improve the operation, rehabilitation and extension of water and sewerage networks, the government developed a new national water policy in 1991, decentralizing the authorities for water policy and removing government subsidies for water utilities. As part of this strategy, the Dar es Salaam Water and Sewerage Authority (DAWASA) was created in 1997 as a semi-autonomous public utility. In 2002, the current national water policy was formulated, which envisaged full cost recovery. While under the 1991 policy homeowners had been urged to construct water storage with a capacity of one day to a week (Kjellén, 2006: 88 *et seq.*), the new policy was demanding universal metering and the provision of universal services by 2025 (URT, 2002). Within this policy, private and self-organized forms of the co-provision of water and sanitation services were framed as obstacles to realizing the ideal of the networked city, and the city thus intended to prohibit them (*ibid.*).

Against the background of the severe infrastructural crisis in 2003 a US \$164.6 million Dar es Salaam Water and Sanitation Project was financed mainly through international loans to rehabilitate and extend the water and sanitation infrastructure. Based on conditions stipulated by the World Bank, a private consortium was awarded a ten-year lease contract for operating the water system's handling, billing, tariff collection and routine maintenance, while DAWASA remained in charge of rehabilitating and expanding the water network. As a result of controversial debates, this contract was terminated two years later. Since then, the newly founded Dar es Salaam Water and Sewerage Corporation (DAWASCO), a publicly owned company, holds an almost identical lease from DAWASA, and an Energy and Water Utilities Regulatory Authority (EWURA) was established (Kjellén, 2006).

Since the mid-2000s, policies and plans have shown an appropriation of the official approach in networked water supply and sanitation, partly as a result of the increasing political pressures of international NGOs and various engineering firms that are officially advocating for more decentralized sociotechnical alternatives (*cf.* Trémolet and Binder, 2013). For example, the 2009 Water Supply and Sanitation Act provides for the creation of water authorities. It extends the responsibility of the utilities to sanitation, which includes not only sewerage, but all facilities (including septic tanks and pit latrines) necessary to collect and to dispose of human excreta and waste water (URT, 2009). As specified in the 2010 Strategic Sanitation Plan, Section 5.2, it acknowledges the hybridity of the system by officially supporting private service co-provision as well as on-site technologies.

– Challenging the networked city: urban patterns of water and sanitation infrastructures

Dar es Salaam's infrastructural landscapes contain a diversity of water and sanitation arrangements. Its urban morphology features a mosaic of settlements placed in direct proximity to each other, which differ greatly in terms of building patterns, densities and income (Brennan and Burton, 2007). Water and sanitation services reflect this mosaic of land use, which defies a simple dichotomy of wealthy and networked versus poor and non-networked quarters. Instead, the distance of an area from the city centre, as well as the distance to water transmission networks, are additional important factors shaping network connectivity (Interview 8).³

3 See the Appendix for details on interviews cited in this article.

Various authors have discussed the spatial diversity of sociotechnical arrangements in *water supply* (illustrated in Figure 2).⁴ Its *technical structure* is shaped by limited access to piped water, stagnating at roughly 60% of the population between 1990 and 2012 (UN-Habitat, 2009: 272; Smiley, 2013). Even in quarters that are connected to the network, private households are in many cases disconnected; residents have access to water through a variety of technological arrangements such as water kiosks, neighbours' taps, communal pipes or private wells (Kjellén, 2006). Owing to regular outages that result in an average of only eight hours of service daily (EWURA, 2014: XI), the connection to a piped water system neither guarantees a reliable water supply nor does it provide water of drinking quality (Nganyanyuka *et al.*, 2014). Since networked and non-networked plots are often in direct proximity, neighbours' taps provide an important way of accessing water. Simultaneously, the number of kiosks in the city remained stable from 2008 to 2013 (URT, 2013), while water distribution networks were expanded informally by means of 'spaghetti pipes'. These pipes have an impact on the hydraulics of the entire network, as they increase leakage and lead to lower pressure (Kjellén and Kyessi, 2012). Quarters that are situated further away from the city centre often rely on private or common boreholes, tanker trucks (mostly in the wealthier neighbourhoods), pushcart vendors or a combination of these (Smiley, 2013). Various private vendors and intermediaries operating at different scales thus complement the *provision of water services* by DAWASCO. The *regulation of service provision* is shared between EWURA and the local communities. However, various actors operate on a continuum between formality and informality, as regulations by EWURA and the local communities concerning both private vendors and the public utility are hardly enforced (EWURA, 2014). Non-commercial access to water, such as the collection of surface or storm water and the use of wells, renders the situation even more complex and exposes residents to major health risks.

As to the *technical structures* of Dar es Salaam's *sanitation infrastructure* (see Figure 3), 60% of the city's population relies on pit latrines of different standards and 20%, mostly those in the middle- and upper-income brackets, on septic tanks. Only 10% are connected to the public sewerage network and approximately 7% resort to open defecation (Trémolet and Binder, 2013; World Bank, 2012: XIV; Pastore, 2015). The latrines and tanks are emptied using various means, such as vacuum trucks, manually, or by motorbikes equipped with tanks. The faecal sludge is then transported either to one of the city's ponds, where it is anaerobically treated, or it is illegally disposed of elsewhere—on open spaces, via the city's sewerage network or by dumping it into the ocean (Mhamba and Titus, 2001: 222). The sewerage network covers the central business district and discharges into the Indian Ocean. In recent years, satellite networks have been constructed that discharge into oxidation ponds (Trémolet and Binder, 2013). The *provision of sanitation services* is de facto in private hands, and private entrepreneurs empty the latrines and tanks (*ibid.*). The public utility explicitly restricts its management services to the sewerage network, the pumping stations and the treatment ponds, while excluding all other forms of sanitation (*ibid.*). As to the *regulation of service provision*, EWURA is in charge of the public utilities, while the responsibility for monitoring the construction, and for emptying latrines and septic tanks, has been decentralized to the three municipalities under the Dar es Salaam city council (*ibid.*). However, regulations are often ignored, and the municipalities lack the resources, capacities and materials to enforce them, so that sanitation services are largely provided within the informal sphere.

Dar es Salaam's water and sanitation infrastructures comprise a hybrid mix of centrally networked and decentralized on-site systems. While the provision of networked services is in public hands, the majority of the population relies on a variety

4 See, in particular, Kjellén (2006), Kjellén and Kyessi (2012) and Nganyanyuka *et al.* (2014).

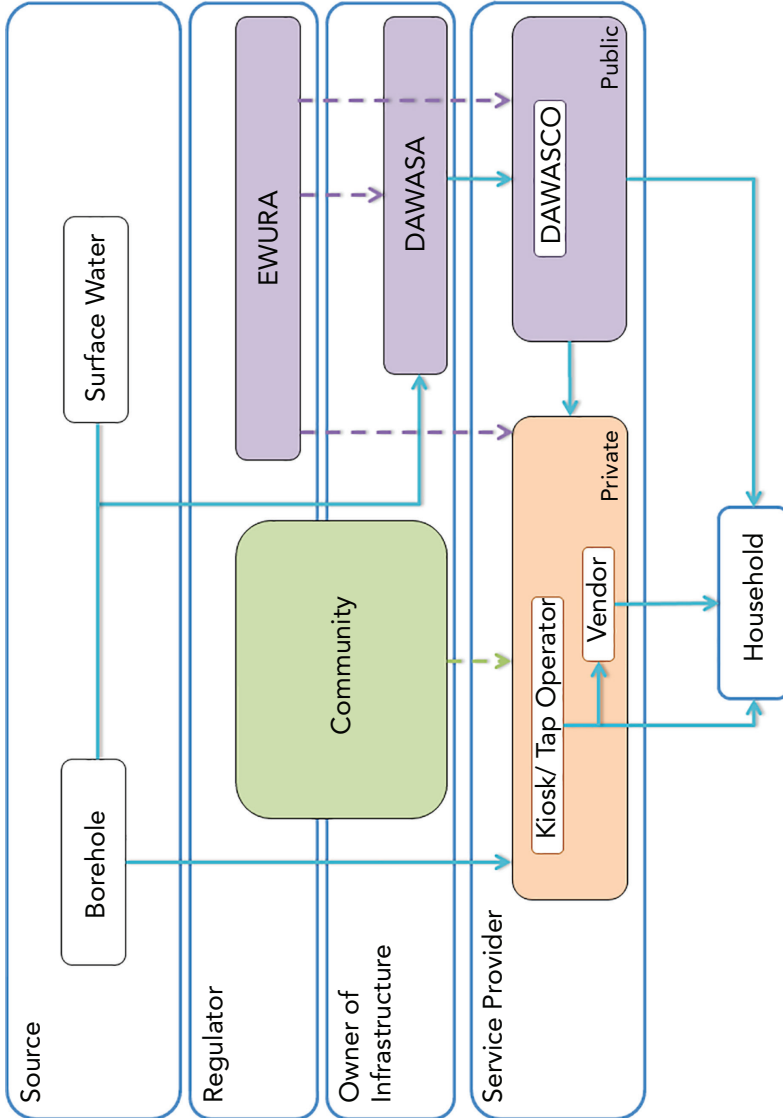


FIGURE 2 Sociotechnical constellations of water supply in Dar es Salaam (sources: authors' own graph, based on Kjellén, 2006; Kjellén and Kyessi, 2012; Smiley, 2013)

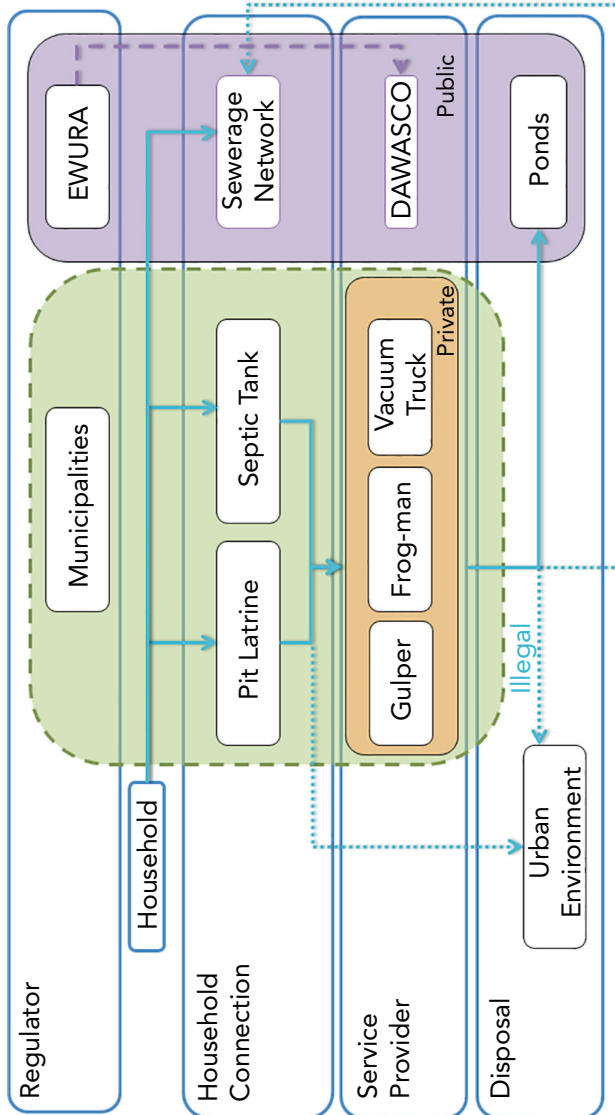


FIGURE 3 Sociotechnical constellations of sanitation in Dar es Salaam (sources: authors' own graph, based on Mhamba and Titus, 2001; Trémolet and Binder, 2013)

of private companies or self-organization through trucks, canisters, wells, septic tanks or pit latrines. Residents of areas without networked infrastructures often pay more for service provision because of the involvement of private intermediaries and face higher health risks and precarious hygienic situations (Kjellén, 2006; Trémolet and Binder, 2013). Consequently, the city was hit by repeated outbreaks of cholera throughout the 1990s and 2000s, and waterborne diseases remain frequent (Penrose, 2010). Overall, urban infrastructures in Dar es Salaam clearly do not conform to circulating ideals of citywide, unitary and public service provision.

Translating the networked city in Dar es Salaam

Translation processes of the ideal of the networked city take place not only in public and expert discourses or within formal planning. Because of the manifold and partly precarious ways in which the citizens of Dar es Salaam access water and sanitation services, the community level is crucial to a nuanced understanding of the translation of the ideal of a networked city. In the sections that follow, we focus on the expansion of water distribution networks, the design and implementation of which reflect specific translation dynamics. These dynamics differ greatly from those in the sanitation domain, where no large-scale projects are currently being implemented. We refer to our analytical framework to examine the specific conditions in both domains that lead to the translation of the networked city ideal.

The extension of the water distribution network

While effective solutions to sanitary challenges are highly controversial, international organizations and government agencies in Tanzania agree in terms of their views on appropriate solutions to water issues, as reflected in local discourses and urban policies. The need for solutions also materializes in investment decisions (interviews 4, 5 and 6). Currently, a range of interventions are taking place in order to increase the amount of networked urban water supply within the nationwide US \$1.4 billion Water Sector Development Programme, which is to a large part funded by the World Bank (URT, 2013).

The expansion of the distribution network aims to tackle the problem of non-revenue water, which international organizations and NGOs as well as local and national governments and the utilities identify as a core obstacle to the recovery of investments and the implementation of a centralized water supply network (interviews 1 and 5). The share of non-revenue water is higher in Dar es Salaam than in other cities in Tanzania and amounts to more than 50% of the water supplied (URT, 2013). This problem has outlasted the shifts in the organizational forms of the utility in the past decades. Neither the inauguration of DAWASA and subsequent contracting to a private company, nor the reassignment of public utility DAWASCO resulted in substantial changes in revenue collection (*ibid.*). The expansion of the distribution network and the installation of prepayment meters in households and small businesses are among the key strategies to reduce informal network connections and to keep non-revenue water provision in check (interview 1).

However, as our in-depth studies of the extension of water distribution networks in the sub-wards Mwisho and Stop Over, in the ward of Kimara in the Kinondoni municipal district at the western outskirts of Dar es Salaam, demonstrate, these interventions do not necessarily bring about the desired improvements. The Ministry of Water invested the World Bank funds not only in the construction of new pipes and meters, but also in the installation of kiosks (interview 15). These kiosks function as backups for individual household connections. Since the newly installed household connections in this particular area regularly malfunction, private individuals run the kiosks and sell the water to subvendors, who then distribute it in the adjacent settlement. In addition, local inhabitants engage vendors who draw water from other

sources, if the kiosks run out of water. This was the case in December 2013 and January 2014, when pipes were broken at several points, and fresh water drained into the dust roads. The pipes had been in disrepair for months (interview 13) and water provision was ‘unreliably rationed’ (interviews 8 and 13). Thus, residents pay for a household connection and additionally for water sold by vendors. Despite many complaints by local households and politicians, DAWASCO, the institution that is responsible for maintaining the networks, has not taken any action so far. According to one resident, a representative of the local DAWASCO branch has claimed that the lack of water can be attributed to faulty construction by the Chinese subcontractor who installed the pipes (interview 12). Since DAWASCO has neither enforced claims against the subcontractor, nor maintained the network, local inhabitants have engaged in repair activities themselves and have hired repair workers (see Figure 4).

The expansion of the water distribution network has not only provoked conflict with residents and local entrepreneurs whose income is threatened by networked supply, but has also led to considerable conflict between the water utilities. Representatives of DAWASA, international NGOs and the Ministry of Water agree that DAWASCO is in charge of repairing and maintaining the network and should thus be held responsible for the persistent problems (interviews 6, 9, 11), but at the same time DAWASCO lacks the necessary revenue to fix them (interview 11). Representatives of DAWASCO are generally aware of the malfunctioning of the distribution network, but point to network bottlenecks and the overall water shortage instead of inadequate maintenance and repair (interview 9), since DAWASA connected approximately 16,000 households instead of the 12,000 they had planned for, in the ‘good spirit’ of not excluding anyone (interview 11). As both water utilities hold each other accountable for the problem of stagnating coverage, this issue and the issue of the unreliability of water supply persist. The World Bank and other international organizations argue that it is the organizational setup that needs to be changed first. As one World Bank expert contends, ‘we need to fix the institutional arrangements. Otherwise this [investment into new technologies] will be a waste again’ (interview 17). A representative of the Ministry of Water generally agrees with the need for institutional change, but states that the main failure of this particular intervention is on part of the external construction company (interview 6). In line with DAWASCO and DAWASA, she prioritizes investments in the expansion of the technical network over further institutional changes (interviews 6, 9, 11).

Our research into the current expansion of the water distribution network shows that the transfer of the networked city ideal involves immense contestations. This is the case even if discourses, as well as policies and investment decisions, imply a smooth transfer of and an *adaptation* to this circulating ideal. The informal, illegal or private tapping of existing lines and the ‘spaghetization’ of the water supply network illustrate everyday *appropriations* of the networked supply by local inhabitants. These place-based appropriations also involve the utilities’ staff, who often provide the connections informally, which have a negative impact on the technical functionality of the networks and on the recovery of network investments. Messy situations for policy-makers and the utilities are the result. Accordingly, representatives of the utilities frame network connections without formal payments as ‘stealing of water’ (interview 11), while representatives of international organizations interpret these connections as pragmatic solutions to the cumbersome, lengthy and often unreliable procedures of formal network connection (interview 5). The Ministry of Water’s decision to invest not only in the construction of new pipes and meters, but also in the installation of water kiosks connected to the central network represents an *appropriation* of the networked city ideal in response to the limited funding capacities and the prevailing ruptures resulting from illegal taps. Ultimately, residents and local entrepreneurs drive processes of *hybridization* by buying water from privately operated boreholes



FIGURE 4 From left to right: Water leakage; and self-organized repair of pipes in the streets of Kimara (photos by Sophie Schramm, 2014)

or from vendors in the absence of reliable household connections. These everyday practices of local residents are a creative response to the lack of reliable networked water supply, but expose them to health risks and reduce cost recovery. Frequently, local users pay for network connections without receiving water, while also having to buy water from kiosks or private vendors at inflated prices. This situation places users under significant tension and subjects them to a convoluted situation that emerges from interdependent but inadequately coordinated activities by multiple private and public actors.

– The low priority of costly network extension in sanitation

The implementation of large-scale projects and public investment in sewerage networks and facilities is much less dynamic than the issue of water supply. The extension of sanitation networks has been criticized by international and bilateral cooperation agencies (interviews 1, 10 and 16), which have increasingly supported ‘appropriate’ or low-cost technologies and institutional arrangements beyond or complementary to DAWASA’s centralized provision, depending on the specifics of an urban area (see Figure 5). This tendency of international NGOs to reject the universal suitability of the networked city ideal and to propose place-based solutions is in line with the Water Supply and Sanitation Act of 2009, which broadened the responsibility of local water and sanitation authorities in Tanzania by including the management of faecal sludge at the household level.

This position is, however, controversial for the ward-level administrations and the utility companies, who see centralized networks as the ultimate solution to the sanitation problem (interviews 3, 6 and 9). DAWASCO is in charge of the sewerage network and centralized treatment facilities only, the City Council manages the drainage of storm water, and the responsibility for wider sanitation issues rests with the municipalities (interviews 9 and 11). This institutional setup also accounts for considerable disaccord among key stakeholders regarding future investments in sanitation. An explanation for the reservations of DAWASA, DAWASCO and the Ministry of Water against on-site solutions is that the promotion thereof devolves their formal authority and attendant financial resources to the municipalities or would at least challenge their inherent operational and business model. However, the authority to shape Dar es Salaam’s sanitation system is unevenly distributed among DAWASCO, DAWASA and the Ministry of Water on the one hand and the municipalities on the other hand. Despite initiatives by international organizations to extend the municipalities’ responsibility and capacity to provide sanitation services (interview 19), experts point out their institutional and financial weakness: the central government decides over 80% of the municipalities’ budget (interview 18). Accordingly, less than 1% of public investments in sanitation are allocated to on-site sanitation services under municipal authority. A share of more than 99% is allocated to the central network, from which only 10% of urban residents benefit (Trémolet and Binder, 2013: 30). As a result of their limited authority, the municipalities’ actual contribution to urban sanitation is not clear to ward-level administrations. A ward chairman in Kinondoni observes that ‘nothing is done at the community level’ and that ‘every household is responsible for its own sanitation’ (interview 20). Another sub-ward leader interprets the absence of a central network as an absence of public responsibility: ‘For sanitation, there is not any institution responsible. This is because there is no sewer system connected to the houses’ (interview 3). Local leaders’ impression that no public agency is in charge of sanitation as sanitation networks are absent might account for their preference for a centralized network. Local decision makers’ opinions, as well the current citywide allocation of sanitation funds, clearly indicate the prevailing preference for centralized systems managed by the utility company over privatized or public-private on-site sanitation.

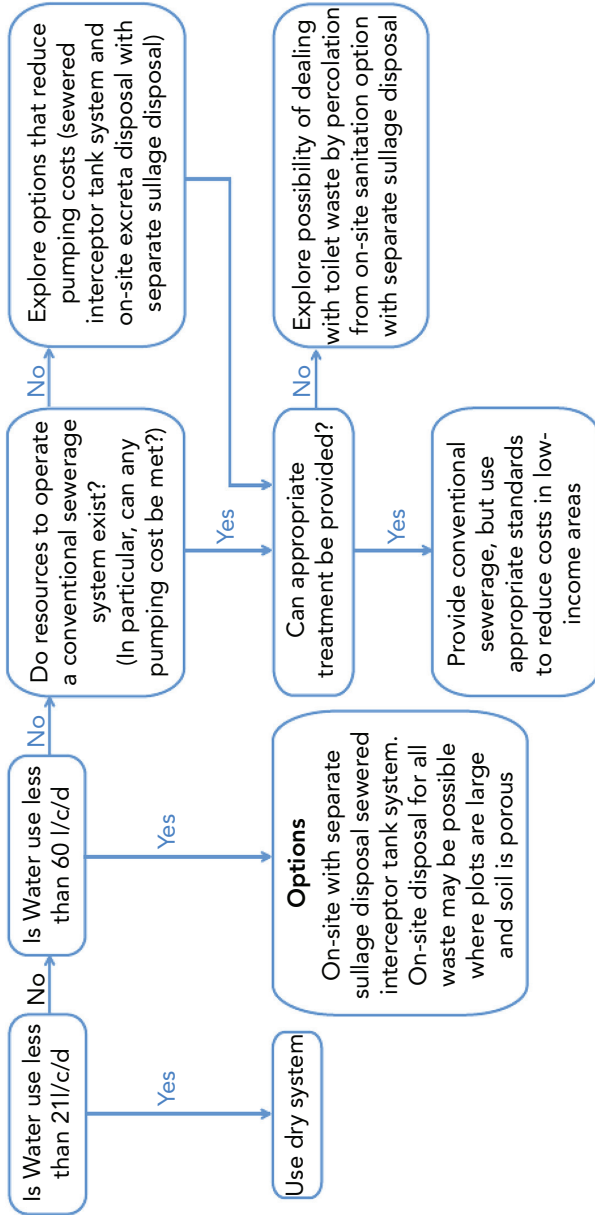


FIGURE 5 Decision tree for sanitation options (source: DAWASA, 2010: 31)

While international organizations, NGOs and formal plans and policies suggest a creative *hybridization* of the ideal and promote ‘appropriate’ on-site technologies, representatives of central and sub-ward level administrations, as well as the utility company itself, prefer universal sanitation networks. Despite the persistent failure of this system to provide sanitation for the majority population of Dar es Salaam, they promote an *adaptation* of the existing sociotechnical constellations to the ideal of the networked city, partly based on their own vested interests. However, this preference is not reflected in their willingness and capability to actually invest in network extensions. Because interventions in the sanitation sector have low priority, the realization of the ideal of the ‘networked city’ is only being pursued half-heartedly. Although it is ultimately not being *refused*, it is *appropriated* and *hybridized* to suit the specifics of the locale and the preferences of local inhabitants, utility companies and policymakers.

– Explaining the different translation dynamics in water supply and sanitation

The comparison of investments in water and sanitation reveals institutional complexities and conflicting interests in the sanitation domain. Neither the utility companies nor the Ministry of Water prioritizes sanitation, while water supply remains their ‘main business’ (interviews 6 and 11). This is in accordance with the priorities of local leaders as well as residents in Kimara, who consider the water supply situation highly problematic, while sanitation is seen as a lower-ranking issue (interviews 12, 13 and 14). From the perspective of local sub-ward leaders, the only alternative to the current private organization of sanitation would be the construction of a centralized public sewerage system. As this does not seem feasible owing to the limited investment capacities of local utilities, high sewerage fees for local households, and the necessity of resettlement, residents accept the current situation (interview 3). Thus, political pressure to address the issue of sanitation needs is low compared to that for water supply needs. Furthermore, the lower priority that the Ministry of Water and the utility company accord sanitation can be attributed to the complex institutional sanitation arrangements: the public network involves not only the city authorities and the utility companies but also the municipalities. At the national level, the Ministry of Water shares its regulatory and planning authority with the Ministry of Health and with the Prime Minister’s Office, the regional administration and local government (Trémolet and Binder, 2013).

While official plans in both domains can be interpreted as adaptations to circulating ideals and technologies—be it the networked city ideal or that of ‘appropriate technologies’—our study indicates the performative processes that are involved in their domain-specific translation. In sanitation, the passivity of local utilities and administrations reveals a balancing act to formally comply with international policy pressure in their official plans. Simultaneously, through their passivity they protect their vested interests in the matter, or their limited resources. Their passive state is amplified by the indifference of local residents and their limited ability to afford sewerage fees. This exacerbates the sanitation crisis, and sanitation is *de facto* left to the private sector or individual self-organization. Investments in water networks indicate an adaptation to the networked city ideal in urban policies and discourses, while the networked supply is in fact appropriated (for example, by ‘spaghetization’) and hybridized through additional sociotechnical solutions (for example, water vending or private wells).

These dissimilar dynamics in translating circulating ideals and models in the two domains can be attributed to various factors. First, the compatibility of circulating ideals with the existing technologies and the built environments played a major role in our case studies. This is evident from the fact that the construction of underground sewerage networks would require considerable reconstruction of existing settlement

structures and individual buildings. It also involves higher costs than the construction of a water supply pipe system, particularly in Dar es Salaam, a city built on swamplands. Secondly, the potential for cost recovery of infrastructure investments is considerably lower for networked sanitation services, and the economic incentives to upgrade networked and on-site solutions are also low. Thirdly, the institutional capacity of public administrations and utility companies to adopt networked solutions shape translation processes. This capacity is lower in sanitation in Dar es Salaam, where service provision is mostly privately organized and where political responsibilities are distributed between different policy fields and levels. Finally, translation dynamics depend heavily on the perceptions, cultural values and practices of users. In Dar es Salaam, residents and politicians are very concerned about water supply, while they do not engage in efforts to establish alternative sanitary solutions.

Conclusions

Our analysis of water supply and sanitation in Dar es Salaam illustrates that the circulating ideal of a networked city has considerably shaped the formal institutions, policies and aspirations of local administrations, international organizations, utility companies and residents since the colonial period. In both domains, we can identify an adaptation of institutions, plans and investment strategies, as well as policymakers' and utilities' preferences for the networked city ideal. Even for sanitation, where international organizations have over the past few decades stimulated a move toward the integration of on-site solutions, and where official plans have been adapted to include these shifting policy priorities, the preferences of central decision makers persistently conform to circulating ideals of a networked city.

However, our empirical insights defy simplistic notions of a linear technology transfer from the global North to the global South or of a 'diffusionist model' (Arnold, 2006: 100). Instead, they provide evidence for place-based creativity, polarization and conflict in translating hegemonic models of urban modernity. Our study indicates that the transfer of technologies, ideas and planning models is usually not a simple repetition of what happened elsewhere. Technology transfer functions within a politically configured and culturally differentiated space. It is profoundly shaped by that context and follows a different technological path involving change and innovation. We argue alongside Sahlin and Wedlin (2008: 219) that, as the ideal of the networked city has to be translated, and as this translation necessarily evolves differently in particular locales and domains, the transfer of this ideal does not necessarily lead to homogenization, but also to variation and stratification. Our case study demonstrates that the transfer of networked city ideals needs considerable translation efforts to the processual, mobile and unequal infrastructural landscapes in urban Africa. Accordingly, the effects of adaptation, appropriation, hybridization and refusal processes that follow diffused ideas and technologies can hardly be foreseen. They do not necessarily conform to plans by specific individuals or organizations, but are often unintended and contradictory. In Dar es Salaam, the place-based translation of the ideal of unitary, standardized, publicly regulated and secure service provision has paradoxically perpetuated its diversity of sanitation services, urban inequalities in accessing critical services and splintered infrastructure topologies.

Our conclusion for planning research and practice is that we need a more interactive, culturally nuanced, relational and multi-sited debate about how technological and urban models travel, and how they function within specific places and infrastructural domains. Not only do we need more research on how hegemonic ideals and models from the global North are translated within the global South, but we also have to address translation processes as reciprocal and multi-directional. More research is thus needed to address the circulation across cities in the global South, and how

practices and knowledge from the global South travel and function within cities in the global North. Faced with the restrictions of a linear transfer of technologies, ideals and planning models, we propose that more caution is required in planning debates on ‘best-practice approaches’ or ‘appropriate technologies’ and their transferability from one context to another. We suggest in particular that contested and multi-faceted translation efforts in African cities of circulating ideals and technologies and resulting appropriations and hybridities need more attention. While planning research and practice needs to consider the massive inequalities in income and service provision and the patterns of rapid urbanization beyond formal land use and infrastructure plans, it has to acknowledge sociotechnical and urban diversity more critically. In other words, ‘no single model can work for the poor’ (interview 7). Here, the study of African cities is particularly productive and enables new empirical and conceptual perspectives not just on processes of adaptation, but also on the creativity and resistance involved in translating travelling models and technologies. Moreover, the study of infrastructural landscapes in urban Africa provides insights for better understanding recent changes in the technological fabric of cities in the global North, where more diversified sociotechnical arrangements increasingly challenge urban and infrastructure planning.

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References

- Anderson, W. (2002) Introduction: postcolonial technoscience. *Social Studies of Science* 32.5/6, 643–58.
- Arnold, D. (2006) Europe, technology, and colonialism in the 20th century. *History and Technology* 21.1, 85–106.
- Baker, T. and C. Temenos (2015) Urban policy mobilities research: introduction to a debate. *International Journal of Urban and Regional Research* 39.4, 824–27.
- Beeckmans, L. (2013) Editing the African city: reading colonial planning in Africa from a comparative perspective. *Planning Perspectives* 28.4, 615–27.
- Behrends, A., S.-J. Park and R. Rottenburg (2014) Travelling models: introducing an analytical concept to globalisation studies. In A. Behrends, S.-J. Park and R. Rottenburg (eds.), *Travelling models in African conflict management: translating technologies of social ordering*, Brill, Leiden and Boston, MA.
- Brennan, J.R. and A. Burton (2007) The emerging metropolis: a history of Dar es Salaam, circa 1862–2000. In J.R. Brennan, A. Burton and Y.Q. Lawi (eds.), *Dar es Salaam: histories from an emerging African metropolis*, Mkuki na Nyota Publishers, Dar es Salaam.
- Budds, J. and G. McGranahan (2003) Are the debates on water privatization missing the point? Experiences from Africa, Asia and Latin America. *Environment and Urbanization* 15.2, 87–114.
- Callon, M., P. Lascoumes and Y. Barthe (2009) *Acting in an uncertain world: an essay on technical democracy*. Translated by G. Burchell, MIT Press, Cambridge, MA.
- Coutard, O. and J. Rutherford (2016) Beyond the networked city: an introduction. In O. Coutard and J. Rutherford (eds.), *Beyond the networked city: infrastructure reconfigurations and urban change in the North and South*, Routledge, London.
- DAWASA (Dar es Salaam Water and Sewerage Authority) (2010) Sanitation improvement plans. Final report. Preparation of a strategic sanitation plan for Dar es Salaam. Dar es Salaam.
- Dupuy, G. (2008) *Urban networks—network urbanism*. Techné Press, Amsterdam.
- EWURA (Energy and Water Utilities Regulatory Authority) (2014) Water utilities performance report 2013/2014. Dar es Salaam.
- Gandy, M. (2006) Planning, anti-planning and the infrastructure crisis facing metropolitan Lagos. *Urban Studies* 43.2, 371–96.
- Graham, S. and S. Marvin (2001) *Splintering urbanism: networked infrastructures, technological mobilities and the urban condition*. Routledge, London.
- Grubbauer, M. (2015) Circulating knowledge, marketization and norm-making: international developers and construction firms in Eastern Europe since 2000. *Global Networks* 15.3, 288–306.
- Hård, M. and T.J. Misa (2008) Modernizing European cities—technological uniformity and cultural distinction. In M. Hard and T.J. Misa (eds.), *Urban machinery: inside modern European cities*, MIT Press, Cambridge, MA, and London.
- Hardoy, J.E., D. Mitlin and D. Satterthwaite (2001) *Environmental problems in an urbanizing world: finding solutions in Africa, Asia, and Latin America*. Earthscan, London.
- Healey, P. (2013) Circuits of knowledge and techniques: the transnational flow of planning ideas and practices. *International Journal of Urban and Regional Research* 37.5, 1510–26.
- Healey, P. and R. Upton (eds.) (2010) *Crossing borders: international exchange and planning practices*. Routledge, London and New York, NY.
- Jaglin, S. (2008) Differentiating networked services in Cape Town: echoes of splintering urbanism? *Geoforum* 39.6, 1897–906.
- Jaglin, S. (2016) Is the network challenged by the pragmatic turn in African cities? Urban transition and hybrid delivery configurations. In O. Coutard and J. Rutherford (eds.), *Beyond the networked city: infrastructure reconfigurations and urban change in the North and South*, Routledge, London.

- Kaika, M. (2005) *City of flows: modernity, nature, and the city*. Routledge, London.
- Kinusi, R.B. and J. Lupala (2009) Building disaster-resilient communities: Dar es Salaam, Tanzania. In M. Pelling and B. Wisner (eds.), *Disaster risk reduction cases from urban Africa*, Earthscan, London.
- Kironde, J.L. (2007) Race, class and housing in Dar es Salaam. In J.R. Brennan, A. Burton and Y. Lawi, (eds.), *Dar es Salaam: histories from an emerging African metropolis*, Mkuki na Nyota Publishers, Dar es Salaam.
- Kjellén, M. (2006) *From public pipes to private hands: water access and distribution in Dar es Salaam*. Department of Human Geography, Stockholm University, Stockholm [WWW document]. URL <http://www.diva-portal.org/smash/get/diva2:189600/FULLTEXT01.pdf> (accessed 28 September 2016).
- Kjellén, M. and A.G. Kyessi (2012) Dar es Salaam: the development of water supply and sewerage systems. In T. Tvedt and T. Oestigaard (eds.), *A history of water—volume 1: water and urbanization*, Tauris, London.
- Kooy, M. and K. Bakker (2008) Technologies of government: constituting subjectivities, spaces, and infrastructures in colonial and contemporary Jakarta. *International Journal of Urban and Regional Research* 32.2, 375–91.
- Latour, B. (2005) *Reassembling the social: an introduction to actor-network-theory*. Oxford University Press, Oxford and New York.
- McCann, E. and K. Ward (eds.) (2011) *Mobile urbanism: cities and policymaking in the global age*. University of Minnesota Press, Minneapolis, MN.
- Melosi, M.V. (2008) *The sanitary city: environmental services in urban America from colonial times to the present*. University of Pittsburgh Press, Pittsburgh, PA.
- Mhamba, R.M. and C. Titus (2001) Reactions to deteriorating provision of public services in Dar es Salaam. In A. Tostensen, I. Tvedten and M. Vaa (eds.), *Associational life in African cities: popular responses to the urban crisis*, Gotab, Stockholm.
- Mitlin, D. (2008) With and beyond the state: co-production as a route to political influence, power and transformation for grassroots organizations. *Environment and Urbanization* 20.2, 339–60.
- Monstadt, J. (2009) Conceptualizing the political ecology of urban infrastructures: insights from technology and urban studies. *Environment and Planning A* 41.8, 1924–42.
- Monstadt, J. and S. Schramm. (2013) Beyond the networked city? Suburban constellations in water and sanitation. In R. Keil (ed.), *Suburban constellations: governance, land and infrastructure in the 21st Century*, Jovis, Berlin.
- Myers, G. (2011) *African cities: alternative visions of urban theory and practice*. Zed Books, London and New York, NY.
- Nganyanyuka, K., J. Martinez, A. Wesseling, J.H. Lungo and Y. Georgiadou (2014) Accessing water services in Dar es Salaam: are we counting what counts? *Habitat International* 44.4, 358–66.
- Njoh, A.J. (2009) Urban planning as a tool of power and social control in colonial Africa. *Planning Perspectives* 24.3, 301–17.
- Pastore, M.C. (2015) Reworking the relation between sanitation and the city in Dar es Salaam, Tanzania. *Environment and Urbanization* 27.2, 1–16.
- Penrose, K., M.C. de Castro, J. Werema, E.T. Ryan and A.I. Ko (2010) Informal urban settlements and cholera risk in Dar es Salaam, Tanzania. *PLOS Neglected Tropical Diseases* 4.3 [WWW document]. URL <http://dx.doi.org/10.1371/journal.pntd.0000631> (accessed 28 September 2014).
- Rakodi, C. (2008) Order and disorder in African cities: the social roots and contemporary outcomes of approaches to governance and land management. Paper presented to the UNU-WIDER project workshop 'Beyond the Tipping Point: Development in an Urban World', 26–28 June, Cape Town.
- Robinson, J. (2002) Global and world cities: a view from off the map. *International Journal of Urban and Regional Research* 26.3, 531–54.
- Rottenburg, R. (2009) *Far-fetched facts: a parable of development aid*. MIT Press, Cambridge, MA.
- Rugemalila, R. and L.M. Gibbs (2015) Urban water governance failure and local strategies for overcoming water shortages in Dar es Salaam, Tanzania. *Environment and Planning C: Government and Policy* 33.2, 412–27.
- Sahlin, K. and L. Wedlin (2008) Circulating ideas: imitation, translation and editing. In R. Greenwood, C. Oliver, R. Suddaby and K. Sahlin (eds.), *The SAGE handbook of organizational institutionalism*, SAGE, London.
- SID (Society for International Development) (2008) Urbanization and water. SID briefing paper. Rome (51 n.1) [WWW document]. URL <http://www.sidint.net/docs/Urbanisation%20and%20water.pdf> (accessed 4 July 2014).
- Silva, C.N. (2015) Urban planning in sub-Saharan Africa: an overview. In C.N. Silva (ed.), *Urban planning in sub-Saharan Africa: colonial and post-colonial planning cultures*, Routledge, New York, NY, and London.
- Silver, J. (2015) Disrupted infrastructures: an urban political ecology of interrupted electricity in Accra. *International Journal of Urban and Regional Research* 39.5, 984–1003.
- Smiley, S.L. (2009) The city of three colors: segregation in colonial Dar es Salaam, 1891–1961. *Historical Geography* 37, 178–96.
- Smiley, S.L. (2013) Complexities of water access in Dar es Salaam, Tanzania. *Applied Geography* 41 (July), 132–38.
- Tarr, J.A. and G. Dupuy (eds.) (1988) *Technology and the rise of the networked city in Europe and America*. Temple University Press, Philadelphia, PA.
- Trémolet, S. and D. Binder (2013) Evaluating the effectiveness of public finance for household sanitation in Dar es Salaam, Tanzania. WaterAid, London [WWW document]. URL <http://www.wateraid.org/~media/Publications/Dar-es-Salaam-sanitation-report.ashx> (accessed 8 August 2013).
- UNDP/BMZ (United Nations Development Programme/ German Federal Ministry for Economic Cooperation and Development) (1999) Decentralization: a sampling of definitions. Working paper prepared for the evaluation of the UNDP role in decentralization and local governance, New York, NY.
- UN-Habitat (2009) Planning sustainable cities: global report on human settlements. Earthscan, London.
- UN-Habitat (2010) The state of African cities 2010. UN-Habitat, Nairobi.
- UN-Habitat (2014) The state of African cities 2014. UN-Habitat, Nairobi.
- URT (United Republic of Tanzania) (2002) National water policy. Dar es Salaam.
- URT (United Republic of Tanzania) (2009) The Water Supply and Sanitation Act. Dar es Salaam.
- URT (United Republic of Tanzania, Ministry of Water) (2013) Water Sector Development Programme 2007–2014. Evaluation of phase I, Oxford Policy Management, Dar es Salaam and Oxford.
- van Vliet, B., G. Spaargaren and P. Oosterveer (eds.) (2010) *Social perspectives on the sanitation challenge*. Springer, Dordrecht.
- Watson, V. (2003) Conflicting rationalities: implications for planning theory and ethics. *Planning Theory & Practice* 4.4, 395–407.
- Watson, V. (2009) Seeing from the South: refocusing urban planning on the globe's central urban issues. *Urban Studies* 46.1, 2259–75.
- World Bank (2012) A case study of public-private and public-public partnerships in water supply and sewerage services in Dar es Salaam. Water papers no. 69032, Washington DC.

Appendix–Cited interviews

- 1 Officer, Water Sector Development Tanzania, German Agency for International Cooperation (GIZ), 27 November 2013
- 2 Informal water vendor, Kimara, 23 November 2013
- 3 Leader, Kimara sub-ward, 19 December 2013
- 4 Head Officer, Water Sector Development Tanzania, German Agency for International Cooperation (GIZ), 4 December 2013
- 5 Secretary, Water Tanzania, Development Partners' Group, 6 December 2013
- 6 Head of Business and Monitoring of Urban Water, Ministry of Water, United Republic of Tanzania, 22 November 2013
- 7 Professor, Institute of Human Settlements Studies, Ardhi University, Dar es Salaam, 22 November 2013
- 8 Officer, Water Sector Development Tanzania, German Agency for International Cooperation (GIZ), 4 December 2013
- 9 Chief Executive Officer, Dar es Salaam Water and Sewerage Company (DAWASCO), 14 January 2014
- 10 Program Coordinator, WaterAid Tanzania, 22 November 2013
- 11 Senior Engineer, Dar es Salaam Water and Sewerage Authority (DAWASA), 26 November 2013
- 12 Resident 1, sub-ward Kimara Mwisho, 23 November 2013
- 13 Resident 2, sub-ward Kimara Mwisho, 23 November 2013
- 14 Resident 3, sub-ward Kimara Mwisho, 23 November 2013
- 15 Water vendor, Kimara, 19 December 2013
- 16 Project Coordinator, Bremen Overseas Research and Development Association (BORDA), 12 December 2013
- 17 Lead water and sanitation specialist, World Bank, 6 December 2013
- 18 Professor, Institute of Human Settlements Studies, Ardhi University, Dar es Salaam, 17 December 2013
- 19 Project Coordinator, Belgian Development Agency (BTC), 4 December 2013
- 20 Chairman, Manzese Ward, 9 December 2013