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Strengthening the human right to sanitation as an instrument for inclusive development

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Chapter 3. Contextualizing the Sanitation Problem

3.1 INTRODUCTION

Sanitation is a complex problem for empirical study. This chapter focuses on the secondary research question of: How does an understanding of the meaning and economic classification of sanitation, the drivers of poor domestic sanitation services, and the main technologies for domestic sanitation services affect the design of sanitation governance frameworks? I address the question through literature review and content analysis. Although the sanitation problem transcends households and permeates all spheres of life (Nygaard & Linder, 1997), this chapter focuses on personal and domestic sanitation and hygiene services as the unit of analysis. This approach is anchored on four main reasons: (a) this reflects the scope of the definition of sanitation in the development discourse (see 3.2) and the human rights framework (see 5.2.3); (b) although the human rights construct does not stipulate any economic model for sanitation service delivery, it imposes an obligation for affordability for domestic users which is affected by the economic classification of sanitation goods and services (see 3.3); (c) the human right to sanitation (HRS) is mainly focused on meeting personal and domestic sanitation needs and therefore needs to address the drivers of poor domestic sanitation services (see 3.4); (d) technologies for domestic sanitation services are not value neutral and may either hamper or improve access and therefore require further consideration (see 3.5). The chapter concludes with identifying linkages between sanitation technologies, the drivers of poor sanitation services, and inclusive development (ID) (see 3.6), and my inferences on the implications for realising the human right to sanitation (HRS) through a predominantly technocratic approach are presented in Section 3.7.

3.2 DEFINING SANITATION SERVICES

Although there was also a decade dedicated to improving access to better water and sanitation services (from 1981 to 1990), the global sanitation target was first introduced into the Millennium Development Goals (MDGs) at the World Summit on Sustainable Development (WSSD) in 2002, (Lenton, Wright & Lewis, 2005). There is no global legal definition of sanitation services. While the WSSD used the term ‘basic sanitation’, the Joint Monitoring Programme (JMP) of the World Health Organization (WHO) and the United Nations International Children’s Emergency Fund (UNICEF) used ‘improved sanitation’ in monitoring and reporting on the sanitation target under the MDGs. What each of these

terminologies means is still contested and the scholarly literature, often without clear definition, refers to basic sanitation (Kamga, 2013), improved sanitation (Munamati, Nhapi & Misi, 2016; van Minh & Nguyen-Viet, 2011), adequate basic sanitation (Giné-Garriga, Flores-Baquero, Jiménez-Fdez de Palencia & Pérez-Foguet, 2017), environmental sanitation (Arimah, 1996), or simply ‘sanitation’ (Guimarães, Malheiros & Marques, 2016). Exceptionally, Victor and Ernest (2007) define sanitation as the maintenance of hygienic conditions through garbage collection and waste disposal services. Nonetheless, the grey literature produced by international organisations like the JMP, the Water Supply and Sanitation Council (WSSCC), the World Health Organization (WHO), and the Millennium Task Force often either contain definitions of sanitation or itemise key components of sanitation from which an underlying meaning can be garnered. The definitions of sanitation focus on: (a) basic sanitation; (b) environmental sanitation; and (c) improved sanitation.

Basic

The WSSD defined basic sanitation to include: (a) improvement of sanitation in public institutions, especially in schools; (b) promotion of safe hygienic practices; (c) promotion of education and outreach focused on children, as agents of behavioural change; (d) promotion of affordable and socially and culturally acceptable technologies and practices; (e) development of innovative financing and partnership mechanisms; and (f) integration of sanitation into water resources management strategies in a manner that does not negatively affect the environment. WSSD thereby linked sanitation with safety (and improved human health, reduced childhood and infant mortality), public participation, affordability, acceptability and sustainability of sanitation infrastructure, which are some of the HRS principles discussed in Chapter 5 (Lenton et al., 2005). Unlike the scholarly literature which mainly discusses basic sanitation from the perspective of the individuals and households (for instance, Kamga, 2013), the WSSD definition has the advantage of taking into cognisance the importance of sanitation services in public places as well, and the need for financial and environmental sustainability of sanitation services.

The Millennium Development Task Force defined basic sanitation as “the lowest-cost option for securing sustainable access to safe, hygienic, and convenient facilities and services for excreta and sillage disposal that provide privacy and dignity, while at the same time ensuring a clean and healthful environment both at home and inside the neighbourhood of users” (Lenton et al., 2005, p.30). The main strength of this definition is that it highlights the fact

that the choice of sanitation instruments, particularly sanitation infrastructure is value laden and dependent on contextual factors like the conditions in the physical environment, and the available financial resources. Hence, what constitutes basic sanitation in one area, for instance in an arid low income formal settlement, may differ from the requirements in another area such as a formal settlement in a riverine area (see 3.5). It is also pragmatic in promoting the balancing of sanitation needs with ensuring environmental sustainability both in the immediate and extended surrounding of users.

The Sustainable Development Goals (SDGs) framework defines basic sanitation service as an improved facility that is not shared, limited service as “an improved facility shared with other households”, and safely managed sanitation service as “a basic facility that safely disposes of human waste” (UN, 2017, p.30). It also defines hygiene coverage as the “availability of a hand washing facility with soap and water on premises” (United Nations, 2017, p.330). The basic definition under the SDG is however more restrictive than the WSSD defined which went beyond excreta management and hygiene, as elaborated above.

Environmental

There are alternative definitions of sanitation which extend beyond the focus on basic sanitation to include wider concerns for ensuring a clean and healthy environment. For instance, the World Health Organization (WHO) broadly defines sanitation, on its website, as “the provision of facilities and services for the safe disposal of human urine and faeces” and “the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal” (Sanitation, n.d.).

This definition has the advantage of integrating the safe containment of excreta with hygiene and the broader concerns for environmental sanitation in some scholarly publications. However, similar to the JMP’s definition, the WHO’s definition does not emphasize sewerage or any form of waste treatment after collection to ensure environmental sustainability. The WHO definition is also vague on whether facilities need to be provided for use in public places or only at the household level but it can be construed to include all spheres of human life, as human urine and faeces can be generated wherever humans exist and would then require safe disposal.

Improved

The JMP, responsible for monitoring access to sanitation under the recently concluded MDGs programme (2015), defined access to sanitation in terms of access to improved facilities which hygienically separate human excreta from human, animal and insect contact. These include flush or pour-flush toilets connected to a piped sewer system, septic tank, or pit latrine, ventilated improved pit (VIP) latrine, pit latrine with slab, and compost toilet, provided they were not public facilities (World Health Organization and UNICEF 2015). Further, only private facilities were classified as improved (Kwiringira et al., 2014; World Health Organization & UNICEF, 2015).

Although the JMP definition prioritises public health through the safe containment of human excreta by using improved sanitation facilities, improved facilities do not prevent contamination from untreated sewage that is discharged into the environment (Bain, 2014; Baum, 2013; Satterthwaite, 2016). Further, the literature suggests that there are underlying issues of poverty and low levels of education among households that rely on shared facilities (Heijnen, Routray, Torondel & Clasen, 2015a), while households that share with neighbours (presumably a relatively smaller group of users with social ties) have higher demographic status than households relying on communal facilities (open to the public use) which are also less likely to be hygienically maintained than the neighbour-shared facilities (Heijnen, Routray, Torondel & Clasen, 2015b). Communal sanitation facilities may also be poorly suited for safe use by women due to privacy and safety concerns, for instance, which raises issues of gender parity (Biran, Jenkins, Dabrase & Bhagwat, 2011). Nonetheless, shared facilities may enhance access to sanitation if hygienically maintained, culturally acceptable, and located in a safe environment (Obani & Gupta, 2016b). They may even constitute an appropriate adaptation response to limited space or resources (Rheinländer, Konradsen, Keraita, Apoya & Gyapong, 2015; Yatmo & Atmodiwirjo, 2012).

3.3 CLASSIFYING DOMESTIC SANITATION SERVICES AS ECONOMIC GOODS

The economic classification of goods and services has important implications for governance institutions that can be further illustrated by reference to Thomas Hardin's Tragedy of the Commons in the context of environmental resources (Hardin, 1968). The Tragedy of the Commons is founded on the concept of externalities, that is, the costs of production that are not reflected in the final cost of a good or service. It proposes that the environment is more of a common pool resource which is non-excludable but rivalrous and that individuals acting as

rational, independent and free-enterprises realise that the cost of discharging waste directly into the environment is less than the cost of treating the waste before discharge (externalities). This creates an incentive for overexploitation or pollution of the environment in the absence of regulation. The need to internalise externalities and protect the environment from degradation is the basis for environmental law principles like the polluter pays principle which is sometimes relied upon as the justification for the use of economic instruments in governing the environment. Nonetheless, not every aspect of the environment or environmental resources can be readily classified as a common pool resource. For instance, Brölmann (2011) states that the legal model of global commons is not appropriate for global freshwater resources that cannot be localized.

The economic character of sanitation is still in issue and resolving this is important for the efficient production of sanitation services. Although the Dublin Statement of the International Conference on Water and the Environment, 1992, controversially recognised water and by extension sanitation as an economic good, it did not clarify what type of economic good. Sanitation fits into each category of economic goods at different stages, and its status changes over time and can be influenced through human actions (Mader, 2012).

On the one hand, sanitation has the characteristics of a public good (non-excludable and non-rivalrous) because the benefits of accessing and using adequate sanitation, such as reduced public health risks and improved quality of life, extend to non-users as well and are therefore non-excludable and non-rivalrous (Mader, 2012). This would support the provision of free or subsidised sanitation systems for public use. For instance, Agenda 21 frames water as essentially a 'social' good which means poor users need to be provided with free access and users can only be charged equitably for use in excess of basic human needs (United Nations, 1992). However, where funding is limited, investment may be redirected away from the direct provision of private sanitation facilities towards public good components like wastewater treatment and sewer networks (Evans, 2005), although this would not necessarily prioritise the poor.

On the other hand, sanitation can be considered a merit good (and made available to everyone on the basis of need, regardless of the ability or willingness to pay for it) because users display a preference-distortion and sometimes resort to unhygienic alternatives like open defecation instead. The provision of merit goods requires State intervention, otherwise, the private sector, including individual users, may not act in their own best interest, due to

limited knowledge and resources or their value system (Mader, 2012). Still, sanitation does not entirely qualify as a merit good because the negative externalities of poor sanitation and hygiene habits are generally non-excludable. Additionally, private sanitation facilities are excludable and somewhat rivalrous depending on the technology of the sanitation system. In the case of water, there is evidence of the informal privatisation of community taps entrenching inequities in access, by improving water security for some and denying access to the poor and vulnerable, rather than promoting universal access (Udas, Roth & Zwartveen, 2014). The sanitation system further includes public and common good components, without which the sustainability of the private infrastructure (for instance, private toilets) would not be assured (see Table 3.1).

Table 3.1 Classifying sanitation as an economic good

Components of Sanitation Systems	Economic Properties	Class of Economic Goods
Centralized sewer networks	Non-excludable Non-rivalrous	Public good
Water in aquifer, natural resources, roads, etc. required for sanitation services or used as a sink for sanitation services	Non-excludable Rivalrous	Common good
Patented sanitation technology	Excludable Non-rivalrous	Toll/club good
Physical components of sanitation systems that require connection or service fees like toilets	Excludable Rivalrous	Private good

Given that sanitation is increasingly being privatized or delivered through various public private partnerships (PPPs) models, especially in poor countries with weak infrastructure for the delivery of sanitation goods and services, there is a danger that: (a) sanitation goods and services will not be provided by the state; (b) that even if the State provides it, full cost recovery models may result in the sanitation goods and services becoming unaffordable, thereby exacerbating the existing inequities in access to sanitation at multiple levels of governance especially in the context of poor countries; or (c) that the ecological components are externalized.

3.4 DRIVERS OF POOR SANITATION SERVICES

Drivers are the causes of a problem, and can either be direct or indirect. Direct drivers influence local actors to engage in practices that result in poor sanitation services and therefore mostly operate at the local and national levels. In my analysis, I identify direct drivers by asking the following questions: (a) Does the driver reduce the capacity of users to make the necessary investments required to meet their personal sanitation needs? (b) Is the driver external to the service provider yet affecting the providers' capacity to meet the existing sanitation needs within their service areas? A driver which answers to either or both questions is direct (see 3.4.1). I classify the other drivers which occur in the literature but are not direct drivers based on the foregoing selection criteria as indirect. The indirect drivers have an incidental effect on direct drivers and can operate at multiple levels of governance, from international to local (see 3.4.2). The direct and indirect drivers, as well as their scale and context of operation are presented in Table 3.2.

3.4.1 Direct

From the literature, I identified sixteen direct drivers of poor sanitation services, including: (a) six economic; (b) seven social; and (c) four environmental drivers. The direct economic drivers are financial or fiscal factors affecting users' capacity to invest in domestic and personal sanitation services, while the direct social drivers are human, political or cultural factors hindering access to sanitation services and the environmental drivers are inherent to the physical and natural environment.

Economic drivers

First, the huge capital investments required for sanitation services (Lixil et al., 2016; Trémolet & Rama, 2012) will not be made by poor households and residents in informal settlements with a tendency to discount the future (Poulos & Whittington, 2000). Second, household poverty limits users' ability to pay for connection and maintenance fees or flat rate subscription tariffs, and may ultimately cause service disconnections in the absence of well-targeted pro-poor instruments, like cross-subsidies (Biran et al., 2011; COHRE et al., 2008). Conversely, lack of subscription from users reduces the available financial resources for the maintenance of existing facilities, service expansion and investments in new infrastructure (World Health Organization [WHO] & UN-Water, 2015) Third, even where users subscribe for sanitation services, too low or inefficient tariff collection systems and

poor revenue collection may be a driver of poor sanitation in formal and informal settlements (USAID Egypt, 2013). Fourth, the inherent preference-distortion characteristics of sanitation as a merit good (see 3.3) coupled with the existence of free though unhygienic alternatives like open defecation, hampers willingness to pay and reduces the level of demand for sanitation services (Department for International Development [DFID], 2007; Mader, 2012; Obani & Gupta, 2014a). Fifth, risk aversion affects investment in resilient systems (Saqib, Ahmad, Panezai & Rana, 2016) and some economic actors may be averse to investing in sanitation services for the poor without assurances of significant returns on their investments (Grey & Sadoff, 2007). Sixth, unaffordable tariffs and high connection and maintenance fees, coupled with low incomes, limit households' ability to access sanitation services (Biran et al., 2011; COHRE et al., 2008), and the threshold for affordability is a key issue especially in the context of informal settlements (Fonseca, 2014).

Social drivers

First, a long distance to sanitation facilities reduces accessibility, increases waiting times, and may compromise the safety of vulnerable users, like women and children who try to access the facilities at night (COHRE et al., 2008; Biran et al., 2011). Second, the exclusion of minorities from the design, operation, maintenance and use of sanitation infrastructure exacerbates inequitable access and may fuel conflicts over sanitation (Evans et al., 2009; van Staple, 2013). Third, negative social practices like non-prioritisation of sanitation services or the location of public sanitation infrastructure based on political considerations rather than overriding public interest and efficiency hampers equitable access (Mader, 2012; Schuller & Levey, 2014). Fourth, negative cultural practices which inhibit safe waste management and the maintenance of hygiene standards (Ersel, 2015), or constrain the siting of sanitation infrastructure, without any environmental or public health basis are also drivers of poor sanitation (Akpabio, 2012; Evans et al., 2009; IRIN, 2012). Fifth, even where the infrastructure is available, poor maintenance and improper use may result in either damage or lack of use among girls especially (Biran et al., 2011; Garn et al., 2014, 2017; Simiyu, 2016). Sixth, space constraints, especially in poorly planned settlements or emergency situations, hampers the installation, operation and maintenance of facilities, technologies and infrastructures (Katukiza et al., 2010; Katukiza et al., 2012; Johannessen, Patinet, Carter & Lamb, 2012). Seventh, in informal settlements especially, tenure insecurity and the underlying power issues, limit access to formal sanitation services especially where service providers are not legally obliged to extend their coverage to informal areas, forcing the

residents to resort to either open defecation and other unsanitary practices or unregulated and often more expensive informal services for their basic needs (Dagdeviren & Robertson, 2009; Murthy, 2012).

Environmental drivers

First, a challenging or inaccessible topography, compounds the technicality or cost of providing sanitation; for instance, through preventing the laying of pipes at the right depth to establish the required slope for the smooth operation of the system, requiring additional infrastructure or necessitating increased system capacity to avoid the sewage infiltration by groundwater (Cairns-Smith, Hill & Nazarenko, 2014). Paradoxically, it is the poor and marginalised groups of people who tend to settle in such physically challenging areas that are relatively cheaper to acquire or lease and during emergencies such areas are worst hit and their residents less resilient. Second, pollution, droughts and other forms of water scarcity hamper the operation of conventional sewage systems and affect self-supply options like wells, thereby reducing the availability of water for personal sanitation and hygiene uses (Johannessen et al., 2012). Third, natural hazards, which could be climatological (like extreme temperatures and wildfires), geophysical (like earthquakes and volcanoes), hydrological (like floods), or meteorological (like hurricanes and cyclones) (Watt and Weinstein 2013), may destroy non-resilient sanitation infrastructure or critical infrastructure like roads and power supply networks which are necessary for delivering sanitation services in humanitarian situations disrupt services and contaminate water sources which are required for sanitation and hygiene uses like hand washing (Bates, Kundzewicz, Wu & Palutikof, 2008; Misra, 2014). The impact of natural hazards is especially significant in poorly resilient communities (Qasim et al., 2016; Roosli & Colins, 2016; Sharifi & Yamagata, 2016). Fourth, particularly during emergencies, high temperatures and high turbidity in source water may also affect the operation of sanitation systems (Ensink et al., 2015).

3.4.2 Indirect

From the literature, I identified nine indirect drivers of poor sanitation services, including: (a) four economic; (b) four social; and (c) one environmental driver. The indirect economic drivers are financial or fiscal factors exerting an underlying influence on users' investments in sanitation, and are mainly linked to public financing. The indirect social drivers include

social conditions and demographic factors, while the environmental driver is not confined to the locality.

Economic drivers

First, although there is limited evidence that foreign debt relief inevitably results in increased public expenditure on social infrastructure (Dessy & Vencatachellum, 2007; Kaddar & Furrer, 2008), foreign debts reduce the capacity of poor States for such investments (Varma et al., 2008). Second, within formal and informal settlements and humanitarian situations, insufficient funds partly due to the fragmented governance of sanitation (Isunju, 2011), and lack of targeted financing coupled with low visibility of humanitarian crises and chronic emergencies (United Nations Children's Fund [UNICEF], 2015; 2017) affects sanitation services. Third, national poverty limits the ability of poor countries to invest in sanitation infrastructure and estimate the recovery time for critical infrastructure affected by emergencies (Zorn & Shamseldin, 2015). Fourth, sanctions may also affect public investments in sanitation infrastructure; hence, General Comment No. 15 (2003), articles 31 and 32 (see 5.2) implore States to refrain from imposing embargoes and similar measures that frustrate the realisation of the right to water, or using water as a means of coercion (Obani & Gupta, 2015).

Social drivers

First, insecurity and conflicts (such as intra-communal dissensions over sanitation projects or conflicts over transboundary water resources) may hamper access to sanitation services through the destruction of sanitation infrastructure (Obani & Gupta, 2015), and limited social cohesion (often lacking in informal settlements or among people living in humanitarian situations or populations in transit) to support self-help enterprises (Isunju, 2011). Second, lack of education and awareness, minimal engagement with the relevant agencies and failure to report service problems also hinder sanitation and hygiene awareness, sustainability of services, and enforcement of civic rights (Munamati et al., 2016; Akpabio, 2012). Third, mass migration and rapid urbanisation creates additional stress for existing resources and increases the likelihood of the spread of water and sanitation related diseases in the absence of adequate infrastructure (Vuorinen, 2007). Fourth, in formal and informal settlements and emergencies, population density significantly increases pollution (Saqib et al., 2016), and affects the sustainability of sanitation infrastructure like sewer systems (Cairns-Smith et al., 2014; Schouten & Mathenge, 2010).

Environmental drivers

Although the links between climate change and human health are yet to be fully established, climate change could indirectly drive poor sanitation services by exacerbating extreme weather events and variability, leading to the destruction of sanitation infrastructure (Rabbani, Huq & Rahman, 2013). The risks are particularly high for poor countries lacking the institutions, funding, and infrastructure to invest in necessary climate mitigation and adaptation measures (Grey & Sadoff, 2007).

Table 3.2 Direct and indirect drivers of poor personal and domestic sanitation services

Drivers		Eme.	For.	Inf.	Key References	
<i>DIRECT</i>						
Eco.	Discounting the future				Poulos & Whittington 2000	
	Household poverty				Biran et al. 2011; COHRE 2008	
	Inefficient tariff collection system				USAID Egypt 2013	
	Preference distortion affecting WTP				Mader 2012; Obani & Gupta 2014a	
	Risk aversion				Grey & Sadoff 2007; Saqib et al. 2016	
	Unaffordable tariffs & connection fees				COHRE et al. 2008; Fonseca 2014	
	Distance to the facility				Biran et al. 2011; Mader 2012	
	Exclusion of minorities from accessing services				Evans et al. 2009; van Staple 2013	
	Negative social practices				Akpabio 2012; Ersel, 2015	
	Non-acceptance of sanitation facility				Ersel 2015	
Social	Poor maintenance culture/improper use of facilities				Garn et al. 2014, 2017; Simiyu, 2016	
	Space constraints				Katukiza et al. 2010; 2012	
	Tenure insecurity				Dagdeviren & Robertson 2009; Murthy 2012	
	Challenging or inaccessible topography				Schuller & Levey 2014	
	High temperatures/high turbidity in source water				Ensink et al. 2015	
	Natural hazards				Labib & Read 2015; Qasim et al. 2016	
	Pollution/water scarcity				Johannessen et al., 2012	
	<i>INDIRECT</i>					
	Eco.	Huge foreign debts that limit public spending				Varma et al. 2008
		Insufficient/poorly targeted funds				Isunju 2011; UNICEF 2015
National poverty					Zorn & Shamseldin 2015	
Sanctions affecting the sanitation sector					Obani & Gupta 2015	
Social	Insecurity, conflicts and poor social cohesion				Isunju 2011; Obani & Gupta 2015	
	Low awareness about sanitation				Akpabio 2012; Munamati et al. 2016	
	Mass migration/urbanisation				Juuti 2007; UN-Habitat 2016	
	Population density/growth				Cairns-Smith et al. 2014; Saqib et al. 2016	
Env.	Climate variability and change				Misra 2014; Rabbani et al. 2013	
Nat. - National; I. - International; Eco. - Economic; Env. - Environmental; Eme. - Emergency; For. - Formal; Inf. - Informal						

Source: This table builds on Table 12.1 in Obani & Gupta, 2016b

3.5 TECHNOLOGIES FOR DOMESTIC SANITATION SERVICES

This section focuses on the basic technologies used for domestic sanitation service delivery, including: (a) toilet systems (see 3.5.1); (b) on-site septic tanks (see 3.5.2); (c) sewer systems (see 3.5.3); (d) sludge treatment (see 3.5.4); and (e) the sanitation ladder and service levels commonly used for measuring and regulating the level of access to sanitation technologies and services.

3.5.1 Toilets

The first toilets in human history were simple holes in the ground. Subsequently, ancient civilizations across Africa, Asia and Europe were motivated by health, environmental, and religious values to construct both private and public toilets and washrooms for the easy and safe containment of sewage (Juuti, 2007). With the development of microscopes in the middle of the 19th century, people began to realise the health risks posed by contaminated water, leading to increased interest in water supply and toilet systems (Juuti, 2007). Toilet systems may generally be wet or dry, and in some cases bio-physical factors such as water quantity or quality may necessitate further technological innovations such as the floating toilet being developed for use in floating communities (Akpan, 2015).

Wet system

A wet toilet system, such as pour flush toilets, requires water for the evacuation of excreta from the toilet into a single leach pit, twin leach pits through a division chamber, or septic tank. While the solid wastes settle to the bottom of the tank, the organic components are decomposed by bacteria (Parkinson, Tayler, Colin & Nema, 2008). The wastewater could be treated through artificial wetlands or anaerobic filters, before discharge into a drain or watercourse, or infiltration in cases where the ground conditions permit, otherwise untreated effluents discharged into the environment poses both human health and environmental hazards (Parkinson et al., 2008). The estimated cost of a pour flush latrine is around USD 70 while a septic tank latrine costs around USD 160, including operation and maintenance costs (van de Guchte & Vandeweerd, 2004).

Dry system

A dry system, such as ecological sanitation (Ecosan) which separates faeces and urine, or the pit latrine, eliminates the need for immediate evacuation and wastewater treatment by combining the toilet and storage and is commonly used in informal settlements, humanitarian

situations, and rural areas (Simha & Ganesapillai, 2016). Peepoo bags lined with sanitising agent which breaks down excreta inside the bag to be reusable as fertilizer is also an alternative dry system which presents a sustainable alternative to open defecation, especially in informal settlements and humanitarian situations (Wirseen, Munch, Patel, Wheaton & Jachnow, 2009). Ecosan requires conscious effort and places more demand on the behaviour of the users compared to some other forms of on-site systems which do not require such separation (Parkinson et al., 2008). Pit latrines can be built from local materials, and modified to suit user preferences and at very low construction and maintenance costs, hence, their prevalence in Community Led Total Sanitation (CLTS) interventions in developing countries (Chambers, 2009; Mehta, 2011; United Nations Children's Fund [UNICEF], 2012). The latrines can however cause odour nuisance (Nakagiri et al., 2016), surface and groundwater pollution due to flooding, poor drainage especially in places with a high water table, or a significantly higher risk of groundwater contamination where the walls are unlined thereby allowing nitrogen and pathogens from sewage to leach into the soil (Katukiza, 2012). The pit latrine has evolved through different design adaptations (ranging from the simple pit latrine to the ventilated pit latrine) and further technological improvements are key to improving the design of pit latrines to promote safe and sustainable use (Nakagiri et al., 2016). A simple pit latrine costs around USD 45, while ventilated improved pit latrine costs around USD 65 (van de Guchte & Vandeweerd, 2004).

3.5.2 On-Site Systems

On-site systems retain faeces and wastewater using pits, vaults, or septic tanks, until the receptacle is desludged, and are therefore appropriate for dry toilets or for use in places with adequate space for a soak pit or constructed wetland and grey water management, and a low water table with no flood risk (Katukiza et al., 2012). The receptacles of on-site systems can be manually emptied. Apart from the high haulage costs and problems of access in densely populated settlements, the public health risks of manual evacuation has led to the practise being proscribed in some countries like India and Nigeria. There are other relatively hygienic alternative technologies for pumping out the sludge, such as the Manual Pit Emptying Technology (MAPET), and the UN-Habitat Vacutug which require less skill, low operating and maintenance cost, and can manoeuvre tight spaces characteristic of informal settlements (Katukiza et al., 2012; Thye, Templeton & Ali, 2011). However, pumping fails under weak latrine substructure; the technologies generally cover only a maximum haulage distance of

0.5 km to the treatment plant, and are unable to evacuate dry sludge and solid particles (Harvey, 2007). Alternatively, smaller vehicles such as the narrow-wheel base truck can also be used to navigate congested areas (Parkinson et al., 2008). Households typically bear at least 70% of the capital cost and 90% of the operating cost of on-site systems (Cairns-Smith et al., 2014). The capital cost of an on-site septic tank system ranges from between USD 70 and USD 360, depending on the size of the septic tank required which varies according to the size of the household using the system, average water use, and the amount of exfiltration from the system (Cairns-Smith et al., 2014; WASHCost, 2012). The annual operating cost is much less ranging from USD 4 to USD 12, depending on the distance to the disposal site, type of tank, the size of the tank relative to the size of the household, and local pricing (Cairns-Smith et al., 2014).

3.5.3 Sewer Systems

Although the water flush system has gained wide acceptance and represents the standard for improved sanitation in many formal settlements, without adequate sewage treatment it could easily lead to the spread of diseases especially in crowded conditions and to the pollution of surface waters when the untreated sewage is channelled into surface waters (Juuti, 2007). Around the twentieth century, sewers were developed to transport sewage from the toilets to the treatment facilities (Juuti, 2007). Sewer networks require a sufficient quantity of wastewater flow to convey sludge through pipes from densely populated human settlements to sewage treatment plants, and may be centralized or decentralized systems (Tilley, Zurbrügg & Lüthi, 2010).

Centralized conventional sewer systems

Centralized conventional sewer systems are ideal for high population density areas with over 30,000 people per square kilometre and are often designed to serve the maximum projected total population of the network area because of the high cost of alterations after the initial installation (Cairns-Smith et al., 2014). The projected capital cost of centralized conventional sewer systems ranges from USD 130-USD 330, with actual costs around USD 180-USD 260 per capita where the entire target population connects to the network; otherwise, the actual capital costs could be as high as USD 220-USD 940 per capita for those connected to the network (Cairns-Smith et al., 2014; Dodane, 2012; Winara et al., 2011). The operating costs for centralized conventional sewer systems range from USD 12 to USD 28 per capita, depending on the cost of energy, manpower/system automation, operation and maintenance,

type of treatment, source of financing, and the topography of the service area (Cairns-Smith et al., 2014). For instance, automation may reduce manpower cost; a flat topography would require extensive pumping, thereby raising energy costs for the system, and additional financing charges for systems being funded through loans (Cairns-Smith et al., 2014).

Decentralized simplified sewers

Decentralized simplified sewers serve relatively smaller areas through reduced pipe diameters, gradients, and depths, and may be required where centralized sewer systems have become ineffective due to blockages and non-functional treatment plants (Cairns-Smith et al., 2014). Decentralized sewers are appropriate for high density urban areas with relatively high wastewater production, low soil permeability, and space constraints (see Figure 3.1) (Paterson, Mara & Curtis, 2007). They are relatively easier to upscale and cheaper to install and maintain than the conventional sewerage (Mara, 1996; Mara & Guimarães 1999). Further, such systems often involve community participation in the design and implementation which promotes households' connections to the network, thereby reducing the per capita capital costs as a result of lower number of connections to the network than projected (Cairns-Smith et al., 2014) but require periodic cleaning to prevent overflow from manholes and blockage of the sewers (Katukiza et al., 2012). The annual per capita cost of decentralized simplified sewer systems ranges from USD 105 to USD 155; the operating costs is low within the range of USD 4 to USD 10 per capita because the sewage is transported through gravity-based flow, over a shorter distance to the wastewater treatment plant (Cairns-Smith et al., 2014; van de Guchte & Vandeweerd, 2004).

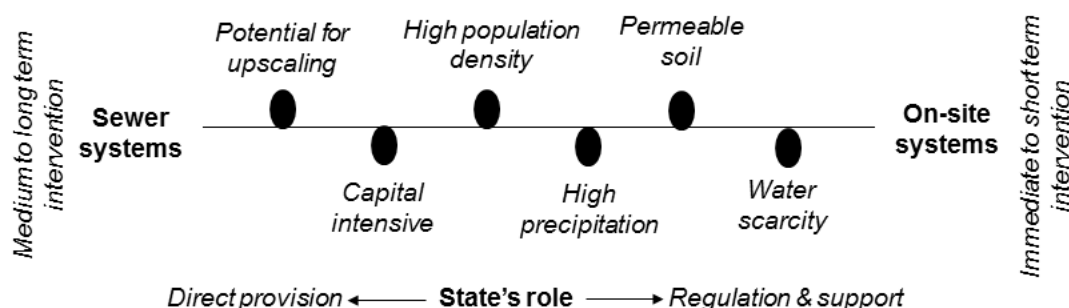


Figure 3.1 Factors influencing the choice of technologies for sewage management

3.5.4 Sludge Treatment

Although the pathogens contained in the faecal sludge undergo some natural degradation on-site, there is need for further treatment before reuse or disposal, to prevent pollution (Tilley 2008). While the type of sludge treatment required depends on the concentrations of pollutants and pathogens, legal requirements including the terms of the discharge consent, and the proposed use of the effluent, most treatment technologies often combine both physical processes, like the removal of large particles by coarse screening or the sedimentation of particles through the force of gravity, and biochemical processes such as aerobic and anaerobic degradation (Mengistu, Simane, Eshete & Workneh, 2015; Parkinson et al., 2008). The effluent from these processes may be further subjected to tertiary treatment to facilitate the removal of nitrogen, phosphorus, and heavy metals or other industrial pollutants (Fan, Zhou & Wang, 2014; Vinnerås 2007). Sludge treatment may result in a solid fraction which requires additional treatment before reuse, and a liquid fraction which requires polishing treatment in order to meet legal requirements for discharge consent or to prevent negative environmental impacts where infiltration of effluents is permissible (Parkinson et al., 2008). Short term alternatives are also available where the required treatment level cannot be achieved before reuse, including restricting the types of crops irrigated with wastewater, employing drip irrigation, and equipping farm workers with protective gear (Parkinson et al., 2008).

3.5.5 Sanitation Ladders and Service Levels

Sanitation ladders

Sanitation ladders emerged in the 1980s through participatory instruments like the Participatory Hygiene and Sanitation Transformation (PHAST) (see 7.3.3). They offer reference points for local communities to deliberate and reach a consensus on appropriate technology options for their sanitation needs (Potter et al., 2011). Sanitation ladders have also been adapted at the international and national levels of governance (see Box 3.1).

Box 3.1 Sanitation ladder for rural sanitation technology in Lao DPR

In Lao DPR for instance, six technological options were identified for rural sanitation technology using the following criteria: (a) sustainability and lasting long-term benefits, (b) immediate benefits in terms of quality, convenience, reliability, (c) capacity requirement to provide supply-side support, (d) operation and maintenance, (e) potential for up scaling, (f) cost effectiveness, and (g) accessibility. The ladder had at its lowest rung improved traditional practice, then conventional dry latrine, lid/cover latrine, ventilated improved pit latrine, pour flush latrine and at its highest the rung septic tank system (Lahiri & Chanthaphone, 2000). This encouraged the participation of local stakeholders in the policy process and offered a guide for improvements in sanitation access.

Technology-based sanitation ladder

The technology-based sanitation ladder features prominently in international sanitation governance; particularly under the MDGs framework and the 2030-bound SDGs (see 3.2). The MDGs sanitation ladder comprised of three rungs to measure progress towards: (a) improved (use of facilities which separate excreta from human contact), (b) unimproved services (use of improved facilities that are shared between two or more households), and (c) open defecation (UN, 2017). The MDGs ladder did not sufficiently address the health risks posed by poor management of excreta despite the use of improved facilities (Baum et al., 2013; Exley, Liseka, Cumming & Ensink, 2015), and downplayed the importance of shared improved facilities for the poor and people living in densely populated areas, for instance (Obani & Gupta, 2016). It also hampered innovation by imposing a predefined list of improved facilities (Kvarnström et al., 2011).

The SDGs ladder has introduced additional rungs and terminology to capture five service levels, namely: (a) safely managed (use of an improved facility which is not shared and excreta is safely treated *in situ* or transported and treated offsite), (b) basic (use of improved facility that is not shared), (c) limited (use of improved facilities that are shared with two or more households), (d) unimproved (use of pit latrines without slab or platform, hanging latrines and bucket latrines, and (e) open defecation (UN, 2017). The SDG ladder also introduces three rungs for hygiene, namely: (a) basic (hand washing facility with soap and water in the household), (b) limited (hand washing facility without soap or water), and (c) no hand washing facility.

The SDGs ladder reclassifies ‘unimproved’ sanitation under the MDGs as ‘limited’. This is significant as there were already around 600 million people using limited service in 2015 (UN, 2017) and the reclassification supports investment in improved facilities for shared use which may be the most efficient option in densely populated informal settlements, for

instance. Further, the SDGs promotes the HRS in four ways: promoting progressive realisation through prioritising improvements for people at the lower rungs; integrating environmental concerns to ensure safe handling of excreta through the use of safely managed facilities; expanding the focus on hygiene; and prioritising universal coverage. It is also important to incorporate the safe disposal and treatment of the wastewater from hygiene uses and menstrual hygiene within limited services, to advance gender equality. This is illustrated in Figure 3.2.

Function-based sanitation ladder

The function-based sanitation ladder is an alternative to the technology-based ladder that additionally incorporates user/health functions at the lower rungs and environmental functions and integrated approaches to sanitation at the higher rungs (Kvanström et al., 2011). The function-based ladder promotes safe management of different waste streams and enhances resource recovery better than the current technology-based ladder. Further, it is capable of spurring local solutions to sanitation problems and inspiring stakeholders to think beyond the provision of certain technologies, based on health and environmental considerations (Kvanström et al., 2011). Progress towards the higher rungs of the ladder may require higher capital investment. This results in poor countries focusing more on providing services at the lower rungs, while richer countries that have contained the health and microbiological risks can focus more on higher environmental functions (Keraita, Drechsel & Konradsen, 2010). It is nonetheless important to ensure that issues of accessibility, affordability, participation, and non-discrimination are addressed even at the lower rungs, to integrate HRS principles (see 5.3) in the process of increasing coverage and environmental functions (Obani & Gupta, 2016).

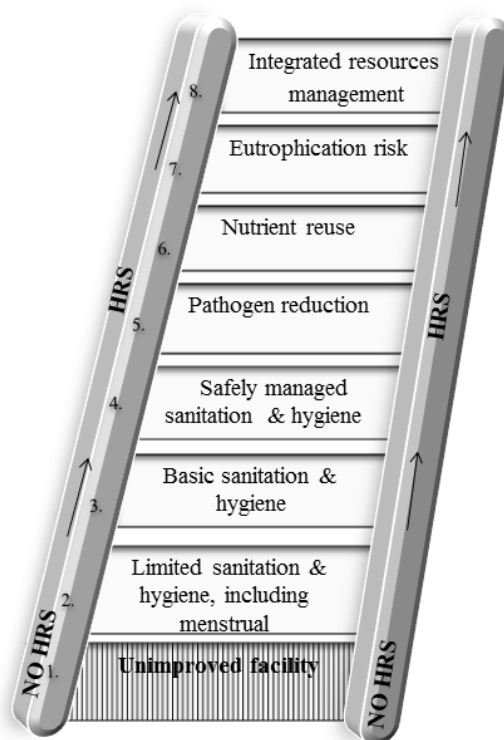


Figure 3.2 Proposed sanitation ladder that integrates technologies and functions (Adapted from Figure 2 in Obani & Gupta, 2016, building upon the new SDGs sanitation and hygiene ladder)

Sanitation service levels and service level contracts

With the participation of the private sector in sanitation service delivery, service levels are stipulated in sanitation Service Level Agreements (SLA) signed between the State and the utility/service provider, as well as in Service Level Contracts (SLC) signed between the utility/service provider and the users which stipulate the standards and terms of use of the services provided. A detailed SLA which stipulates clear standards for services promotes better coordination of the sanitation sector, and strengthens transparency, monitoring and accountability. Depending on the terms, an SLA could also improve equitable outcomes by ensuring standardized services irrespective of the location or status of the users who sign SLC with utilities/service providers (Potter et al., 2011).

Sanitation service levels like the sanitation ladder also stem from a predominantly technocratic response to the sanitation problem. The concept of sanitation service levels determine the level of access to sanitation services based on a predefined set of service

parameters or indicators. Examples of indicators used to determine sanitation service levels for households include the type of technology, accessibility and ease of use, reliability, environmental impact and the levels of health concern resulting from the sanitation facility (COHRE et al., 2008; Potter et al., 2011). In line with the broad meaning of sanitation in the post-2015 development agenda (see 3.2), it is equally important for service levels to regulate not only (a) access to and standards of toilets, but additional components of sanitation such as: (b) sewage network coverage, (c) quality of sewerage and solid waste collection, treatment, disposal, reuse and recycling services, (d) efficiency of participatory mechanisms and consumer complaints handling mechanisms, (e) financial sustainability of sanitation governance, including support for the poor, vulnerable and marginalized who would otherwise be unable to access sanitation.

Further, building on the technology-based and function-based ladders, sanitation service levels may be classified into four, as follows:

- (i) **No access:** Open defecation with very high health concerns
- (ii) **Basic access:** Use of hygienically maintained standard toilet built with a minimum pit depth of 3.5 m and connected to a septic tank (Potter et al., 2011); located down slope and at least between 15m to 30m away from a water source, depending on the local circumstances (Potter et al., 2011; Sphere Project, 2011),²¹ used by a maximum of between 10 to 20 people per drop hole, depending on the local circumstances and the needs of users (Potter et al., 2011; Sphere Project, 2011); sludge accumulation rate of 0.03 m³/person/year (Potter et al., 2011); waste treatment and safe disposal; facilities for safely disposing menstrual products; water and soap for hand washing and hygiene, and hygiene promotion to ensure good sanitation practices (COHRE et al., 2008; Committee on Oversight and Government Reform, 2011; Moore, 2001).²²
- (iii) **Intermediate access** – In addition to (i) and (ii), use of facilities that are not shared, guaranteed privacy and continuous access day and night; mechanical emptying facilities for septic tanks; sewer connections in dense urban areas (COHRE et al., 2008).

²¹ These values are indications at best. It is more practicable and efficient to determine the minimum technical standards for toilets and other sanitation facilities on a case-by-case basis, depending on local factors, like topography.

²² Minimising the number of users per drop hole reduces toilet waiting times and is critical for women who often experience relatively longer waiting times than men due to physiological and cultural issues or even physical factors like having fewer toilets designated for women's use.

- (iv) **Optimal access** – In addition to (i), (ii) and (iii), use of wastewater, stormwater and solid waste removal services, and the maximisation of health and environmental functions from sanitation systems (as outlined in Figure 3.2) (Kvanström et al., 2011).

3.6 TECHNOLOGIES FOR DOMESTIC SANITATION SERVICES, DRIVERS AND INCLUSIVE DEVELOPMENT

This section first provides an overview of the impact of technologies for domestic sanitation services (see 3.5) on the drivers (see 3.4) in sub-section 3.6.1, then the implications of the technologies for ID (see 3.6.2).

3.6.1 Sanitation Technologies and the Drivers of Poor Sanitation Services

Technology is crucial for the delivery of sanitation goods and services, promotes participation in the choice of instruments (through the sanitation ladder), and facilitates the monitoring of service standards for the users' protection (through SLAs and SLCs) (see 3.5.5). Depending on their design, technologies may be adapted to address direct environmental drivers related to space constraints and the local topography (Katukiza et al., 2012). Technology also provides the means of implementing other sanitation governance instruments; for instance, guaranteed free access to sanitation services (see 5.4.2) requires physical sanitation infrastructure (technology) that does not deny users' access due to non-payment. Nonetheless, technology is a relatively inflexible governance instrument (Majoor & Schwartz, 2015) and depending on the type, may require a high level of technical knowledge and expertise for operation and maintenance (see 3.5). Further, the choice, design or application of technologies (see 3.2 and 3.3) may compound the drivers of poor sanitation services and hamper ID (dos Santos & Gupta, 2017), where for instance:

- (a) sanitation technology is designed with a limited public health focus on excreta management that does not address the non-health related psychosocial factors (like social norms and perceived gains for social status) which influence investment decisions and the use of sanitation services (Hulland, Martin, Dreibelbis, Valliant & Winch, 2015; Joshi et al., 2011);²³

²³ cf. Gross and Günther 2014 suggest that low cost technologies rather than health, prestige, or safety will promote latrine construction.

- (b) there are no public sanitation facilities and networks, and this limits access for vulnerable groups like homeless people, internally displaced people and populations in transit (de Albuquerque, 2009);
- (c) there is a mismatch between conventional systems and local preferences or environmental conditions (Fatoni & Stewart, 2012; Paterson et al., 2007);
- (d) patented sanitation technology is difficult or expensive to adapt locally, especially for poor countries (Viola de Azevedo Cunha, Gomes de Andrade, Lixinski & Féteira, 2013) or there are other concerns over the general cost and durability of sanitation technologies (Hulland et al., 2015); and
- (e) sanitation systems are complex, or the technical expertise for the operation and maintenance of facilities is not locally available (COHRE et al., 2008; Fatoni & Stewart, 2012).

3.6.2 Sanitation Technologies and Inclusive Development

Since the 1960s, there have been concerns expressed over the impacts of science and technological innovations on various human rights.²⁴ In relation to the water, sanitation, and hygiene (WASH) sector, technologies ought to ensure social and relational inclusion, and environmental sustainability in order to be inclusive (see 2.4.3). To illustrate this using the sanitation ladder (see 3.5.5), the sanitation ladder can potentially improve social and relational inclusion by integrating users in the process of selecting instruments, technologies and service levels (see Q3 and Q4 in Figure 3.3). It is however important that the ladder does not only present predefined technological options but offers an opportunity for users to develop solutions that best suit their unique circumstances and maximise health and environmental functions (see Rungs 2 – 8 in Figure 3.2 and Q4 in Figure 3.3). The impact of sanitation technology also depends on the local context (for instance, are open toilets culturally acceptable? Are the facilities hygienically managed? Is the sewage safely collected, treated, disposed of, and recycled or reused?), and other related policies like whether or not

²⁴ See United Nations, Proclamation of Teheran, Final Act of the International Conference on Human Rights, Teheran, 22 April to 13 May 1968, U.N. Doc. A/CONF. 32/41 (1968). Para. 18 http://legal.un.org/avl/pdf/ha/fatchr/Final_Act_of_TehranConf.pdf; United Nations (1968b). Resolution adopted by the General Assembly. 2450 (XXIII). U.N. Doc. A/10034 (1968). Para. 1(a); United Nations (1970). Human rights and scientific and technological developments. U.N. Doc. E/CN.4/1028/Add.6 (Dec. 29, 1970), and A/8055; United Nations (1975). Declaration on the use of scientific and technological progress in the interest of peace and for the benefit of mankind. General Assembly. Resolution 3384 (XXX); United Nations, Vienna Declaration and Program of Action,} 11, U.N. Doc. A/CONF.157/23 (July 12, 1993).

informal settlements are excluded from coverage. The analysis following below is based on an inductive analysis of the technologies discusses in Section 3.5.

Social and relational inclusion

Sanitation interventions that are designed from a purely technocratic perspective may either exacerbate inequities in access to sanitation or be perceived as doing so. The 2011 toilet wars in South Africa are reminiscent of this. In the run-up to the local government elections in that year, there were many protests against unenclosed toilets in the informal settlement in Khayelitsha, Cape Town (Robins, 2014). The open toilets were widely seen as representing the political inequities, indignities and injustices of the apartheid regimes (Robins, 2014), thereby diminishing social and relational inclusion or were at least perceived to do so (that is, Q1 in Figure 3.3). Conversely, social and relational inclusion require the effective participation of all stakeholders, especially the poor, vulnerable and marginalised users, in every process for sanitation governance, for instance baseline studies on the status of sanitation services, setting of targets and service standards, design and/or selection of sanitation technologies and their location, the negotiation of SLAs and SLCs (see 3.5.5), and the implementation of monitoring and evaluation mechanisms. Social and relational inclusion also requires the equitable pricing of sanitation services at a level which stimulates providers and users to overcome the preference-distortion associated with merit goods, while also protecting access for the poor and vulnerable who may otherwise be deprived of services (see 3.3).

Ecological inclusion

Dry toilet systems like pit latrines are relatively cheap and can be built with locally sourced-materials and technology (which *prima facie* indicates social and relational inclusion within the bottom quadrants of Figure 3.3), but would fall within the lower left quadrant in Figure 3.3 (see Q3) where they are unlined and contaminate the groundwater. Ecosan contributes to environmental sustainability and therefore falls within the right quadrant of Figure 2, depending on whether or not there is equitable access in favour of the vulnerable and marginalised population (that is, Q2 or Q4 in Figure 3.3). Peepoo bags are environmentally sustainable because of their waste treatment properties and therefore fall within the right quadrants of Figure 3.3, depending on the level of accessibility for the vulnerable and

marginalised population (Q2 or Q4 in Figure 3.3). Septic tanks and manual evacuation techniques, without treatment fall within the left quadrant in Figure 3.3, while evacuation technology like MAPET, VACUTUG, and narrow wheel base trucks that are suitable for informal settlements promote social inclusion would promote ecological inclusion if the sewage is treated (Q4 in Figure 3.3). Floating toilets improve accessibility for informal settlements and emergency situations like floods but can contaminate both surface and groundwater (potentially falling into Q3 in Figure 3.3). Water flush systems expend a lot of water and can cause environmental pollution, depending on the level of sludge treatment. The technology-based sanitation ladder *prima facie* excludes relational and environmental concerns, beyond excreta containment, therefore it falls within the left quadrant (see Q1 and Q3 in Figure 3.3), whereas the function based ladder which integrates health and environmental functions falls within the right quadrant (see Q2 and Q4 in Figure 3.3).

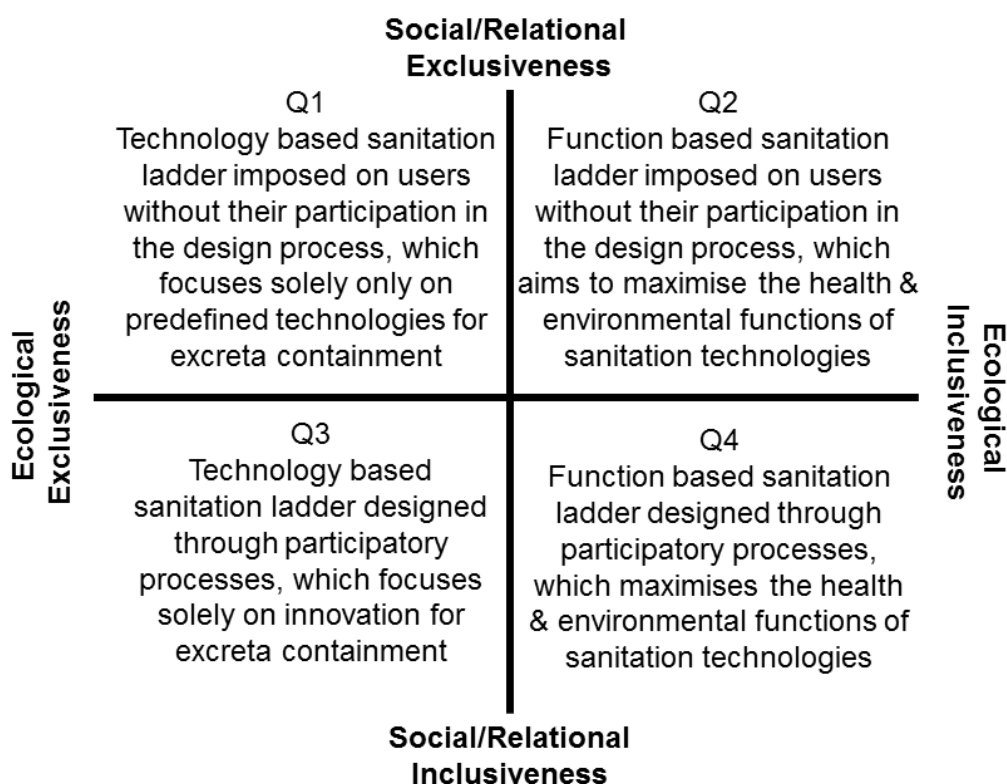


Figure 3.3 Assessing the sanitation ladder for inclusive development

3.7 INFERENCES

This chapter contributes five key messages with import for designing sanitation governance frameworks. First, it shows that there are multiple meanings of sanitation by different actors

at various levels of governance, from international to local. Some definitions and actors focus on the “lowest-cost option for securing sustainable access to safe, hygienic, and convenient facilities and services for excreta and sullage disposal that provide privacy and dignity, while at the same time ensuring a clean and healthful environment both at home and inside the neighbourhood of users” (the Millennium Development Taskforce’s definition of basic sanitation). Others highlight the need for access to improved technology for excreta containment and disposal and discountenance shared facilities (for instance, JMP’s definition of improved sanitation), or more broadly the need to ensure a clean and healthy environment (for instance the WHO definition) and respect for human rights (for instance the SDGs sanitation target). Nonetheless, each of these definitions are value laden and require further analysis. Taking the definition of basic sanitation as an example, among the poor, the ‘lowest-cost option’ may be a form of shared facility which allows for the costs of sanitation services to be spread among the users but shared facilities also raise important equity and safety concerns. Overall, the contestations show that the definition of the HRS ought to address gender equality, accessibility for vulnerable users like children, hygiene and maintenance of the facility, affordability of tariffs, and operating and maintenance costs, environmental sustainability, and social and relational equality between poor and rich users/households, to ensure inclusive outcomes (see Chapter 9).

Second, classifying sanitation or sanitation components as economic goods presupposes a quantifiable economic value and underlies the commodification and commercialisation of sanitation services and this chapter highlights an ambivalence among scholars regarding the economic nature of sanitation, with the multiple properties of a public good, merit good, or private good. A public good is non-excludable and non-rivalrous but this can be altered through commodification with the result that the poor who cannot afford to pay are excluded from accessing sanitation goods. Merit good refers to components where sanitation offers externalities that are critical to the wellbeing of both users and non-users and the environment and therefore requires State investment to augment shortfalls from the market and users. Private good refers to components of the sanitation system that allow for excludable consumption of sanitation goods and through the markets, based on the ability to pay. Further, common good components of sanitation like ecosystems that serve as natural sinks for sanitation services are non-excludable and rivalrous and therefore need to be protected from depletion as a result of unsustainable use. Toll goods components like patented sanitation technology are also excludable but non-rivalrous and may therefore be denied to

poor users due to the operation of market forces. The inherent complexity of classifying sanitation goods mirrors the pluralistic foundations of sanitation governance and is an indication of the complex interactions between the different principles that converge in sanitation governance (see 5.6.3, 6.6.3, 7.4.3 and 8.6.3).

Third, there are seventeen direct drivers and nine indirect drivers of poor sanitation services covered in the literature, and they often reinforce each other within and across different scales. Although the literature mostly analyses the drivers (causes of poor sanitation services) in the context of specific vulnerable groups like residents of informal settlements, women, school children and people in detention centres or humanitarian situations, similar drivers may nonetheless apply across different settings (see Table 3.2). The challenge for sanitation governance in relation to drivers is therefore to: (a) operationalize sanitation governance principles using instruments that can address one driver (for instance, household poverty) without exacerbating another driver (for instance, pollution of natural resources and environmental stress caused by changes in the households' consumption patterns and poor management of increased wastewater), and (b) formulate instruments that can be adapted across different scales (including local, national and international) which would improve a comparison of their performance and learning.

Fourth, technologies are relatively inflexible but necessary for the operationalization of most of the other (regulatory, economic, management, and suasive) governance instruments discussed in the literature (see 5.5, 6.4, and 7.3) and in the context of my case study (see 8.5). The current predominantly technocratic response to the sanitation problem offers potential for enhancing participation (like the sanitation ladder) and instruments for containing human excreta. However, it does not always adequately address the complex interconnectedness of the drivers of poor sanitation services, definitional issues and the complexity of classifying sanitation goods and services in economic terms due to underlying factors like the design and suitability of the technologies to the local context; access problems for vulnerable groups; the cost and durability of the available technologies; and the poor integration of psychosocial considerations like social norms and the status of users, which affect the adoption of sanitation technologies (see 3.6.1).

Fifth, sanitation technologies differ in the extent to which they promote ID depending on whether or not the technologies improve affordable access to sanitation services and participation in the sanitation governance processes for the poor, vulnerable and marginalised

groups (social and relational inclusion), and whether or not the technologies promote environmental sustainability and minimise the harmful effect of sanitation service delivery on the environment (ecological inclusion). Conversely, even where a sanitation technology *prima facie* ensures environmental sustainability and is designed to be affordable, excluding the poor or residents of informal settlements from accessing the technology would still hamper ID. Hence, the truth about the impact of sanitation technologies on ID lies in the details of the principle or (regulatory, economic, management or suasive) instrument which the sanitation technology is designed to deliver. As a result, sanitation technologies are not discussed as a stand-alone theme in the subsequent discussion of instruments in Chapters 5, 6, 7 and 8.

The above five conclusions are critical for further elaborating on the HRS as will be shown in this thesis.