SLURC/DPU Action-Learning Alliance

Understanding urban risk traps in Freetown

MSc Environment and Sustainable Development

Practice Module 2017-18

POLICY BRIEF Nº 5

Key points

• Safe water is not sufficient; surface water is mostly contaminated whereas underground water is partially contaminated due to latrines and dumpsite infiltration in the aquifer.

• The only safe source of water is the Guma Valley network. But this source is poorly maintained and has no capacity to serve all Freetown population (only 61%), as it has not been expanded to keep pace with the city's development.

• In order to reduce the risk of waterborne diseases epidemics, the cycle between drinking water sources and faecal matter contamination must be broken through the prioritizing of safe and wholistic integrated faecal sludge management.

• The most affected groups are low-income citizens living in coastal zones, near river basins and in hill zones. These groups lack access to infrastructure and water supply. Among them, children under five are most vulnerable. Moreover, well-off residents face serious risk.

• Urban water and sanitation planning and management must be integrated to the other city systems as all of them interrelate.

• The roles and responsibilities for water and sanitation management are not clear. As a result, NGOs, private sector and local councils have had to get involved.

• At the national level, there are some laws and policies established to structure the management of the water and sanitation systems. However, control and implementation of these are the main challenge in addition to establishing financial equilibrium and support.

Water and sanitation related diseases

"Kroo Bay Primary, Freetown, Sierra Leone." James Mollison

Summary

Widespread poverty, lack of financial resources, and human capital hinder the institutional capacity to cope with the requirements of the rapidly growing population of Freetown. The expansion and proliferation of high density informal settlements, without access to social infrastructure and services implies that a large proportion of citizens face everyday risks such as poor health caused by waterborne diseases (malaria, cholera, typhoid, etc). Small disasters (localized floods and landslides), large disasters (tropical storms, floods) along with inefficient waste management and drainage systems intensify the impact of these risks by spreading diseases rapidly among larger portions of the population, transforming slums into waterborne epidemic zones. Residents see their capacities to face health risks undermined by the constant shocks of negative events.

In this context, this policy brief seeks to identify the underlying causes of risk reproduction mechanisms, the pathways and cycles of contamination while recognizing the most affected groups. This, in order to provide policy makers with the information to design and implement policies that break the main pathogenic transmission cycle of waterborne diseases by focusing on safe faecal sludge management and integrated urban planning, health, and ecological management while carefully considering budgetary constrains .

Authors

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The distribution of safe water supply and sanitation infrastructure in Freetown is strongly related to the past; Initially, British citizens occupied the center of the city while creoles and native communities settled in the eastern periphery of the city center. As the population expanded, Europeans migrated to western areas to escape from crowdedness and the rising unsanitary conditions.

After independence, the pattern was continued, leading to today's west-east divide; with the wester area established as an upper-class residential area and the eastern area as an industrial zone (Ministry of Health, 2008). The industries are inoperative nowadays and they have been replaced by informal settlements inhabited by low-income groups who are unable

Recently, rapid population growth triggered by rural-urban migration and natural growth has overwhelmed the planning capacity of the authorities to provide infrastructural development and services to residents (Macarthy, 2016), especially to those of low-income. Moreover, years of political conflict and mismanagement have confined access to piped water, sanitation and hygiene facilities to the original place of construction (a small portion of the city center) and some western "privileged" zones. (Ministry of Health, 2008).

The spatial and socio-economic gaps between the west-east sections of Freetown are reflected in the quality of housing and environmental conditions (Doherty 1985). Quality housing structures are mainly found in the west part, while in contrast, the poorest in the east (Ibid).

Currently, urban development is mainly happening in the eastern part, especially in hill sides and seashore along the traditional center. The settlements in these locations are highly dense (60% of the population lives in slums) built without proper planning and considerations of basic infrastructure. They are characterized by poor-quality housing, lack of access to the sewerage system and piped water supply (Doherty, 1985; Ministry of Health, 2008). Hence, the unhygienic conditions lead to the proliferation of water and sanitation related diseases outbreak and is constantly menacing Freetown's public health (see Figure 1).

In the following two sections, the researchers attempt to identify the weakneses of the water supply and sanitation system to set the basis to understand the pathways in which waterborne diseases outbreaks emerge.

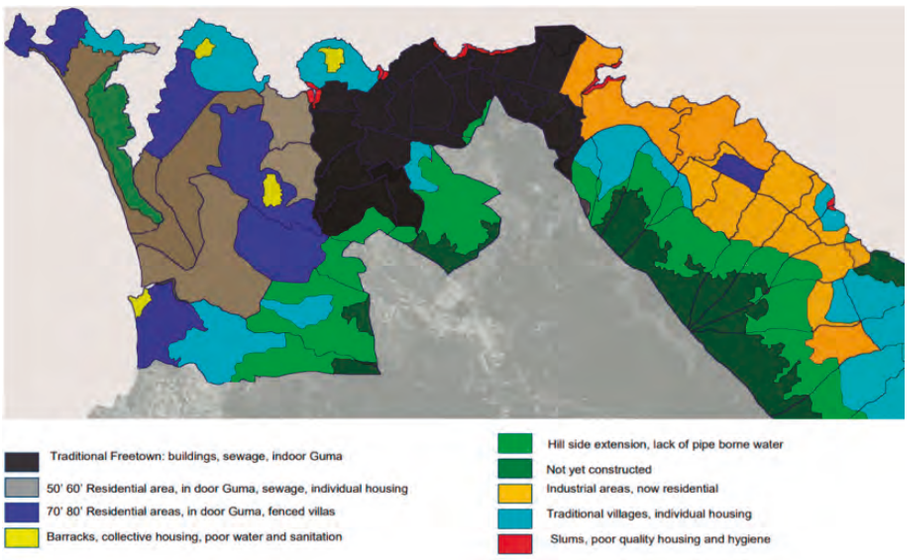

Figure 1. Typology of the dwelling, Urban Freetown: ACF (2008)

Freetown was founded in 1792 as the head of several settlements for slaves freed from Nova Scotia and the West Indies (Doherty, 1985). The settlement has grown from a small fortification with an initial population of around 1000 people at the end of the 18th century (Ibid) to 1,055,964 people that currently live in The Western Urban Area (Statistics Sierra Leone, 2015). According to the 2004 population census, between 1963 and 1985 alone, Freetown's population grew by around 116% (Macarthy, 2012). However, a significant proportion of this population consists mainly of low-income groups that live in informal settlements that have grown along the hill slope areas and on the shorelines of the Atlantic.

WATER SUPPLY INEQUALITES AND INEFFICIENCIES

The water from the Guma Valley Water Company (GVWC) network is uncontaminated and the main drinking water source. In 1967, when the dam was built, the population was much smaller than it is today. Nowadays, the length of the pipe network is insufficient to serve all of Freetown´s population.

Although the Guma Valley network potentially covers almost 60% of the city area (see Figure 2), not everyone has access to water. For example, in the same street, connections to the network are uneven. Those who don't have in-door piped water must rely on street taps. In the absence of public facilities, this group relies on buying water from neighbours, which may be unsafe sources depending of the environmental condition of the community.

Due to shortage of funds, human resources and other internal problems, the GVWC has been unable to enlarge the water distribution network to deal with the increasing water demand of an expanding city with rapid population growth. As a consequence, long surface-laid polythene spaghetti service lines have popped up in the recent year across the city.

The main challenge for having a just supply of safe water is the poor management of the distribution system. As most of the safe supplies originate in the west, this area has access to the majority of the water with the best quality. As the network reaches the east side, the quantity of water decreases due to overconsumption and leakages over the supply chain. The far eastern ends of the city receive virtually no water at all.

However, the west side also face problems. For instance, the Wilberforce and Hill Station network sections are too elevated to receive water through a gravity system. In order to overcome this problem, water is transferred to those locations by pumping stations. However, due to poor maintenance, technical problems and shortage of electricity, these stations hardly ever work, leaving the water from the Congo Dam reservoir as the only alternative.

Morevover, people living in Freetown´s hills can seldom rely in pumped water supply as the system is expensive to maintain. As a consequence, these communities tend to drink water from springs that in most of the cases are located along the streams or river beds, and the water in reality come from a contaminated river rather than water from an aquifer.

Secondary or alternative networks are used in the rest of the city. All of these networks are either polluted or at risk of accidental contamination when the rainy season starts.

Thunderhill and Allen Town secondary networks are owned and operated by the Guma Valley Water Company. Other independent local networks have been built by local or international NGOs. The problem is that these networks are at high risk of contamination because they get water directly from polluted rivers, and the water is used without treatment.

Wells and boreholes are the main sources of water for the inhabitants of the lower eastern parts of the city. There are two causes for wells to be contaminated.: (1) when wells are not protected or the water extraction system is unsafe and (2) when ground water sources are contaminated by adjacent pit latrines.

WATER ACCESS

In Freetown, access to water and sanitation varies significantly among groups with different socio-economic conditions. The Guma Valley Water Company network has potential to provide water to areas where 60% of the city dwellers live, but the network´s several problems make it impossible (Burby et al., 2000). Because of these same glitches, the wealthier sectors of the population can access to water for free. Meanwhile, the rest of the city has to pay for the water at kiosk or communal water points, given that these are functional. The Freetown City Council (FCC) and the GVWC, which are the government departments responsible for the water supply, are neither well-funded nor equipped or capacitated to meet the demands of a growing population.

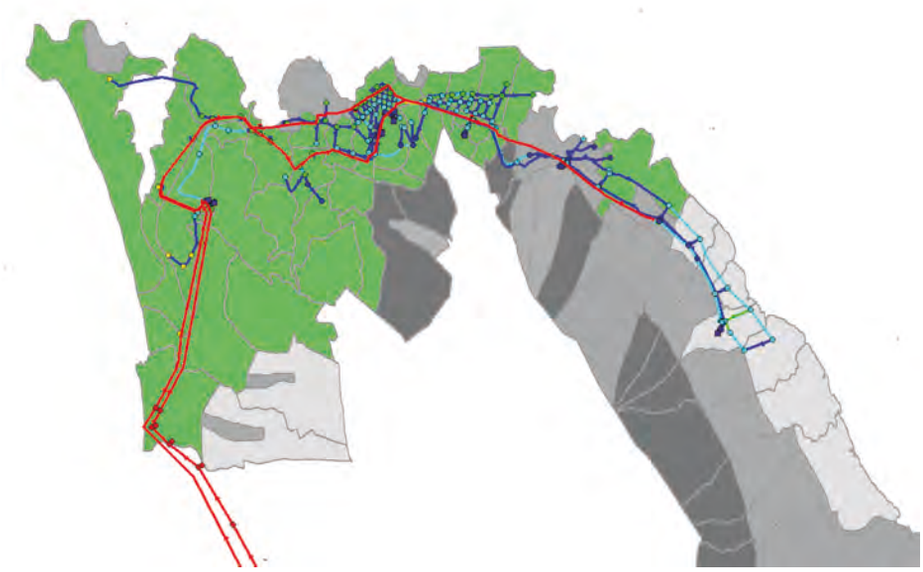

Figure 2. Areas covered with piped water distribution Guma Valley Network: ACF, (2008)

FAECAL SLUDGE MANAGEMENT

It has been estimated that in average 80,000 m3 of faecal matter is generated annually (WASH Consortium et al. 2014). However, poor sanitation infrastructure and inefficiencies in faecal sludge management imply that only a small proportion of the sludge is safely removed, transported, treated and disposed. This mishandling exposes residents of the surrounding areas to various health risks.

The infrastructure is limited in terms of sanitation. The majority of the facilities are presumed to be unimproved pit latrines (75%), while only 13% of facilities relate to flushed toilets connected to the sewerage network (DFID and GVWC 2008). Furthermore, it is estimated that 7% of the population lack access to any type of toilet (see Figure 3).

Since 60% of the people live in overcrowded areas with limited access to WASH services, the structures are often shared by many users.

The 2004 census indicates that 75% of sanitation facilities are shared and only 25% are private.Thus, poor quality and shared facilities may lead to overcrowded and unhygienic conditions for users and the community in general.

Faecal sludge is managed through the networked system (sewerage system) that serves a small portion of the Central Business Center (CBD) (DFID and GVWC 2008) and a non-networked system. 90% of the population is served by on-site sanitation structures (pit latrines and septic tanks) (WASH Consortium et al. 2014) (Mikhael 2010 as cited by WASH Consortium et al. 2014). In both cases, the management system is highly inefficient.

Only 10% of the excreta is managed safely (green arrows) as the containment structure is safely covered when being full, whereas, the remaining 90% is unsafely disposed (red arrows) creating serious health hazards and risks for the population

Sanitary Type		Private	Shared	Total
Unimproved	Uncontrolled (bucket, open defecation)	1%	6%	7%
	Pit (traditional simple pit)	15%	60%	75%
Improved	Ventilated improved pit (VIP)	1%	1%	2%
	Flushed outside (pour ush)	1%	2%	3%
	Flushed inside (WC)	8%	5%	13%
Total		26%	74%	100%

Figure 3. Type of sanitation facilities (DFID 2007 projections based on 2004 Census)

Sewerage system

The existing sewerage (4km in length) partially serves commercial and political-administrative buildings in the CBD together with few households (0.3% of the population). It has been reported that defective construction works and poor maintenance cause flows coming out of the manholes or blockages during the rainy season (DFID and GVWC 2008). Leakage during conveyance is also a serious problem. Wastewater is not treated before disposal and therefore raw sewage is discharged directly into the mouth of the Sierra Leone River.

Only few houses are equipped with septic tanks in informal settlements. Nonetheless, it is assumed that in wealthier residential areas, such as Hill Station and Aberdeen, septic tanks are more common (ACF 2008). Septic tanks are emptied using vacuum trucks that transport the waste to Kingtom dumpsite, where the sludge is reported to be burnt or used as manure for the farms close to the site (GTZ supported project, King tom) (ACF 2008) or disposed untreated into the ocean.

The majority of on-site sanitation facilities are unimproved pit latrines due to the inaccessibility to water and high cost of installations of more sophisticated forms of sanitation (DFID and GVWC 2008). Often these facilities are dug by the households themselves, unlined and of very poor quality. In crowded areas, limited space may lead to dig latrines located in the vicinity of wells. In hill sides, houses are built on terraces equipped with a dry stone wall. The latrine is dug nearby the house, in the terrace. If the work is not properly done and the latrines are not waterproof.

In addition, two sea outfalls located at the Government Wharf and King Jimmy convey the sewage into the sea (DFID and GVWC 2008). Thus, 4% of the sludge is unsafely transported and disposed through the sewerage system, contaminating the environment (see Figure 5). For instance, Susan's Bay settlement receives the sewerage from the CBD as it is conducted to the ocean through the settlement. The saline and muddy water of the area is known to host the cholera vibrio for months (ACF 2008). The area reports cholera outbreaks annually (ACF 2008).

On-site sanitation

96% of the sludge is first contained in on-site sanitations. Out of the total amount of sludge generated in Freetown, only 23% is safely transported and legally disposed in the only official faecal sludge dumpsite of the city: Kingtom (see Figure 6). However, the two ponds of this dumpsite have been inoperative for many years and a third area is used alternatively where untreated sludge is conducted to a nearby creek (WASH Consortium 2012) and the sea through high-density informal settlements. The remaining 77% of sludge

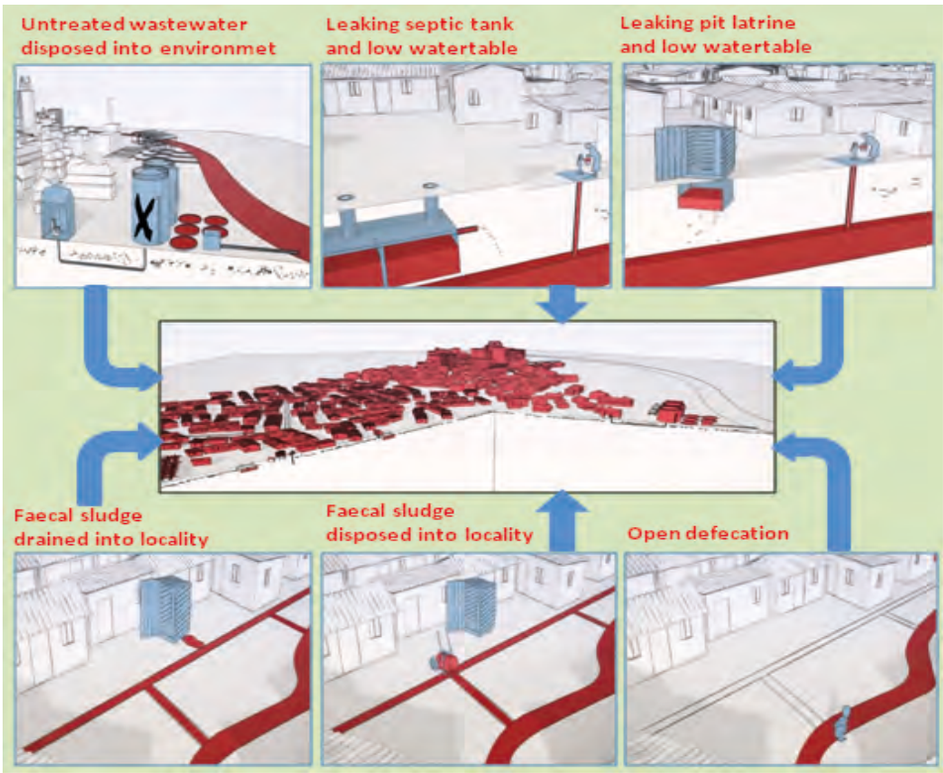

Figure 4. Contamination pathways of the local communities: Elaborated by the authors

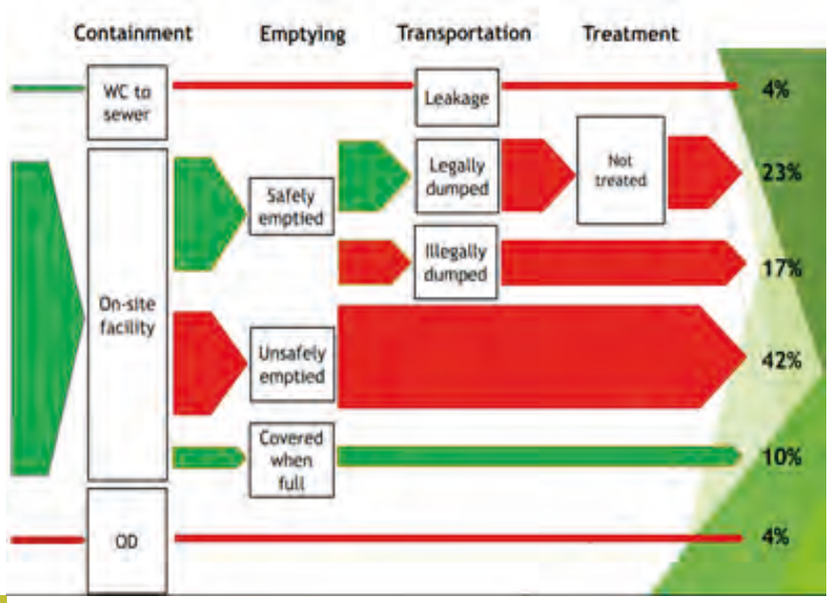

Figure 5. Faecal Sludge Flow: Mikhael's (2010)

There can be leakage from the dry stone wall in the slope (ACF 2008). Hanging toilets, common in coastal settlements, discharge excreta and wastewater into the sea. In all these cases, the soil, drinking water and environment is contaminated with faecal matter.

In Mikhael's study (2010) on Sanitation Market Assessment commissioned by GOAL considering a sample of 22 out of the 63 sections of Freetown, it was found that manual dislodging workers dispose the sludge by burial in a nearby pit (81%) and by discharging it into a drainage ditch, stream or the sea (13%). Faecal sludge emptied by vacuum tankers was most likely to be disposed at the Kingtom site (57%). The tankers dispose the sludge onto a flat area already filled with refuse and faecal sludge. Much of that sludge then drains down through a series of troughs and discharges into the Congo Creek and White Man's Bay (WASH Consortium et al. 2014). It is estimated that 7% of excreta is deposited in the local environment through open defecation. However, the rates vary by

From the above mentioned, it can be observed that contamination of the locality can occur due to the nature of the containment, as well as due to the emptying, transportation, treatment and disposal mode. Moreover, the systematic disposal of untreated faecal sludge pollutes the city along the shallow water aquifers, which serve as source of drinking water for 24% of the population of Freetown (WASH Consortium et al. 2014).

RISK BY AREA

In this section the authors identify the city regions where risk of contracting waterborne diseases seems to be higher. From the analysis five different type of regions emerge:

1. Northwestern coastline slum areas

These settlement are located at the river estuaries(i.e. downstream and end of the water system), where pollutants from upstream rivers or water are likely to accumulate (Hamza, 2006). Thiss, there is a high risk of waterborne related diseases.due to the high population density, poor housing quality and poor sanitation infrastructure and services.

2. Barracks

Similar to the slums, with the rapid urban development of thecity and the expansion of urban areas is generating increasing number of houses being redisign so as to accommodate more individuals. As a result, overcrowding and few toilet structures contribute to deterioration of sanitation conditions

3. Traditional center

In the northern part of Freetown, Kossoh Town and Susanne's Bay are trading area and commercial center (ibid). With the improvement of urban economy and the expansion of trading limit, these area attract large population quantities and migrants. Crowding conditions and few water supply and sanitation structures create unhygienic conditions favorable to waterborne diseases outbreaks.

4. Mountain sides

In Freetown, there are large dimensions hillsides. Along with the development of urbanization and modernization, the formation of these settlements is due to the
population growth. In this context, the most
scarcity of potable water is the highest priority risk of the residents. Even the currently running water system, Guma Valley Network, cannot meet the demand for water consumption owing to regional characteristics of geographical location and high elevation (KPBS, 2015).

Furthermore, there is not sufficient latrines coverage. Thus, local residents are exposed to health risks due to contamination of faecal matter from open defecation and leaking latrines whose patogenic agents end up in local drinking water sources

5. Eastern coastline

These areas are exposed to contamination
in the groundwater as a result of that the local source of potable water is primarily relying on original wells, even though the deep underground water is of relatively good and safe quality (Van Duijvenbooden et al., 1981). It is a common case that a proportion of wells are suspended due to the highly polluted aquifers, which leads to serious damage to the source of drinking water.

LARGE SCALE EVENTS: FLOODS

Floodings during heavy rains occur due to soil saturation (deforestation) and inadequate urban development; encroachment of water bodies and creeks, construction in floods-prone areas (see Figure 6), inefficient drainage system and solid waste management (see Figure 7). Drainage systems are blocked by soil erosion and stuck solid waste (MLCPE and FCC 2014). These conditions compound sanitation related inefficiencies, as outbreaks are likely to occur during rainy seasons (ACF 2008) and risk of epidemics is elevated in the aftermaths of floodings, as overflowing excreta from soak-away pits and overflowed sewage rises to the surface (Ministry of Land, Country Planning and the Environment and Freetown City Council, 2014) polluting the urban environment and unprotected water sources with faecal matter containing pathogenic agents that threaten human health with waterborne diseases. The incapacity of the authorities to response to such events along with stagnant polluted water and waste increase

The Office of National Security reports as coastal flooding zones: Kroo Bay and White Man's Bay, Susan's Bay, Madina and Mafenbe, Mabella, Congo Town, Kanikey (MLCPE and FCC 2014). There is no coincidence that some these areas are also highly cholera epidemic outbreak prone. Inland floods also occur in areas cholera outbreaks zones such as Lumeley (Figure 7).

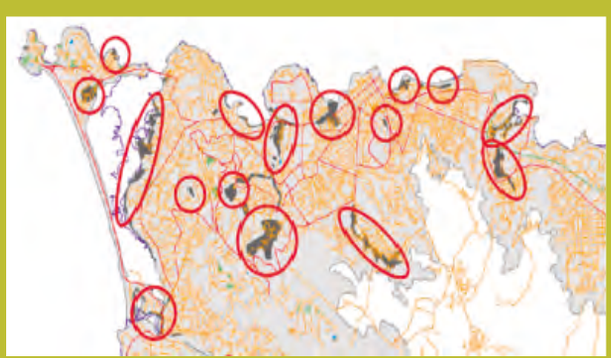

Figure 6. Flooding prone areas

Figure 7. Waste contaminated areas

Source: MLCPE and FCC (2014)
Pink squares refer to solid waste transition points, pink dots to industrial contamination,
and large pink areas correspond to water contamination by drained solid waste

The weather and topology of Freetown, the patterns of human settlement and the lack of access to WASH infrastructure and services create favorable conditions for the proliferation of waterborne diseases such as cholera. Overcrowded settlements located in coastal, river basins, and close to streams subjected to flooding during rainy season (especially during August and September) making them contamination and epidemic outbreak prone areas, especially those in coastal areas in the northwest of the city. According to the WASH Consortium (2013) the most affected areas Greybush, Mabella, Susan's Bay, Kroo bay, Rokupa, Kuntoloh.

The 2017 SLURC survey on 15 informal settlements of Freetown shows the deplorable sanitary conditions of the population. Flush toilet is available for a large portion of the residents only in the CKG settlement. However, it seems that these facilities are mostly shared. The majority of settlements have large proportion of the population either sharing facilities or without toilets. This situation may deteriorate conditions in slums with larger populations, such as, Moyiba, Marbella and Susan's Bay. All of the settlements surveyed reported to have as priority health issues: cholera, diarrheal diseases, gastrointestinal issues or malaria.

Moreover, low-density and good structures settlements in southwest elevated areas where upper-class residents live are also in risk of contamination. Because, they are located beyond the realm of the GVWC and sewerage system, they lack access to piped water and need to rely on on-site sanitation. Water must be obtained by digging wells or springs, which may be contaminated with improperly build on-site sanitation infrastructure or during the transportation and disposal procedures. This is the case of Juba, Malama and Lumeley.

In the east, people unable to afford the prices of the center and find space in the already overcrowded locations, turn to the hills for affordable housing. However, piped water and sanitation infrastructure is unavailable. Water is obtained from insecure sources such as faecal matter contaminated springs. The pollution occurs due to poorly constructed latrines and open defecation practices. For example, Coconut Farm and Quarry's contamination is flushed down to Cline town and Kissy By Pass I, etoilets and widespread open defecation is practiced. For example, Coconut Farm and Quarry's contamination is flushed down to Cline town and Kissy By Pass I, especially during the rainy seasons.

The center, also overcrowded, is at risk due to the overaged and poor maintained sewerage system. Moreover, in Kingtom, where the solid waste and faecal dumpsite is located, residents face serious health risks due to the extreme pollution of the area. In addition, the dumpsite's untreated sludge is conducted to the ocean through coastal slums such as Susanne's Bay. The situation of Susan's Bay is compounded since people use the sea as drain off for latrines and hanging toilets, while open defecation is widely practiced.

That is, settlements in the center and in hill zones flush contamination to the coastal areas and finally into the ocean, where conditions are prone to outbreaks.

This seems to indicate that in order to implement effective measures to improve sanitation in coastal areas, actions must be taken in the hills and center, implying that an integrated approach considering the dynamics of the city sections must be implemented.

FINANCING SANITATION

Despite the relevance of sanitation to the wellbeing, health and prosperity of people, the Government of Sierra Leone assigns to it only an insignificant portion of the national budget (WASH Consortium 2013). In 2012, only 0.018% (a 30% reduction since 2010) of the national budget were allocated to sanitation. Recently, the government compromised to invest 1% of the budget by 2015. Higher levels of expenditure were observed in 2013 (0.3%) and 2014 (0.5%). Nevertheless, the level of expenditure is inadequate to make substantial progress. The *Africa Country Diagnostic* has estimated that in order to meet the MDGs target, the country will need to invest on average 16.6% of its GDP annually (Banerjee and Morella 2011; Barrie n.d.). In addition, although the country's expenditure in water and sanitation has increased, it is highly dependent on official development assistance[1] (Barrie n.d.).

This implies that people, especially those living in the slums, must allocate a large portion of their income into the construction and improvement of facilities, despite of the fact that most slum dwellers live below the international poverty line. In the Goal's *Sanitation Market Assessment*, it was estimated that households within the project area were in average composed by eight people, while three-quarters of surveyed population lived with less than US$ 1.25 per day and the majority rented their house. Nonetheless, they contributed to the construction of their sanitation facilities by spending between US$ 260 and US$ 290, representing 35% of annual household income. Improvements keeping the sanitation facilities clean and safe have also been costly, requiring households to spend on average US$ 84, representing 11% of annual household income (Mikhael, 2010b).

Moreover, the same survey found that households spent on average US$ 73 to empty and mechanically dispose the faecal sludge from on-site sanitation structures and US$ 50 to do it manually (Mikhael, 2010a). Because manual operators are cheaper and able to access the slums, they retain the largest portion of the market (59%). The remaining share is covered by private and public mechanical operators (Mikhael, 2010a). On the other hand, the *Non-Tax Revenue Department*'s database from 2006 contains 136 records and reveals that each institution, regardless its size, commercial activity and water consumption level, pays for the usage of sewerage system only 250,000 Le per annum[2] (DFID and GVWC 2008).

This indicates that the poor people living in risky zones pay larger portions of their low income in order to access sanitation facilities and services than the few institutions served by the sewerage systems, which implies less money available for education, health, nutrition, savings and improvement of living conditions.

SOLID WASTE MANAGEMENT

Currently, the produced solid waste is collected for disposal at sites by the Freetown Waste Management Company (FWMC). However, due to the amount of produced solid waste outweighing FWMC's capacity, it is no possible to efficiently cope with solid waste (Sankoh and Yan, 2013). The main problems revolving around the solid waste issues are the lack of functioning equipment, limited finances, poor environmental control systems, illegal littering and the dumping and open burning of wastes by residents, especially in slum areas (Gogra et al., 2010).

The waste of Freetown is disposed in two landfills, the Granville landfill on the east, and the Kingtom landfill on the west, both of these landfills are open dump sites. Furthermore, the location of the Kingtom landfill, right on the Atlantic Ocean, makes it susceptive to floods (Sood, 2004). Additionally, open dump sites can significantly contaminate groundwater. Whereas water soaks through garbage in landfills, it swallows microorganisms and chemicals contained in the rotting materials. The unregulated reset of leachate which is liquid nascent in solid waste in landfills pollutes surface and ground water (Sood, 2004). Aside from these two dumpsite, wastes are haphazardly disposed of on roadsides, streets and storm drains. These wastes eventually flow from slopes of elevated areas and end up in the sea (Sood, 2004). One of the biggest informal settlements in Freetown, Kroo Bay, is situated at the estuary of one of the rivers that flows through the city. Thus, all of the waste that is dumped on the streets ultimately reaches the river and thereby contaminating it and spreading this contamination all over Freetown. In addition, as a result of inadequate waste management, drains for the collection rainwater are cluttered with garbage and during severe rainstorms various areas of Freetown are flooded and drains clogged with garbage increase the spreading of diseases which are transmitted by vectors, such as insects and rodents (Gogra et al., 2010). All these problems lead to environmental and public health risks to the inhabitants.

ENVIRONMENTAL JUSTICE

From the analysis of the WASH related disease in Freetown, it can be observed that a pattern of environmental injustice pervades the history of the city. Unequal distributional, lack recognition, and limited participation in relevant decisions of the marginalized groups (impacting even more children under five whose lives are more threatened for waterborne diseases) are constant features of the problematic of water supply and sanitation infrastructure and services affecting them.

For instance, the decision of authorities of concentrating in serving the west of the city in detriment of the east unpleasant area is in accordance with the socio-economic layout of the city. Privilege areas and the unaffordable housing market obliges the poor to locate in zones unfit for residential developments lacking access to basic services and infrastructure. The implication has been that the poor locates in zones that in absence of proper management become subject to floods and landslides and highly unsanitary conditions. Local water sources get contaminated with bad quality onsite sanitation facilities transforming these settlements in waterborne diseases proliferation prone zones. In addition, the topography and the geographical location of the slums creates a situation in which pollution from the settlements in hill sites flows down to the settlements in coastal areas. Furthermore, the central region sewerage is directed to these low-laying settlements and the ocean making their environment even more polluted and more vulnerable to cholera and other diarrheal diseases outbreaks. These conditions give rise to poor health which affects further the capacity to work and generate income. Poverty and extreme poverty means that slum dwellers can't face adequately the financial requirements to deal themselves with quality sanitation facilities and recover from flood events.

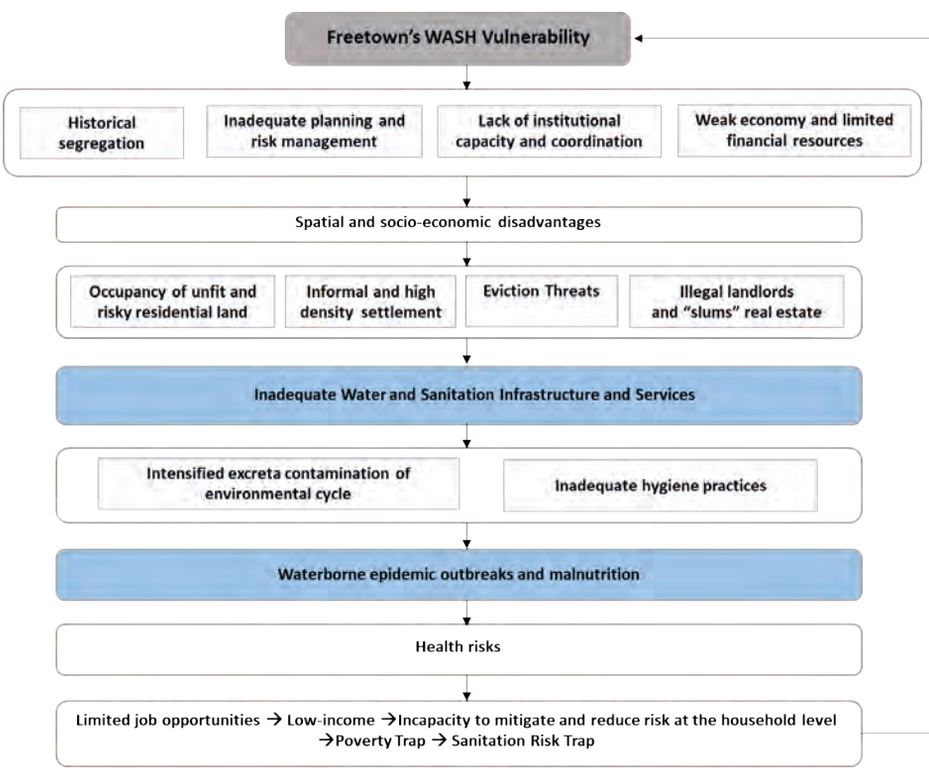

Figure 8. Freetown risk trap production and production process. Source: Elaborated by the authors

These events flush away their assets but spread away illness by depositing pathogenic agents all over the community environment including drinking water sources. The wet and accumulated solid waste serves as breeding ground for vector transmitters of more diseases. Such deplorable conditions lead the government to declare some of these areas as epidemic prone zones. and thus, it threatens residents with eviction. This in turn justify the lack of interest in investing in integrating these areas through proper access to all sort of social infrastructure and services, despite the urgency of implementing aggressive projects to improve the situation of the informal settlements.

The cascade of cause and consequences (see Figure 8, the production and reproduction of sanitation risk traps) generated create a sanitation and poverty trap for those who are vulnerable. Despite in some informal settlement self-organized community groups have formed and tried to tackle their problems in an act of responsible citizenship to clean-up their common spaces and make their community more livable. Support and cooperation from the government is needed but coupled with bottom-up citizen participation and recognition of their needs.

Lastly, the conglomerate of institutions, WASH consortium, and NGO's facing the challenges related to health with clear roles and objectives along with the fragmentation of efforts lead to a lack of capacity to organise and manage resources to provide fundamental and integrated solution to reduce to the minimum risks of waterborne diseases.

FINANCIAL CONTEXT

In order to understand financial dynamic in water and sanitation, it is important to mention that the main water distributor, GVWC, can only cover 15% of its total costs from tariff revenues (UNDP, 2009). The reasons are: Non-revenue, as almost 50% of the treated water is lost through commercial losses (illegal connections) and physical losses (the breakage or leakage in pipes), Tariff setting, as registered consumers pay a flat-rate basis which is very low (less than 0.01 US cent per gallon and Tariff collection, monitoring and enforcement, as the billing collection ratio only amounts to 30%. On the other hand, establishing the water sector on a financially sustainable basis requires finding the right mix between the ultimate revenues for the sector, the so-called '3Ts': tariffs, taxes, and transfers. Moreover, the projection investments in Freetown by 2017 are the approximately US$ 80M to improve water supply only and sewerage coverage is ignored (President's recovery priorities, 2017). Therefore, spread of diseases related to water and sanitation could increase.

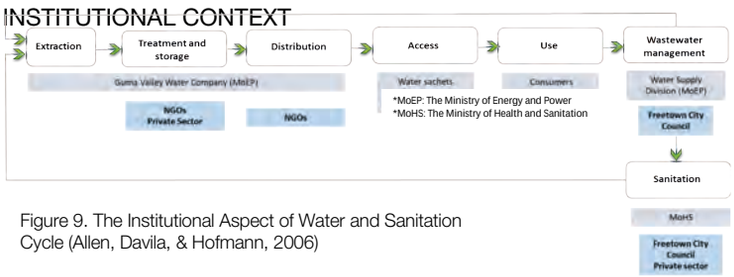

Figure 9. The Institutional Aspect of Water and Sanitation Cycle (Allen, Davila, & Hofmann, 2006)

Figure 9 represents the institutional aspects of water and sanitation cycle. As a consequence of Freetown's conditions aforementioned, the ones in grey that are supposed to be responsible for their stage have been replaced by some institutions in blue. For example, NGOs, private sector and Freetown Council. This situation can be explained in some extent in the financial context.

CHALLENGES - POLICIES AND REGULATIONS

According to the Sierra Leone's government Agenda for Prosperity (2013 - 2018), various challenges have limited the attempts to solve the water supply and sanitation issues. These challenges rose from not having a central body which is responsible for managing resources in an integrated manner in order to meet the needs of a socio-economic development, in addition to the lack of knowledge on surface water and groundwater resources (The Government of Sierra Leone, 2013). Moreover, the scattered nature of laws

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