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DOMESTIC WASTEWATER MANAGEMENT IN SATELLITE TOWNS AROUND NAIROBI CITY: A COMPARATIVE STUDY OF MLOLONGO AND RUIRU IN KENYA

Wallace Mochu[1] & Gerryshom Munala[2]

[1]*Centre for Urban Studies, Jomo Kenyatta University of Agriculture and Technology, P. O. Box 6200-00200 Nairobi*

Abstract

Management of domestic wastewater has a direct impact on the environmental health of urban dwellers and the general physical condition of an urban settlement. This paper analyses domestic wastewater management in Mlolongo and Ruiru towns in Kenya. The methodology applied for the study was by survey through observation of wastewater systems in the neighbourhood, and interviews of home owners and tenants, and selected key County Government informants. The study revealed Mlolongo relied entirely on decentralized systems while Ruiru had a hybrid system consisting of pockets with centralized system but the larger areas relying on decentralized systems. The study revealed that 98% of the residents in Mlolongo rely on septic tanks, conservancy pits, and pit latrines while 48% of residents in Ruiru depend on septic tanks and communal toilets for their domestic wastewater management. The domestic wastewater systems were rated to be very poor by over 50% of the residentswith little or no participation by the residents in their management. The study demonstrated that the decentralized wastewater systems covered the entire satellite towns under study. 68% of residents in Mlolongo and 48% of the residents in Ruiru share their wastewater collection facilities with more than 15 persons. On sustainability, the study revealed low score from managerial, organizational, environmental, planning, and financial perspective. A sustainable model of managing domestic wastewater in satellite towns has been developed that aims at recognizing the need of recovering resources from the domestic wastewater while minimizing the user costs.

Keywords*: decentralized management, domestic wastewater, Mlolongo, Ruiru, satellite towns*

1. Introduction

Wastewater management refers to the principles and practices relating to the collection, treatment, removal or disposal of human excreta, household wastewater and refuse as they impact upon people and environment (Wendland & Albold, 2010; UN Water, 2011). It is estimated that over 2.5 billion people or two-thirds of the world's population, live without

access to improved sanitation(UN Habitat, 2016).Peri-urban areas are defined as the intersections of urban expansion into rural land and they have unique and distinct characteristics. There, land is overtaken by unplanned and often informal development and basic infrastructure and other services are inadequate and often lacking (UN Habitat, 2014). As a consequence, domestic wastewater management continues to be a huge challenge especially in the satellite towns that continue to be magnets for accommodation needs of the city residents. The World Bank points out that only 31.2 percent of urban population in Kenya have access to improved sanitation facilities(The World Bank, 2011) and notes that the situation is more prevalent in urban areas.It is against this backdrop that this study sought to assess the management of domestic wastewater in satellite towns around Nairobi City with an aim of developing an effective and sustainable model that can be adopted in light of competing public resources for service provision to the urban residents.

2. Background to the study

The NairobiIntegrated Urban Development Planstates that Nairobi City accommodates more than a third of Kenya's total number of urban dwellers(JICA, 2013). In 2009, the population size was approximately 3.8 million residents growing at an annual rate of 3.9 percent(GoK, 2009). This unprecedented growth of the primate city has brought attendant challenges that include acute housing shortages, traffic congestion, pollution, and uncontrolled peri-urban growth (Omwenga, 2010; UN Habitat, 2014).The rapid, rather uncontrolled informal development of Nairobi, as well as a complicated land market has pushed development into the formerly rural areas of current satellite towns, such as Ruiru and Mlolongo. It is projected thatby 2030, Nairobi will be home to over 7 million people majority of whom will be accommodated in the satellite towns and informal settlements (JICA, 2013; Omwenga, 2010). The current spatial planning interventions have been developing existing urban areas, urban renewal schemes and establishment of satellite cities at some distance from the capital to disperse urban population and economic growth.

The study was undertaken in Mlolongo and Ruiru satellite towns in Nairobi, Kenya. Mlolongo is located South-East of Nairobi along Mombasa road approximately 16km from the city while as Ruiru is on the North-Eastern along the Thika Superhighway approximately 25km from the city centre (Imwati, 2013; Olonga, R. et al., 2015). The two towns are situated on the periphery just outside the boundary of the Nairobi City County on the upper and lower side respectively. The study focused on the residential and the commercial zones in the 2 urban centres.Figure 1 shows the map of Nairobi indicating the location of Mlolongo and Ruiru towns (Figure 2).

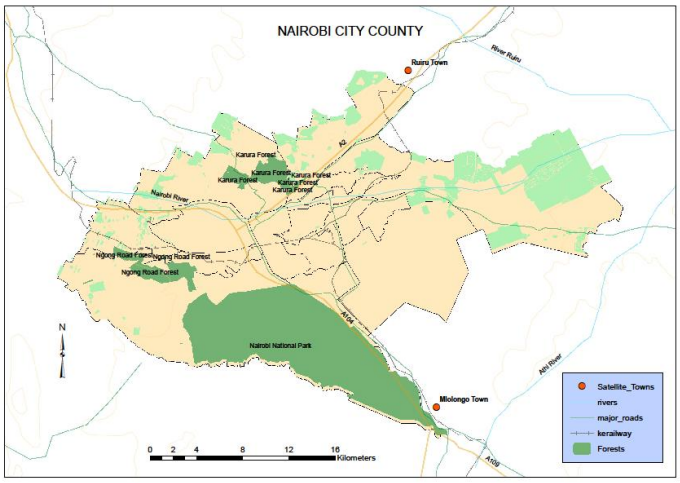

Figure 1: Map of Nairobi City showing the location of Mlolongo and Ruiru Towns

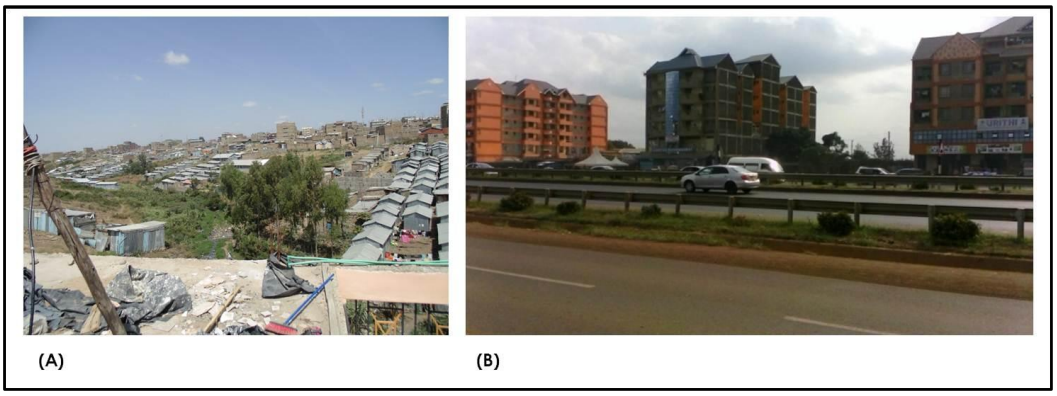

Figure 2: Plate showing (A) section of Mlolongo Town (B) Highrise buildings in Ruiru

2.1Statement of the problem

There is a widespread domestic wastewater management problem in Mlolongo and Ruiru towns.Firstly, the wastewater management system has not kept up with increasing demand from the growing population in the satellite towns and has inadequate capacity for wastewater treatment. The sewer network infrastructure covers approximate area of 208km2 which is 30% of total surface area(Olonga, R. et al.). This is complicated by the fact that Mlolongo and Ruiru fall under Machakos and Kiambu county boundaries respectively and therefore, they depend on these two county governments for service provision.Ferrara, C. et al. (2008) summarised the state of sanitation in Ruiru as follows:

'*Ruiru is a microcosm of the larger global problem of urbanization and expanding populations. Ruiru lacks adequate water supply and sanitation services to support its 180,000 inhabitants'.*

Secondly, domestic wastewater is discharged locally on open ground and vacant lots, creating ponds of foul-smelling stagnant water. The domestic wastewater is left to meander through channels in the commercial and residential areas causing health and aesthetic pollution in the

neighbourhoods. Some of this wastewater has found its way into the rivers and boreholes causing health complications to the urban residents(Olonga, R. et al.).

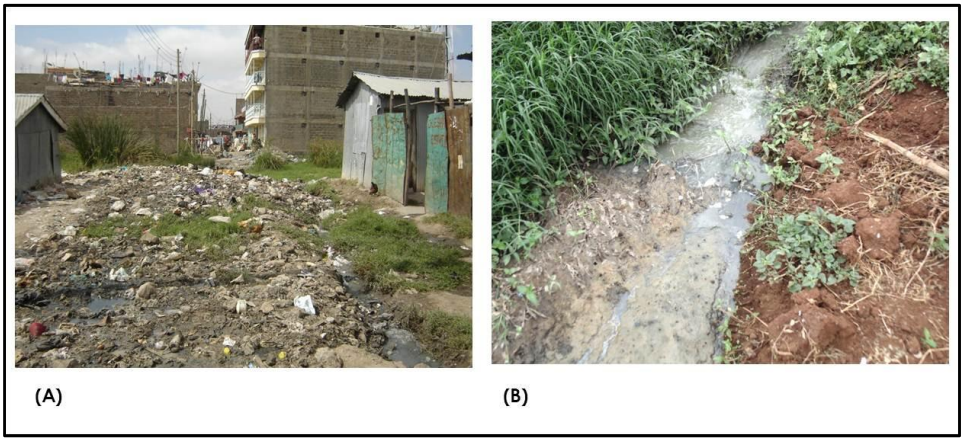

Figure 3: Plate showing (A) clogged drains in Mlolongo (B) polluted river in Ruiru

The statistics at the local health centres show widespread water-borne infections among the children and adults attributed to ineffective management of domestic wastewater(Dobsevage, S. et al. 2006). Mlolongo town is facing similar sanitation problems. Imwati (2013)noted that due to lack of proper planning and ineffective development control, the dormitory town lacks essential infrastructural facilities to manage storm water and wastewater. He observed as follows:

'The above scenario is typical of many other peri-urban settlements of Nairobi City, and by extension other urban areas of the country that now calls for urgent spatial development planning and management interventions.'

The main objective of this study was to examine domestic wastewater management in Mlolongo and Ruiru satellite towns of Nairobi City. In furtherance tothis objective, the study examined the methods of domestic wastewater management; assessed the level of coverage of the sanitation systems; determine the level of sustainability of the domestic wastewater management systems; and develop a sustainable model of managing domestic wastewater in Mlolongo and Ruiru

3. Literature Review

The study analysed critically current available literature on wastewater management in peri-urban areas from globaland local perspectives. Literature on models of wastewater organizational structures, institutional and regulatory frameworks, operations and maintenance, costs and finance was reviewed. On organizational structure, Hophmayer-Tokich (2012)noted that conventional systems are less suitable due to lack of economies of scale, weak financial and managerial capacities. In addition, these constraints are likely to be

more severe in satellite neighbourhoods due to financial and institutional weaknesses. Kenya uses conventional wastewater treatment systems which are inadequate and non-functional in many urban areas due to high costs of operation and maintenance (Opaa & Omondi, 2012). De Gilsi et al. (2014) noted that the conventional systems regard wastewater as 'waste' and therefore disregard the potential to recover key resourcesfrom the wastewater. He noted that most system designs are linear and do not consider the cyclic character of most natural systems.Parkinson & Tayler (2003) have addressed operational sustainability of decentralized systems and deficiencies of centralized approaches to service provision in peri-urban areas. They have argued that provision of infrastructure in satellite towns tend to occur in a 'piecemeal' fashion and thus there is often a lack of comprehensive system for the collection and disposal of wastewater.Omenka (2010)noted that decentralized systems have their share of challenges resulting from choice of inappropriate technology and a lack of proper maintenance. He argues that the degree of collectivization at any stage of the treatment and reuse or disposal processes will be determined by a variety of local circumstances that includes development density, topography, soil and site characteristics, community attitudes and desires with regard to land-use issues.

O' Keefe, M. et al. (2015) noted that within an urban area, there are a multitude of actors operating at different scales and with different institutional arrangements. They argued that this can lead to a complex patchwork of provision systems which are not coherent or sustainable. However, the reliance of traditional wastewater-treatment systems on large-scale infrastructure generally results in a natural monopoly and hence a lack of market competition.They noted that weak or conflicting governance arrangements and lack of high level political leadership created inertia within the provision structure hence difficulties in providing improved sanitation.Munala (2009) developed a viable pro-poor public-private partnership management model for water supply services by analysing Kisumu City in Kenya. He advocated for co-sharing of responsibilities as an option for sustainable wastewater management.

In his study on factors influencing wastewater management and reuse in peri-urban areas in Kenya, Ashiembi (2013) argued that water scarcity in Ongata Rongai satellite town in Nairobi influenced the reuse of wastewater by the residents mainly for agriculture.Domestic wastewater can be recycled/reused as a source of water for a multitude of water demanding activities such as agriculture, aquifer recharge, aquaculture, firefighting, flushing of toilets, snow melting, industrial cooling, parks and golf course watering, formation of wetlands for wildlife habitats, recreational impoundments, and essentially for several other non-potable

requirements (Parkinson & Tayler, 2003; Drechsel, 2010; Hophmayer-Tokich, 2012).Kaluli et al. (2015) advocates for the formulation of a national wastewater reuse policy which would provide guidelines on safe water reuse in Kenya.

According to Hophmayer-Tokich (2012), wastewater management is capital intensive for both investments and operations and maintenance costs. She concludes that it is highly unlikely to cover all costs of wastewater management through user charges.According to Swedish International Development Agency(2015), financing needs for urban environment interventions are high and require special attention. Local authorities must be involved and strengthened in order to be able to handle both investments and operations. On sustainability, it is vital that the inhabitants' ability to pay is taken into consideration when formulating designs, fees, connection charges, and organization of operations. Swedish International Development Agency(2015) concluded on the need to mobilize the best possible combinations of different financing plans and models to support wastewater management. Gauss (2008) argues that the costs related to wastewater management are prohibitive in areas of low population density. This is attributed to longer length of sewer per user and thus reduction in the economies of scale. Therefore, the literature review has reinforced the study through informing that the organizational structure, institutional and regulatory framework, system of operations and maintenance, cost and financing have a direct effect on the management of domestic wastewater systems in urban areas.

4. Methodology

The study was essentially empirical and exploratory, and the main objective was to analyse the domestic wastewater management systems.Exploratory design approach provides information about the conditions of the problem under research.The research framework was divided into 3 main areas: the pre-field work; actual field work; and post-field work. Pre-field work stage involved the review of previous literature on domestic wastewater management in other urban areas and design of the data collection tools. The phase also included working on the population size and determination of the sampling framework.A pre-survey was conducted prior to the actual fieldwork to familiarize with the two towns, test the research instruments, and establish contacts with the key informants.During the field work phase, primary data was collected through observation, photography, household interviews, and the key informant interviews. The target population was all 7,015 households in Mlolongo and 8,750 households in Ruiru (Kenya National Bureau of Statistics, 2009). Because the study is on domestic wastewater management, the research was carried out in the residential and commercial zones in Mlolongo and Ruiru where domestic wastewater is produced.

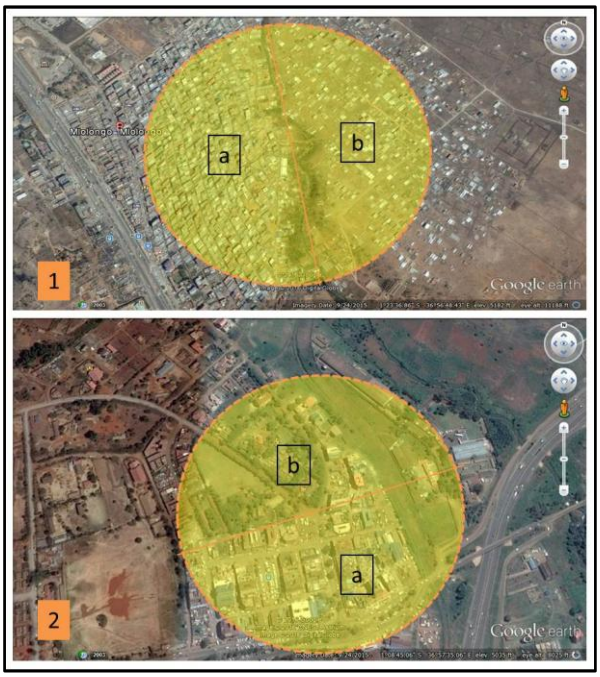

Figure 4: Plate showing clusters for sampling in (1) Mlolongo and (2) Ruiru

As shown in Figure 4, the study adopted cluster sampling to guide the process of sampling the household respondents. The scope of the study was the commercial and residential zones in the town. As indicated in Figure 4, the commercial zones are labelled as (a) while the residential zones are labelled (b). Non-random sampling technique was used to pick the household residents for the study. Specifically, the researcher applied purposive sampling technique. Under this methodology, cases are handpicked because they are informative or they possess the required characteristics. The researcher personally administered the household interview schedules in the two clustered zones in order to obtain information on the status of domestic wastewater management.During the field work, 100 household interview schedules were administered; 25 in each cluster. The study also obtained qualitative information from the key informants from the county governments of Machakos and Kiambu for Mlolongo and Ruiru towns respectively. During the post-field phase, data was collated and analysed using SPSS 18 and presented in the form of graphs, tables, and pictorials.

5. Results and Discussion

The first objective of the study was to determine the methods of domestic wastewater management in Mlolongo and Ruiru towns. The study revealed that Mlolongo town was on decentralized wastewater system while Ruiru was on a hybrid system, that is, a combination of centralized system and decentralized system in some zones in the town. The study showed that residents were relying on four systems, namely: sewered line; communal latrines; single-household latrines; and septic tanks/conservancy pits. According to the research findings,

Mlolongo town relies on decentralized wastewater management system since there is no sewer infrastructure. As shown in Figure 5and 6, the surveyrevealed that 52% of households in Mlolongo relied on septic tanks/conservancy pits, 28% on communal latrines, while 20% depended on single-household latrines for their wastewater collection and disposal needs. On the other hand, 28% of residents in Ruiru town depend on septic tanks, 28% on sewer lines and communal latrines, while as 20% relied on single-household latrines. According to a Kiambu County official in the public health department, the town was in the process of implementing a sewer infrastructure plan to serve the entire town and the surrounding estates. However, the systems were rated as very poor. When asked about the condition of the domestic wastewater collection system, 32% of residents in Mlolongo rated them as very poor while 20% of their counterpart in Ruiru rated theirs as also very poor.

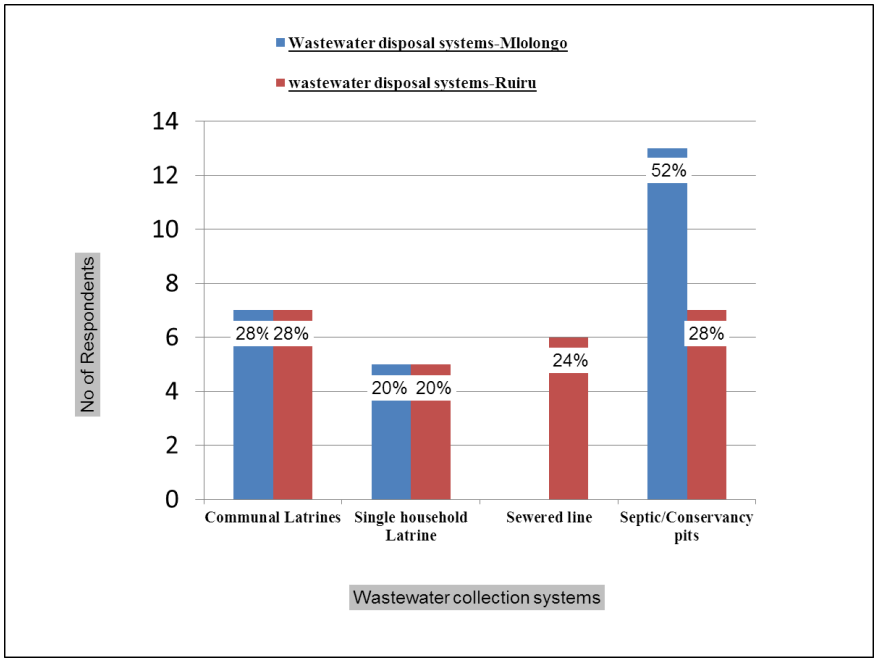

Figure 5: Domestic wastewater collection systems

Figure 6: Plate showing (A) a public toilet in Mlolongo (B) sewer line in Ruiru

The second objective of the study was to determine the level of coverage of the domestic wastewater management systems. The study revealed that Mlolongo town had no centralised domestic wastewater management systems and was entirely running on decentralised systems such as communal toilets, public toilets, septic tanks and conservancy pits. According to the sub-county planner, the Machakos County government was in the process of developing a spatial plan for Mlolongo town and wastewater management would be a priority. However, only 12% of the respondents were aware of initiatives to address domestic wastewater challenges in the town. On the other hand, Ruiru town is in the process of implementing a wastewater management plan through the laying of the sewer infrastructure to connect the commercial centre and the major estates and industrial zones. According to the Kiambu county officials at Ruiru, the county governmenthas prioritised on water services provision due to lack of enough funds. Domesticwastewater collection, transportation and disposalis handled by the private sector and local non-governmental organizations (NGOs). It is worth noting thatthe county government approves development plans that cater effectively on wastewater management through septic and conservancy tanks. Thus in both towns, wastewater coverage is way below standard and this was also expressed by the respondents as shown in Figure 7. In their opinion, 68% of residents in Mlolongo and 48% of residents in Ruiru said that they share their wastewater collection facilities with more than 15 persons. Figure 8 shows a communal toilet in Mlolongo and a sewer line in Ruiru.

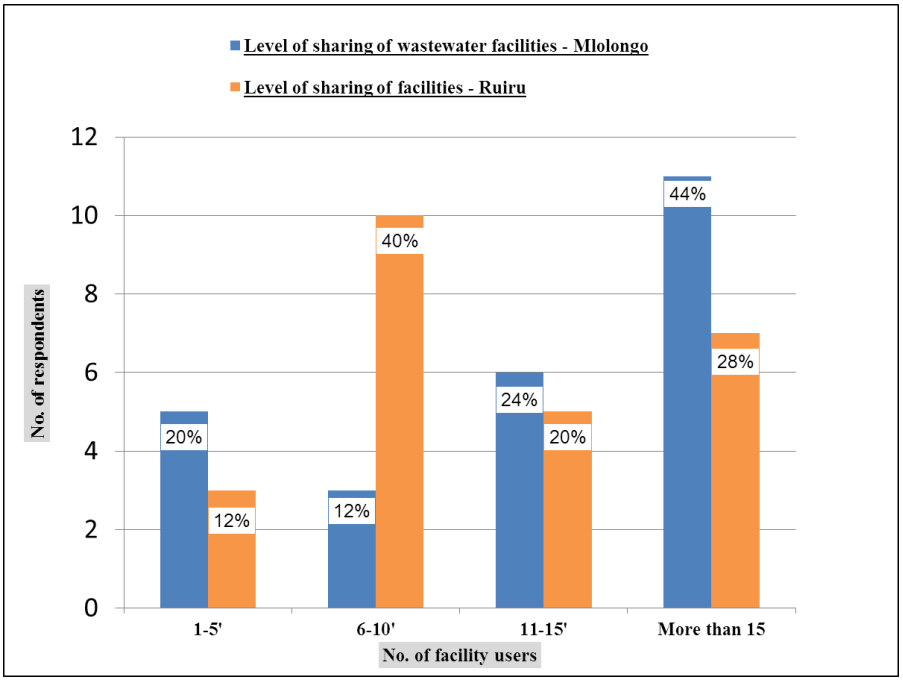

Figure 7: Level of sharing of the domestic wastewater facilities

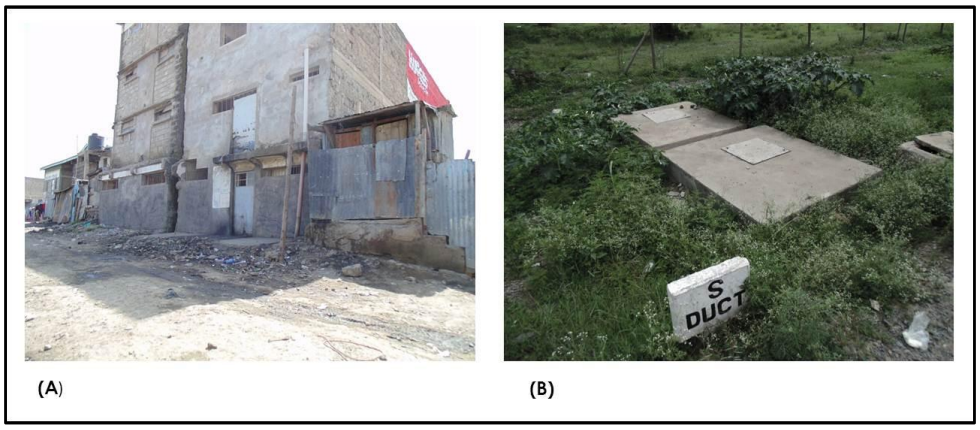

Figure 8: Plate showing (A) community toilet in Mlolongo (B) sewer line in Ruiru

The third objective of the study was to determine the level of sustainability of the domestic wastewater systems in both Mlolongo and Ruiru towns. This was determined in the following ways;

Organizational sustainability: The study revealed that management of the domestic wastewater systems was organized individually at the household level therefore losing out on economies of scale. This affects operations and maintenance of the systems as skills were missing sometimes with low collection rate of fees.When their opinion was sought on sustainability, 70% of residents in Mlolongo said they actively participate in the operations and maintenance of the domestic wastewater facilities in their neighbourhoods. This is in dark contrast to respondents in Ruiru where only 32% confirmed some level of participation in domestic wastewater management. This implies that community participation in investment, design, operations and maintenance decisions of domestic wastewater system has a positive effect on the level and standard of service provision. Figure 9 shows some of the domestic wastewater collection facilities in Mlolongo and Ruiru.

Figure 9:Plate showing (A) public toilet in Mlolongo (B) pour-flash toilet and (C) pit-latrine in Ruiru

Institutional management: Though the residents revealed that the county governments were responsible for investment and maintenance of domestic wastewater management, the study revealed that there was little or no coordination among the actors in the delivery of services.In their opinion, 76% of respondents in Ruiru asserted that the county governments were responsiblefor domestic wastewater service provision. Similarly, 60% of respondents in Ruiru town also indicated that county governments had a leading role in providing residents with domestic wastewater services. It is indicative to note that the residents were aware of the effect of devolution on service provision with only 16% and 20% of residents in Mlolongo and Ruiru respectively putting the role of domestic wastewater management at the door step of the national government.

Financial sustainability: Rated against the level of income of majority of the residents, the domestic wastewater systems were rated as highly unsustainable. About 44% of the households in Mlolongo indicated they paid a range of 5001-7000 Kenya Shillings when they sought emptying services. The cost of emptying was higher in Ruiru with 8% of the residents having indicated they paid 10,001 and above Kenya Shillings for wastewater emptying services. More residents in Mlolongo lived in rented houses and thus were able to share the cost of wastewater management. This reduced the amount of money they paid on average as compared to Ruiru where more residents lived in their own homes.The frequency of emptying was higher in Mlolongo than Ruiru where 84% of the residents emptied their facilities between 1-6 months while 68% of the residents in Ruiru emptied their facilities over the same period of time. 32% of residents in Ruiru emptied wastewater after 12 months and above while 16% of residents in Mlolongo emptied after 12 months. This was attributed to the fact that over 97% of the residents in Mlolongo depend on septic and conservancy pits while as some residents in Ruiru are connected to the sewer network and a higher number of them were owner-occupiers.A huge chunk of the families' disposable income was being used to settle domestic wastewater management bills and therefore most of the residents cannot afford to pay the full cost of domestic wastewater management. Figure 10 shows some of the vacuum tankers available for domestic wastewater emptying and transportation in both Mlolongo and Ruiru towns.

Figure 10: Plate showing vacuum tanks in (A) Mlolongo (B) Ruiru

Environmental sustainability: The research established that there is little or no recycling/reuse of domestic wastewater to remove nutrients. The study revealed that the level of reuse was higher in Mlolongo at 92% and considerably low in Ruiru at 32% of the respondents sampled. This is represented in Figure 11. This implies that there is a higher level of recycling of domestic wastewater in Mlolongo than in Ruiru. One of the reasons is that Mlolongo town is situated on the South east side of Nairobi, an area that is drier as compared to the upper zones. Therefore, there is a severe shortage of water and this is seen in the dual water distribution system where water from the boreholes is used for secondary purposes such as washing clothes, flushing toilets, and gardening while as water that is supplied by Mavoko Water and Sewerage Company (MAVWASCO) is used for cooking and drinking.The research study revealed that 76% of the respondents in Mlolongo reused domestic wastewater for flushing toilets while 12% of respondents in Ruiru reused domestic wastewater for agriculture and the same for landscaping. According to the county government officials in Mlolongo and Ruiru, there aresome residents who are using wastewater to irrigate their crops in both towns but this is haphazard and not formally organized. Most of the domestic wastewater found its way into the rivers, ponds, and dams causing further pollution and environmental degradation. As a result, there is indiscriminate disposal of untreated effluent with serious consequences on water quality and overall public health. Figure 12 shows pictorials on the use of domestic wastewater for urban agriculture in both Mlolongo and Ruiru.

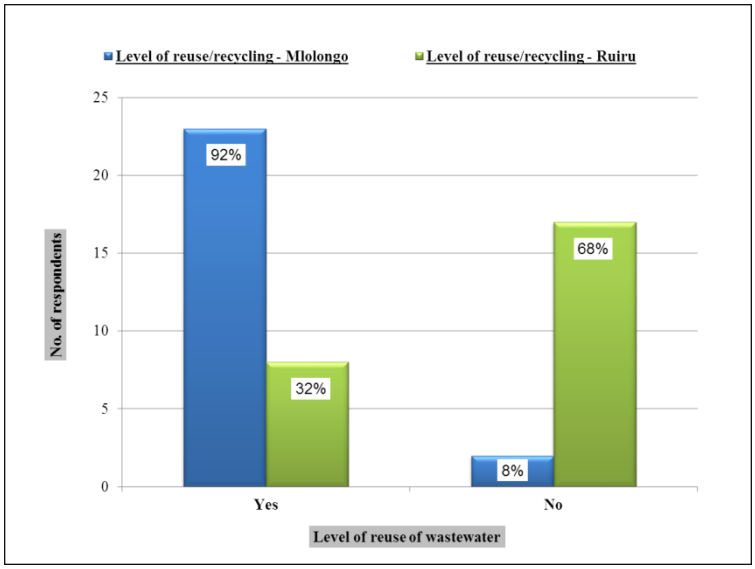

Figure 11: Level of reuse of domestic wastewater in Mlolongo and Ruiru

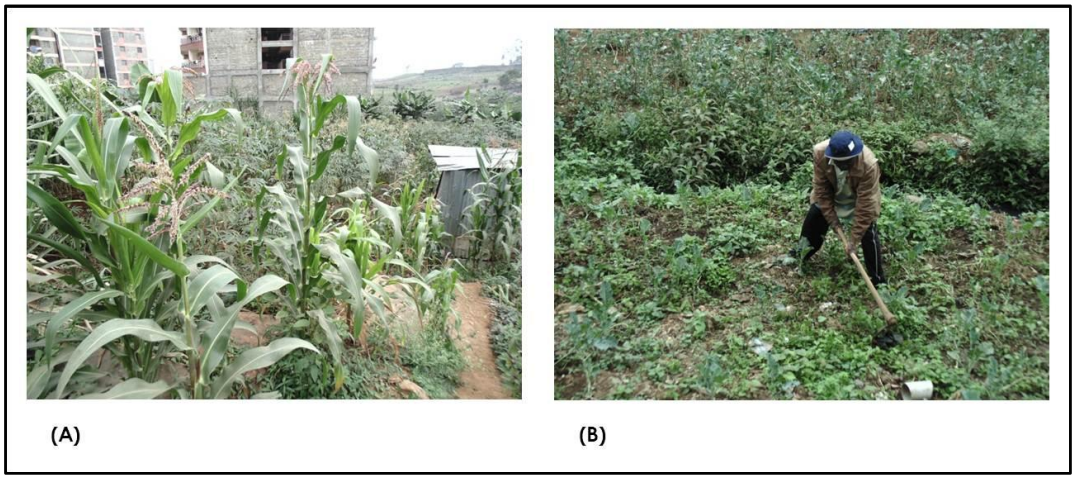

Figure 12: Plate showing (A) maize crop under cultivation in Mlolongo and (B) a man tending to his horticultural crops in Ruiru

5.1 Comparative analysis of the sanitation chains for Mlolongo and Ruiru Towns

Both Mlolongo and Ruiru have a linear system of domestic wastewater system. Domestic wastewater is generated at the household level where it is contained in various ways, for example, communal pit latrines, cess pits, conservancy pits, septic tanks, and sewer lines. The operations of management, emptying and maintenance of the collection systems is done by the landlords but the tenants pay for the services. For example, each tenant in Mlolongo is charged Ksh. 200 (approximately 2 dollars) per month to cater for solid waste and wastewater services. 74% of the residents in Ruiru said that the charge for water and wastewater is 'bundled' in the amount of rent paid at the end of the month. The study revealed that emptying is more frequent in Mlolongo than in Ruiru. The domestic wastewater is transported using the services of private players who operate vacuum tankers. Some of the

wastewater is sold to EPZ which is a quasi-government organization for treatment and final disposal in the river system. According to the sub-county planner, much of the wastewater in Mlolongo is dumped illegally in Katani. Ruiru town has a sewer treatment plant where the private vacuum owners sell to the county government. The waste is then treated to primary level and then disposed of in the river system.

Therefore, domestic wastewater in both satellite towns undergoes a 6-stage linear process with little or no recovery of resources. Each stage is associated with costs and bureaucracy and hence contributes to the unsustainability of the management system. The sanitation chains are shown in Figure 13.

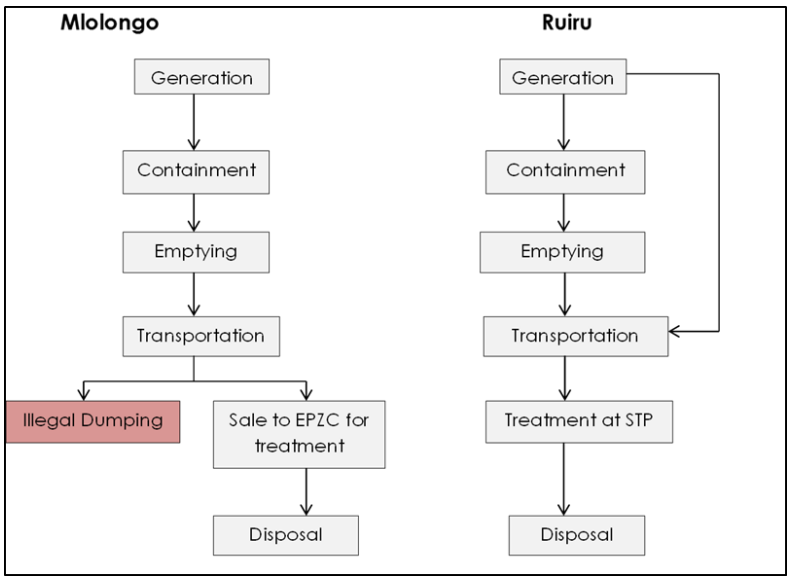

Figure 13: Sanitation Chains for Mlolongo and Ruiru Towns

6. Recommendations

6.1 Management sustainability

Management sustainability involves the process of ensuring that the principle of subsidiarity where decision making is at the most basic level and the urban locals are empowered to take a more leading role in domestic wastewater operations. The formation of communal management groups at the household level will promote the development of communal ownership spirit that support effective and efficient management of domestic wastewater.

6.2 Planning sustainability

Economies of scale can be realized if the domestic wastewater collection systems are organized from the current individual into communal networks. This will entail networking several systems from the household level and development of a communal 'management' centre.This communal networking enables greater participation of the residents in operations

and maintenance of the systems and also reduction of the volume and frequency of emptying which has a huge bearing on financial sustainability.

6.3 Financial sustainability

It is recommended the need to ensure that the ability of the users to pay for the domestic wastewater collection and disposal is taken into consideration when planning for the systems. This is a system that provides for minimal cost or that can be commercialized to provide for employment opportunities to the residents in satellite towns. There is a need to identify unnecessary stages in the collection, transport, and disposal of domestic wastewater.

6.4 Environmental sustainability

Environmental sustainability envisages a system that reduces the amount of domestic wastewater being generated at the household level and also development of systems that allows for re-use and recycling of the domestic wastewater eg. For irrigation, production of fertilisers, landscaping. The essence is to enable the recovery of resources from the domestic wastewater.

6.5 Model of sustainable domestic wastewater management

Aspecific objective of the study was to establish a sustainable model of domestic wastewater management in satellite towns around Nairobi. The model thus developed will aim at reducing the financial cost of containment and transportation, encouraging community partnerships and participation in operations and maintenance of the systems, and recouping of resources through production of biogas and fertiliser for urban agriculture. It is premised on the fact that the current system is unsustainable to the residents in terms of financial costs, technology adopted, environmental and social requirement among others.The import of the model will be to minimize the cost of operation, enhance local management, and enhance recovery of resources. The model involves eliminating the unnecessary levels in the operational chain to enhance efficiency and seeking ways of encouraging community and private sector participation in management. This is depicted in Figure 14.

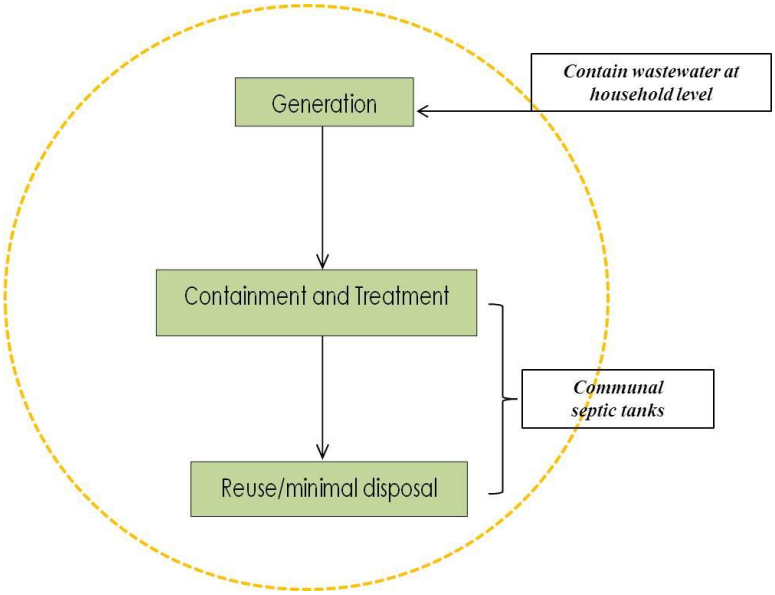

Figure 14: Proposed sustainable model of domestic wastewater management

At the policy level, it is imperative to develop domestic wastewater systems that allow for recouping of resources at the end of the sanitation chain. The strategy should be developing closed systems that seek for reuse or recycling of domestic wastewater. Such resources can include fertilizer, water for secondary uses, and methane gas that can produce green energy for electricity requirements for the town residents. There is an overwhelming opportunity for practicing organized urban agriculture in the satellite towns around Nairobi using domestic wastewater.Figure 15 demonstrates how the sustainable model could be applied in the satellite town of Mlolongo. The gist of the model is to have the individual household systems inter-connected to flow into communal septic tanks. The communal tank thereby becomes the centre for domestic wastewater containment, re-use and recycling processes, and recovery of resources from the wastewater. Secondly, the adoption of community participation in operations and maintenance of the domestic wastewater systems. Management of domestic wastewater at the satellite towns should be tied to communal networks that help increase efficiency and effectiveness. The community groups will enable the residents to have more bargaining power in matters urban governance and this would have a multiplier effect in other sectors such as the solid waste management.Local level management would help reduce the cost of wastewater management through reducing the sanitation chain and eliminating the unnecessary levels that add on the final cost of wastewater disposal.

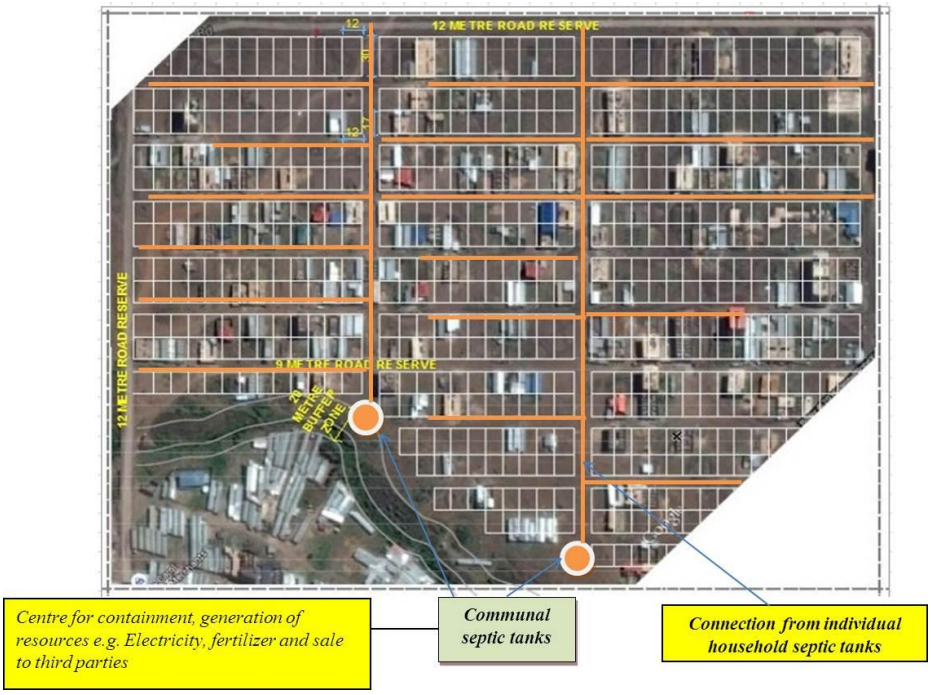

Figure 15:Proposed domestic wastewater management model for Mlolongo town

7. Conclusion

As documented by Raschid-Sally, & Jayakody (2008),improper wastewater management,for example, overflows, lack of and poor infrastructure maintenance, insufficient treatment could lead to surface and groundwater pollution. For domestic wastewater, the suitability of various sanitation technologies must be related appropriately to the type of community and also dependent on ability of the urban residents to pay user costs. The study has revealed that the provision of effective and efficient urban governance system to manage the collection, transportation, and disposal of domestic wastewater in satellite towns around Nairobi is lacking. The study has demonstrated the direct correlation between the organizational structure, institutional framework adopted, operations and maintenance processes, cost and financing mechanism with the management of domestic wastewater in Mlolongo and Ruiru towns. This implies that the management of domestic wastewater in satellite towns around Nairobi is dependent on organizational structure deployed, operations and maintenance systems, legal and institutional framework and costs and financing mechanisms.The study has demonstrated that leaner and more flat decentralized organizational structures are better for efficient, reliable, and effective decision making processes. Decision making is easier and the costs of disposal are considerably minimized for the urban residents.On operations and maintenance, the study has revealed that the local urban community participation in investment of wastewater systems, daily operations and maintenance of the collection and disposal systems assisted in ensuring ownership and reduction of costs and frequencies of

emptying. The residents are able to participate in delivering collection systems, organize the rates and frequency of collection, and ways of recycling/reuse.

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