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Closing the Loop:

Capturing the Value of Sustainable Sanitation to Benefit Urban Agriculture

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Figure 1: Urban Agriculuture in Mwanza, 2023. (Authors' own)

POLICY BRIEF

Key points

- **Uncaptured Value.** There is an opportunity to realise the uncaptured and unrecognised value of treated faecal sludge and wastewater in the current sanitation system through additional investment in co-composting and collaboration with local farmers and communities.

- **Integration of Scales.** The integration of a variety of context-appropriate solutions at multiple scales, from the household level to the city-region level, has the potential to address gaps in access to sanitation facilities, reduce the pollution of waterways, and deliver additional environmental, public health, and social benefits to local communities.

- **Urban agriculture.** Urban agriculture plays a key role in the local economy and food production, this includes urban farmers that can become critical stakeholders in closing the loop sanitation approaches through facilitating the biological re-use of treated faecal sludge and wastewater, and thereby mitigating the negative environmental and public health impacts of water contamination from sewage and industrial fertilisers.

- **Perception.** There is significant potential to address the social stigma associated with the re-use of faecal sludge and wastewater by shifting perceptions through community-level collaboration, knowledge exchange, awareness campaigns, and the demonstrations of re-use value through urban agriculture and the greening of public spaces.

Introduction

This policy brief seeks to identify pathways for stakeholders in urban areas to reduce the environmental and public health impacts of inadequate sanitation and capture a variety of benefits through the transformation of the sanitation value chain. Rapid urbanisation combined with limited local government capacity often results in unimproved sanitation systems in cities, leading to public health risks and environmental degradation including soil and water pollution. Urban agriculture also contributes to water pollution due to reliance on industrial fertilisers, which often seep into water bodies that serve as sources of drinking water for a city. Lake Victoria supports cities like Mwanza, in Tanzania, but is rapidly deteriorating following decades of sewage dumping and agricultural runoff. To address these related challenges, we recommend linking sanitation to urban agriculture.

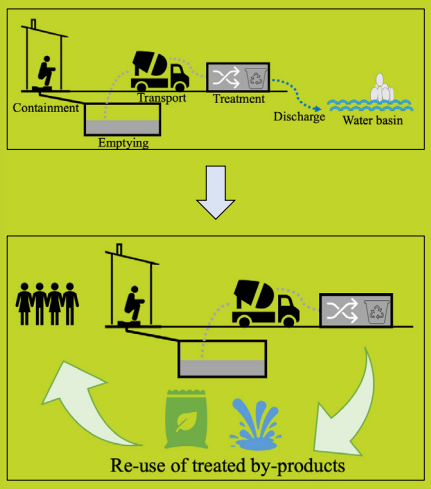

Figure 2: Diagram of closing the loop in sanitation (Authors' own).

The sanitation value chain is typically conceived of as a linear, multi-step process where waste is first contained, before it is emptied into a form of transportation and taken to be treated and finally disposed of (See Fig.2). When the 'start' and 'finish' of the value chain is connected by reusing treated by-products such as fertiliser for agriculture or as a soil conditioner, the value chain transforms into an ecological one. Ecological sanitation is defined by the World Health Organization (WHO) as sanitation systems "based on the ecosystem and the principle of closing the material flow cycle" [1]. Approaches based on this principle are referred to as 'closing the loop', and they represent an alternative to 'flush and discharge' solutions such as conventional sewerage, or 'drop and store' solutions such as pit latrines [2]. Under an ecological approach, human excreta can be transformed from a public health risk and environmental pollutant into an organic fertiliser that can be used by urban farmers and for the greening of public spaces. Overall, linking the sanitation chain to plant growth allows for **circularity**, or **closing the loop**.

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1. What Does Closing the Loop Look Like?

Approaches to closing the loop can target one or multiple aspects of the sanitation value chain. Interventions along the whole value chain can bring about benefits including increased access to upgraded sanitation facilities, the reduction of environmental and public health impacts, and the provision of resources to urban farmers. Interventions take the form of integrated solutions implemented at multiple scales to address gaps in the current sanitation system while capitalising on existing infrastructure and practices. There are several barriers that have limited the implementation of these approaches in Mwanza such as financial and topographical constraints, the need for infrastructure investment, as well as barriers associated with stigmatisation.

Currently, the sanitation system in Mwanza is composed of separate systems at two scales and levels of formality. The formal system operates at the city-region level and due to financial and logistical factors, it is only available to a small minority of households. It takes the form of collection via sewerage connection or septic tanks, before pipes or vacuum trucks transport it for treatment at the Butuja Wastewater Stabilisation Ponds ("WSP").

The informal system operates as the default system for the majority of Mwanza's residents. It is characterised by on-site sanitation, primarily in the form of pit latrines which may be lined or unlined. Both types of pits present health challenges to users, nearby residents, and the surrounding environment through potential physical hazards, pathogens and pollutants.

Our research has identified the potential to address gaps in the current system and 'close the loop' through integrated interventions across three levels: the city-region scale, the community scale, and the household scale (see Fig.3).

1.1 Mwanza's Sanitation Plan

The present strategy for addressing the public health, environmental, and social challenges of sanitation in Mwanza is to expand the formal centralised system by connecting more households, treating more waste at Butuja WSP. Due to recent expansion of the piped network and the construction of simplified sewage systems, current coverage is estimated at 23%, leaving 77% of residents with decentralised or on-site sanitation [3]. The WSP are being expanded to increase capacity, SSS continue to be built, and there are six new WSP planned to increase capacity further, though Mwanza Urban Water Supply and Sanitation Authority ("MWAUWASA") does not currently have the capital required to build new WSPs.

The impetus for MWAUWASA's programme of system expansion is the Lake Victoria Water and Sanitation (LVWATSAN) project. LVWATSAN is a multilateral programme supported by UN-Habitat and the European Investment Bank. The goal of the project is to improve water quality in Lake Victoria by improving water and sanitation in the urban areas surrounding the lake [4].

1.2 Methodology

Our research was undertaken as a part of the ESD Learning Alliance's partnership and ongoing projects with OVERDUE. The Learning Alliance and OVERDUE have focused on addressing sanitation justice in multiple urban areas in sub-Saharan Africa. We aimed to understand how other successful cases of closing the loop and ecological sanitation approaches were implemented and how they could be applied in Mwanza.

The research approach sought to build on previous work beginning with extensive desk-based research that commenced in January 2023 followed by on-site and in-person research that was conducted in Mwanza, Tanzania throughout April and May 2023.

The fieldwork was conducted by the team over a 10-day period, including 4 transect walks, 22 individual interviews and 4 focus group discussions with local stakeholders including policy makers, farmers, engineers and other sanitation service providers at the WSP, agricultural fields and informal settlement areas across Ilemela, Mabatini, Kambarage and Bwiru Ufundi in Mwanza. The majority of the time in the field was spent in the area between the WSP and Bwiru Ufundi settlement, which is uniquely positioned adjacent to Lake Victoria and a large multi-tenanted agricultural area (See Fig.4).

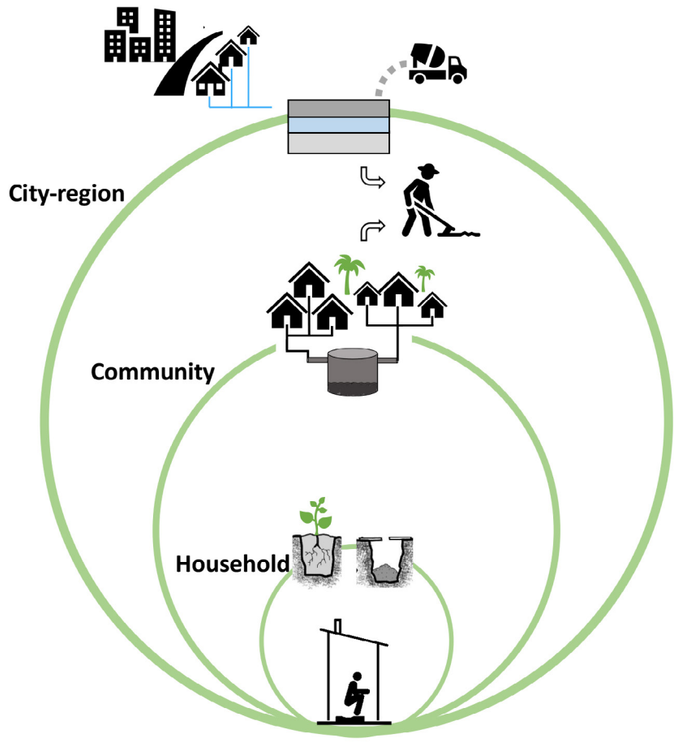

Figure 3: Closing the sanitation loop at three scales (Authors' own)

1.3 Research Findings

There is evidence that closed-loop sanitation systems work.
Our research identified a diverse range of closed-loop sanitation solutions at various scales around the world [2]. A commonality among these solutions is an ecosystem approach that considers urine and faeces as valuable resources that play a role in soil fertility and food production [2]. An ecosystem approach allows for similar principles to be applied while allowing for adaptation and adjustment to a local context.

Figure 5: Butuja Waste Stabilisation Ponds, 2023, Authors' own (Left-top: Dumping FS, Left-bottom: Maturation pond with effluent release, Right-top: Discharging effluent to Sabasaba river, Right-bottom: Dried sludge in drying bed)

Ecological sanitation has been best demonstrated at smaller scales.
Closed loop solutions are typically implemented at smaller scales and often overlap with sanitation interventions referred to as decentralised waste-water treatment solutions ("DEWATS"). The term DEWATS refers to systems of excreta capture, collection, treatment, and distribution that are not connected to a large-scale sanitation system. As smaller projects these schemes are commonly run by community-based organisations or smaller businesses and provide an effective form of faecal sludge (FS) management especially for unplanned settlements. Typically, they rely on biological or ecological treatments that are safe in a community setting [5].

Fig. 4: Mwanza's sanitation system (This map was created based on the interview data through QGIS by Authors in 2023)

Conventional approaches to modernising wastewater treatment have largely failed to meet all sanitation needs across urban centres. In Mwanza, there is significant room for decentralised systems at different scales to increase sanitation access to the over 70% of households that are not connected to a centralised sewerage and treatment system [3].

Agriculture and sanitation systems can be mutually beneficial.
Urban agriculture is most valued for its contributions to food security, but it has significant potential in contributing to other urban services such as municipal sanitation. By reframing human waste from a problem to an asset and exploring the potential links between urban agriculture and sanitation end-products, significant steps can be taken in improving sanitation and food security while safeguarding environmental and public health.

2. City-Region Scale Loop

At the city-region scale in Mwanza, the loop is comprised of the piped sewage network (including SSS), as well as decentralised containment where waste is transported via sanitation trucks to the WSP (See Fig.4). Waste is treated in three anaerobic ponds, four facultative ponds and six maturation ponds, treating around 5,000m^3/day with a total capacity of 5,750m^3/day [6]. Treated effluent is released into Sabasaba river which flows into Lake Victoria, and FS is dried in drying beds intermittently (See Fig.5).

2.1 Uncaptured Value

The current system is capable of effectively treating a limited capacity of waste and mitigating faecal contamination in Lake Victoria. The uncaptured value in this loop is in the 10,000m^3 of existing treated FS that has accumulated since the ponds were built but which needs to be excavated from the ponds and dried. With additional investment in co-composting and increased organizational capacity to manage the collection of waste and distribution of compost, MWAUWASA can implement its own closed loop approach by ensuring treated FS is used by urban farmers in Mwanza. As co-composting requires organic waste there is also potential for collaboration with municipal solid waste management. MWAUWASA and our research identified other approaches to closing the loop, such as producing briquettes for energy, but these require higher financial investments, the building of separate plants, and result in slow returns on cost-recovery.

2.2 Integration of Scales

This loop is limited by the challenge of connecting all households to a centralised system. MWAUWASA's planned expansions are hindered by land requirements, limited capital and unpredictable service demand. In the face of these challenges the majority of the population will continue to rely on decentralised and on-site solutions. MWAUWASA remains far-sighted in its plans and the director of the WSP confirmed aims to construct six further WSPs around Mwanza to increase the service area. This would result in a higher volume of treated FS.

Currently, MWAUWASA and private sanitation truck drivers provide a critical link between the WSP and decentralised containment, by collecting and transporting waste safely. Leveraging their services will allow for integration of decentralised solutions into the city-wide scale. Capturing decentralised flows into the centralised system will increases potential FS volume, making it a viable organic fertiliser supply option for urban farmers.

2.3 Urban Agriculture

Re-use potential in the immediate WSP vicinity is high given the nearby farming communities. Anecdotally, there is evidence of re-use as WSP staff acknowledged that farmers/individuals have come to collect the dried FS and that a nearby school collected dried sludge for use in their garden. Interviews conducted with farmers located near the WSP indicated that one farmer is already diverting the treated effluent to irrigate his crops. However, farmers in Bwiru-Ufundi confirmed physical challenges to this potential and that only those in close proximity to the WSP can feasibly re-use end-products. To bolster a system of regular re-use, MWAUWASA would require long-term collaboration with urban farmers who can play an active role in the collection and distribution of faecal compost. In addition, MWAUWASA and local farmers could engage city-regional level agricultural stakeholders such as the Ministry of Agriculture and farming associations to shape agriculture-sanitation connections. This has been evidenced by the desire of urban farmers to participate in formal sanitation discussions.

2.4 Perception

While government bodies like MWAUWASA and urban farmers are ready to use treated sanitation outputs to fertilise crops, there is an invisible barrier of negative perception to address. Interviews with farmers and residents showed that safety of faecal compost must be ensured, and that the social perception of reusing wastewater/FS must be understood. Therefore, there is an urgent need for sanitation and public health workers to understand these perceptions and any cultural significances, while addressing sanitation taboos and educating the population on the potential for safe re-use of treated sanitation. Overall, public campaigns and community discussions will elevate people's understanding of sanitation re-use, its safety, and how it can improve overall sanitation and agricultural practices.

Case Study 1: Wastewater for Irrigation in Accra, Ghana

In Accra, the centralised sexwerage system approximately serves 7% of the population with the remainder of waste being dumped into the ocean [7]. As the flow of human waste far outstrips the capacity of centralised treatment facilities, alternative, decentralised treatment methods are critical for addressing challenges associated with effective waste management.

Here, re-use has been integrated into waste management as an alternative to 'treatment for disposal'. Of the approximately 80 million litres of wastewater generated per day, 15% is used up by urban vegetable farmers [7]. Urban farmers have proven to be an important stakeholder in Accra's sanitation system, significantly contributing to the city's environmental health by diverting wastewater from Korle Lagoon to urban farms. Urban agriculture thus creates an avenue for recycling readily available wastewater and FS which are effective soil conditioners, despite high pathogen levels.

Farmers are adopting safer irrigation practices that utilise a multi-barrier approach, a low-cost alternative that employs conventional treatment processes such as flocculation, filtration and sedimentation. For example, at La Fulani urban agriculture site, partially treated wastewater is diverted by farmers from non-functioning treatment plants into a furrow irrigation system for targeted re-use, predominately in areas close to the treatment plant.

Although this case presents the potential of wastewater re-use for irrigation, it should not be considered as a 'one size fits all' approach for wastewater re-use as there are various techniques that can build upon current farming interventions and be adapted contextually. In addition, negative health risks remain within this case and show that conventional wastewater treatment remains critical. Nonetheless, exploring alternative and decentralised solutions will be essential for improving the overall sanitation profile within urban centres.

Figure 6: The use of wastewater for irrigation in Accra (Source: [7])

3. Community Scale Loop

The focus on centralisation of the sanitation system under the city-region loop overlooks the immense potential of a closed loop approach at the community scale. The community scale refers to the settlement or neighbourhood level, bigger than a single household but not extending to an entire local government ward. It is important to consider the community scale as a spectrum of many different sized communities where multiple solutions can be considered.

3.1 Uncaptured Value

Ecological approaches to closing the sanitation loop at the community scale present several opportunities to capture value that are not possible under the current sanitation system. Closing the loop at the community scale can reduce infrastructure costs compared to centralised solutions by eliminating the need to extend pipes and drains over long distances and challenging terrain.

The smaller scale makes it possible for sanitation systems to reach households that could not feasibly be connected via the main piped network or SSS, reducing the prevalence of unimproved sanitation facilities, and effectively mitigating public health risks. Investing in a community scale sanitation system will also efficiently avoid seepage from unlined pits or clogged pipes, thus improving the built and natural environment. Since localized solutions can be adapted according to specific contexts, this would serve as an opportunity to empower communities and individuals, allowing them to take ownership of their sanitation challenges and solutions [8,9]. Case Study 2 shows how both individual entrepreneurs and their communities can benefit from community level sanitation solutions. Through interviews and observations in Bwiru Ufundi, it is evident that a DEWATS approach would provide numerous benefits to the community and local farmers. Individuals aware of ecological approaches to closing the loop are keen to educate others on their potential, as well as implementing DEWATS to improve sanitation in the settlement whilst benefitting from the re-use potential of effluent, FS and biogas.

3.2 Integration of Scales

A key aspect of understanding and implementing closing the loop solutions at this scale is recognising and formalising the role of people as infrastructure. Groups and individuals play critical roles at every stage of the sanitation value chain, and smaller-scale approaches rely on actors in the community to design, operate, and maintain sanitation systems.

Currently, there are two groups of service providers who provide FS transportation services to local communities and households; manual pit emptiers (MPEs) and sewage truck drivers. Truck drivers, some of whom are employed by MWAUWASA, are licensed and issued with safety equipment to provide a fee for service to empty septic tanks for households and businesses not connected to the sewer network. However, septic tanks are not feasible solutions for every household due to cost and space for installation, as well as truck access for emptying. Despite these challenges, they remain part of a potential solution at the community level through cooperation and collaboration.

MPEs operate informally and often illegally, despite being the only service provider capable of accessing many pit latrines. This role should be acknowledged and encouraged to protect their safety and improve sanitation outcomes. Providing a more comprehensive spectrum of collection and transportation services at the community level would enable more households to benefit from upgraded sanitation facilities. Small-scale mechanical solutions including Gulpers, Pupu Pumps, Vacutug, Mapet, Nibbler etc., can provide more protection to service providers, increase efficiency, and enable more households to be accessible [9].

Solutions at the community level must be aligned with the local context, including the needs, desires, and ability to pay of community members, as well as the physical realities of the location. The system must also be co-designed, co-produced, co-financed, and co-managed by the community. This will require a a range of other stakeholders including MWAUWASA, local government authorities, and potentially NGOs and businesses to deliver infrastructure and operate and maintain systems alongside the community. A recently developed Sanitation Forum run by MWAUWASA is currently operating a social platform in Mwanza to educate people about sanitation hygiene, support public sanitation needs, and act as a platform to discuss community level sanitation solutions. The Forum provides the opportunity to involve multiple stakeholders in sanitation discussions, particularly marginalised actors such as MPEs, and actors often rendered invisible such as urban farmers.

3.3 Urban Agriculture

Growing crops is a primary economic and sustenance activity for many households in Mwanza [12,13]. The types of activity range from augmenting food supply to providing income for individual households. Urban farmers in Mwanza face several challenges, some of which can be addressed by integrating agriculture into sanitation systems at the community level. For instance, agriculture can function as a final stage of treatment where plants help alleviate soil contamination by absorbing pollutants while producing safe and consumable food [14]. This could complete the sanitation loop without requiring the

Case Study 2: DEWATS in Kigamboni sub-ward, Dar es Salaam.

Dar es Salaam Water and Sewage Authority (DAWASA) considers DEWATS to be effective sanitation solutions and have been working with WaterAid and BORDA to construct them around the city [10]. In 2013, the first FS treatment plant with a capacity of 4m^3/day was constructed in Kigamboni sub-ward [11]. It serves around 1700 households where 10% rely on traditional pit latrines, 53% on improved pit latrines and 37% on septic tanks, and these are served by MPEs and vacuum trucks [10,11]. The plant is owned and operated by a local entrepreneur who charges a service fee to the community dependent on distance from the plant, FS accessibility, waste quantity and amount households can afford to pay [11].

Effluent is released into a drain planted with banana trees, FS is solar-dried in beds to produce biosolids (compost) that are sold to local farmers, and biogas is piped to the operator's household. This decentralised plant therefore provides cost-effective FS management for the local community, thereby reducing illegal sludge emptying practices, while also producing valuable resources for the owner and distributed within the community. It should be noted that although treated discharge proved to be safer than incoming raw sewage, certain treatment standards were not met. Therefore, standards parameters may need to be adapted for these unique systems [11].

transportation of waste out of the community (see Case Study 2).

Interviews with farmers in Mwanza highlighted a general preference for biological fertilisers over industrial fertilisers. However, due to a decline in rearing livestock within the city, farmers struggled to access sufficient animal manure which is typically the primary source of organic fertiliser. Since the organic matter of treated wastewater and FS can contain sulphur, magnesium and micronutrients and demonstrates similar properties as animal manure, there is potential in reusing them in agriculture. Unlike the harmful properties of chemical fertilisers, treated wastewater and FS can mitigate soil degradation and negative impacts on fertility [15,16].

3.4. Perception

Even though the community of Bwiru-Ufundi expressed a prevalent interest in a community septic tank, there were concerns regarding the spatial issues. Since each household only has access to a limited piece of land, the community needs to have a collective agreement on necessary contributions to improve their sanitation provision. There is a need to recognize the importance and urgency to improve sanitation access and establish the understanding that a community septic tank would bring value in improving hygiene, health and overall environment safety.

A co-produced community sanitation project can raise awareness on the safety of faecal compost as a fertiliser. Involvement in the sanitation process allows community members to track the flow of waste from excreta to treatment through the composting of FS and witness first-hand the results of using faecal compost or treated wastewater in agriculture.

4. Household Scale Loop

The household scale represents the most common sanitation systems in Mwanza, namely on-site sanitation and decentralised containment in the form of pit latrines and septic tanks. Given the time that will be needed to overcome the significant accessibility challenges to develop a complete decentralised sanitation system, adopting a circular approach at the household level reflects a practical and realistic way to overcome current challenges.

Household loop options can be applied to on-site sanitation systems such as pit latrines that frequently do not have a form of treatment and present seepage and groundwater contamination risks. It also covers the emerging ecological sanitation technology, with integrated biological treatment systems such as composting toilets or Ecosanitation (Ecosan) [9]. The latter has been tested in various parts of the world with direct mechanisms of using composted faecal waste and urine for agricultural growth.

4.1 Uncaptured Value

There is huge potential to close the loop at the household level. The most documented is the re-use of treated wastewater and FS for agricultural benefits with Ecosan mechanisms of on-site treatment. Outcomes linked to environmental protection, improvements in soil fertility, and community health are part of a broad spectrum of ecological changes that can be associated with Ecosan and are often overlooked in sanitation interventions [18]. However, while Ecosan provides a safe sanitation solution that brings benefits to urban agriculture, applications in Mwanza and other areas have been limited. In the absence of Ecosan facilities, there is a simple model to close the loop from pit latrines, called Arborloo, observed on-site in Mwanza (see Case Study 3). It integrates a circular approach to sanitation which has the potential to greatly improve the living environment of communities.

4.2 Integration of Scales

Working at this level requires empowering users to contribute to upgrading the sanitation system to benefit their living environment. It is also based on recognising the role of the actors, and people as infrastructure, of the decentralised sanitation system. The MPEs will be the change agents, who will be trained in collaboration with engineers and CHW to facilitate the conversion of the filled latrines.

4.3 Urban Agriculture

Urine and composted FS are very effective and low-cost organic fertilisers. The interviewed farmers in Bwiru-Ufundi reported the experience of successfully growing banana trees using composted FS from their household latrine. The safe re-use of nutrients for plant growth thus illustrates the potential of ecosanitation models [19].

4.4 Perception

This loop requires exemplifying the safety and practicality of utilising spaces from unused/abandoned pit latrines. To implement a successful closed loop at household level, lessons from Ecosan projects in other countries reveal the importance of adequate community engagement for behavioural change and the need for follow-up activities to address potential barriers. To fully benefit from a circular loop in reusing waste material, it will also be critical to deliver agricultural training that will provide technical support and address potential challenges such as urine storage, equipment needs, and transportation and distribution, which could impede sustained re-use [18].

Case Study 3: Arborloo model at household level in Mwanza

A short circular loop in sanitation at the household level was observed on-site in Mwanza, in the Mabatini district (see photo). It consists of repurposing disused and dilapidated pit latrines to convert them into green areas where plants can grow. This model, called Arborloo, directly improves the built environment, especially in densely populated settlements. Abandoned pit latrines are hazards that pose significant health and environmental risks as potential breeding grounds for disease-carrying vectors or contaminating groundwater sources.

Converted unused or concrete-enclosed closed pits can be used to support plant life. This addition of green space also has the potential to grow small quantities of food which can augment the food supply at the household level. It will also reduce the risks of pathogen exposure through untreated excreta. Capturing value at this level immediately benefits the living environment, improving the residents' quality of life based on the community's engagement.

Figure 7: Top: Image of growing plants on a pit. (Source: [17]) Bottom: Arborloo in Mwanza, 2023 (Authors' own).

Recommendations

1 Maximise the re-use potential of the current centralised system in a closing-the-loop approach at the city-region level.

- The utility can capitalise on existing functions at the Butuja WSP by establishing a comprehensive co-composting system that de-sludges, processes, and re-uses dried FS that is ready-to-access for end-users, particularly urban farmers.
- The utility and local community leaders can co-produce an effective distribution/collection system with the urban farming communities for optimal use.
- Policymakers and regulators in sanitation, the environment, agriculture, and public health can leverage existing relationships with stakeholders to produce and disseminate data, while simultaneously educating the wider community on the safe re-use of treated FS and wastewater.

2 Recognise and formalise the role of people as infrastructure in an integrated network of context-specific solutions at various scales.

- Utilities and local government can provide recognition, safety equipment and training for smaller-scale solution providers, starting with MPEs as key change agents.
- Utilities, local government, and NGOs can allocate resources to local community leaders to educate the community on the safety and potential re-use of FS and wastewater and organise members of the community to collaborate on potential sanitation solutions.
- A group of stakeholders across the public, private, and NGO sectors can initiate a pilot programme at the community level in collaboration with MWAUWASA that can test the implementation of community-led DEWATS facilities and act as a testbed for further development.

3 Create better linkages with farmers' communities, involving them in the Sanitation Forum, for them to be fully part of the design of closing the loops approaches.

- Collectively, all sanitation actors can develop a new circular narrative on sanitation that reflects the full spectrum of ecological changes, using a re-use lens to educate and promote the safe re-use of treated FS and wastewater in communities.
- Policymakers, community leaders, the utility, and NGOs can create a blueprint that demonstrates the benefit of FS as contributing to organic farming and reducing soil and lake pollution.

4 Test and scale up households and community-scale treatment solutions and initiatives that will empower communities of residents.

- Organisations financing sanitation projects should support local community leaders in their efforts to co-design, co-produce, co-finance and co-manage sanitation solutions at the community scale with local autonomy and responsibility.
- Sanitation projects should test and model Arborloo and Ecosan solutions with communities to identify the best approaches for each location and strengthen capacity-building at the community level by cascading experiences and shared learning.

5 Inform and raise awareness on the safe re-use of treated FS.

- All sanitation and agricultural stakeholders can use available data and evidence to demonstrate that re-used faecal matter and urine are solid agroecological alternatives.
- Policymakers, the utility, and local farmers can work with stakeholders at various levels of the food chain (production, distribution, consumption) to formulate central messages for public acceptance.

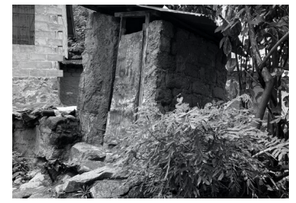

Figure 8: Photos taken during the fieldwork in Mwanza, 2023 (Authors' own)

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