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Determinants of Urban Farmers' Acceptance of Faecal Sludge Compost in Urban Agriculture: Evidence from Dar es Salaam, Tanzania

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ABSTRACT
Urban agriculture plays a crucial role in food security in Dar es Salaam, Tanzania. The use of faecal sludge derived compost (FSDC) is known to aid sustainable and circular agriculture by reuse of valuable nutrients. Key to ensuring environmental and human health safety is by proper processing of FSDC to eliminate inorganic, organic and microbial contaminants embedded in the source materials without compromising nutrient content. However, the utilization of FSDC remains limited due to farmers' prejudice and hesitance. This study investigates the factors influencing urban farmers' acceptance of FSDC for agriculture. A cross-sectional survey of 76 urban farmers was conducted, with data analysed through descriptive statistics and chi-square analysis. Farmers' awareness and experience in applying FSDC in agriculture are important factors that play a role in its acceptance. Results indicate the significant association among garden location in communal areas, income generation as the primary farming purpose, and accessibility of soil inputs are significantly associated with FSDC acceptance. The findings highlight the importance of ease availability and affordability of a compost product with the capacity of enhancing an increase in crop yields to foster acceptance. The study recommends frequent training sessions through workshops and demonstration plots to farmers for awareness-raising and ensuring the good quality of produce by FSDC to promote safe and sustainable reuse of FS in Dar es Salaam's urban agriculture sector.

Keywords: *Faecal sludge; compost; urban agriculture; farmers' acceptance; waste management; sustainable agriculture; Dar es Salaam*

INTRODUCTION

The rapid urbanisation and population growth in cities around the world have led to significant challenges in food security, food availability, waste management, and sustainable development. Urban agriculture is gaining importance as a critical response to these challenges in developing countries as a viable solution for food security, particularly in densely populated cities (Yuan et al., 2022). Among the various agriculture practices, the use of organic compost is emerging as a sustainable approach to enhance soil quality while mitigating waste disposal challenges (Ho et al., 2022). The increase in waste generation in urban areas is in parallel with urban development as population and urbanisation increase which needs management initiatives (Mapunda et al., 2023).

Composting is one of the reliable and less expensive methods of waste management in urban areas that consider recycling organic waste into a useful product (Bazrafshan et al., 2016; Benito et al., 2003). The process accelerates the degradation of organic matter by microorganisms under controlled conditions, allowing sanitisation of the waste by eliminating pathogenic microorganisms and toxic compounds (Zewde et al., 2021). When compost applied into the soil improves the physical, chemical and biological properties of soil, provides good water and air conditions, improves soil structure and reduces erosion.

Dar es Salaam, Tanzania, is currently the second fastest-growing city worldwide, with a population growth rate of 5.6% and expected to have 10 million people in the next decade (Todd et al., 2019). Composting is a sustainable recycling method of organic wastes for the marketable end product to be used as a soil conditioner and organic fertiliser (Badagliacca et al., 2024). As it is in many other cities of the developing countries, Dar es Salaam is experiencing an increased challenge in waste management, including faecal sludge. About 90% of the population in Dar es Salaam rely on on-site sanitation systems that allow faecal sludge (FS) to accumulate and are periodically collected and dumped into waste stabilisation ponds (WSPs) for treatment (Andriessen et al., 2017). Waste stabilisation ponds treat only 43% of faecal sludge in Dar es Salaam in two out of nine available ponds designated for receiving FS and are still found to underperform (Brandes et al., 2015; Kayombo et al., 2019). The remaining amount is either in the prolonged-use pits beyond the filling capacity, emptied in an unhygienic manner, or illegally disposed of in the environment near the water bodies or drainages (Jenkins et al., 2015).

As one of the organic materials in composting, faecal sludge can be used to obtain a very strong and mature end product for agriculture. Faecal sludge is organic waste generated from human sanitation systems, and its treatment and transformation into compost can recycle nutrients back into the soil, helping to restore degraded urban lands (Niwagaba et al., 2014). Among various sustainable agricultural practices, the use of faecal sludge-derived compost (FSDC) stands out as an innovative solution that not only addresses soil fertility but also promotes sustainable waste management (Kenne et al., 2023). The application of FSDC brings vast impact to the soil, enriches it with essential nutrients, improves soil structure, and supports plant health and products yield, making it a valuable resource for urban farmers (Allen et al., 2023; Lomunyak et al., 2024).

The negative impact should not be ignored, as pathogens present in faecal sludge can cause diseases if not well treated (Torgbo et al., 2018). The growing demand for safe and sustainable food sources necessitates a critical examination of the various factors that influence consumer attitudes towards FSDC. Despite its potential, the acceptance of faecal sludge-derived compost among farmers remains a significant barrier to broader implementation and utilisation in urban agriculture due to misconceptions about health

concerns, stigmatisation, and a lack of awareness (Mkude et al., 2021).

Farmers acceptance on FSDC utilization is influenced by several factors, including health and safety concerns, societal perceptions, knowledge and awareness of composting processes, and cultural norms. There is a prevalent fear surrounding the use of human waste in agriculture, even when the composting process adheres to stringent safety standards. This fear is often rooted in the stigma associated with human waste, leading urban farmers to be wary of adopting practices that involve FSDC. Kasala et al., (2016) argues that the criteria that influence peoples' acceptance to FSDC most are the cost of the product, the awareness they have about its use and the quality of the product.

Understanding these factors is essential for designing interventions that encourage acceptance and facilitate the integration of FSDC into urban agricultural practices. Despite the potential benefits of FSDC, adoption remains low, partly due to misconceptions and lack of awareness. Against this background, the study sought to ascertain determinants that influence farmers' acceptance on FSDC utilization in agriculture. The specific objectives of the study were to understand farmers' experience on applying soil inputs specifically to compost and to determine factors influencing acceptance to apply FSDC in their gardens. The overall focus is on which are crucial for designing effective communication and policy interventions.

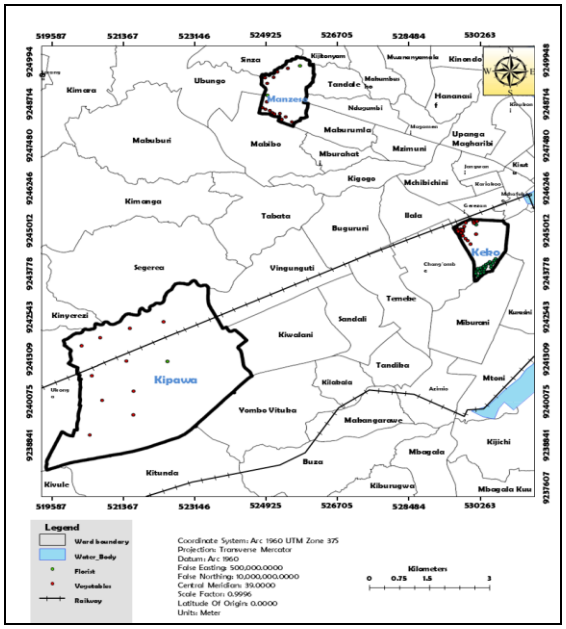
MATERIAL AND METHODS

Description of study area

The analysis was started by locating and map all agriculture areas around water sources and along valleys of three selected study areas Keko, Kipawa and Manzese wards in Dar es Salaam city as detailed in Figure 1.

Figure 1

Mapped urban farmers in the selected case study areas



The areas were selected as representative of highly populated wards, and almost all (99%) residents rely on onsite sanitation systems, making the reliable availability of faecal sludge a source material for FSDC production (Mkude et al., 2021; Seleman et al., 2020). But also in these areas, there is provision of valleys located in areas with water sources for urban agriculture practices. A cross-sectional survey was conducted between February and August 2023 aimed at investigating the factors influencing urban farmers' acceptance of FSDC for urban agriculture within three selected case study areas.

Sampling

The target population involved all urban farmers, 18 years old and above and involved in urban agriculture of vegetables, fruits and ornamental plants. Since the farmers in urban horticulture are neither registered in local offices nor formalized, it is difficult to locate them. The snowball sampling method was relevant to this study due to the informal nature of urban farming or difficulty identifying farmers. The method involved first existing participants recommend future participants and it was applied to attained 70 respondents based

on saturation point who are involved in urban horticulture. Horticulture is the branch of agriculture that involves the growing of flowers, fruits, and vegetables.

Data collection

The study used both qualitative and quantitative approaches in data collection and analysis which employ interpretive and descriptive strategies, offering a wide range of understanding of the phenomenon. While qualitative narratives provide flexibility to the subject under study (Oranga & Matere, 2023), a quantitative research approach is primarily used to quantify empirical data (Ghanad, 2023).

Provisioning of FSDC compost

In the duration of one month prior to data collection, each participant was provided with a 10kg of FSDC for trial in their gardens together with a checking list to fill in whenever the compost is being in use.

Survey

The questionnaire survey was deployed to collect information from respondents. A survey was administered to assess the insights of farmers and the use of FSDC. Seventy farmers were selected at random from each of the three administrative zones: 43 were chosen from Keko, 12 from Kipawa and 15 from Manzese. The questionnaire was developed and validated by pre-testing activity which conducted to 7 participants (10% of total sample size) in Ubungo area, which was not one among study areas to ensure that survey questions were clear and relevant. the questionnaire was customized to include both open- and closed-ended questions in English, but during data collection, respondents were asked the questions in Kiswahili to ensure a clear understanding of the questions and a high response rate as suggested by Almasi et al., (2019). The questions were divided into four major sections: socio-economic characteristics; agricultural practices; use of other soil inputs; and awareness and perceptions of farmers on the reuse of FSDC.

Observation

Observations were also used to get more insight on how the agricultural activities are conducted in the urban areas and the application of the soil inputs.

Statistical analysis

Descriptive statistics were applied for the demonstration of the demographic characteristics of the farmers. The chi-square analysis was further applied to identify significant predictors of acceptance factors, including the use of FSDC in agriculture. Factors analysed include both demographic and non-demographic characteristics related to types and purpose to be involved in horticulture and ownership of the gardens/plots. All analyses were conducted by using the Statistical Package for the Social Sciences (SPSS) version 20.0 with the alpha level set at 0.05 to determine statistical significance.

Ethical approval

This study was approved by the Department of Water Resources Engineering in the University of Dar es Salaam. In addition, administrative approval to conduct the study in the sampled wards was obtained from the Ward offices in Keko, Kipawa and Manzese municipalities. A verbal consent was granted by the participants in the study was sought prior the responding during the study.

RESULTS AND DISCUSSION

Demographic profile of respondents

Data was collected from 70 respondents who are farmers from three study areas with their socio-demographic and farming characteristics as presented in Table 1

Table 1
Socio-demographic characteristics of farmers (n=70)

		Respondents' location					
		Keko		Kipawa		Manzese	
Variable	**Variable category**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
Respondents gender	Male	22	51.16	8	66.67	10	66.67
	Female	21	48.84	4	33.33	5	33.33
Respondents age	15-35	23	53.49	5	45.45	6	40.00
	35-64	20	46.51	6	54.55	9	60.00
Purpose of farming	Subsistence	6	13.95	4	33.33	1	6.67
	Income generation	36	83.72	8	66.67	14	93.33
	Both purposes	1	2.33	0	0.00	0	0.00
Garden location	By the house	8	18.60	4	33.33	1	6.67
	In the communal place	34	79.07	8	66.67	14	93.33

As it is shown in table 1, among the surveyed respondents, majority (>50%) were men from all study areas, with an average age of 35-64 years old. This shows that male at their active age participate more in urban agriculture mainly for income generation. This also was found in other studies. In Nigeria, the situation was found to be similar. The findings reported by Oyegbami & Lawal, (2017) on gender participation in urban agriculture among crop farmers show that 66% were men and even more educated and persistence. Another reason might be due to the nature of household that headed by men as it is in main part of Dar es Salaam. Interestingly, findings are different in Sierra Leone, where it was reported that urban vegetable production is dominated by women in Freetown as men take up other jobs within the city (Oladele Idowu, 2012). But in this society, majority of families were headed by women. More argument is that it could be different in the female headed households' society where female farmers tend to limit their labour input in farm activities because of heavy commitment to reproductive roles such as nurturing and caring for children, hence more men would participate in farming.

The type of crops cultivated found to vary with areas. In Kipawa and Manzese, about 83% and 87% of gardeners respectively, cultivate leafy vegetables such as amaranth, spinach, and pumpkin leaves. These are the common edible leafy vegetables in Dar es Salaam hence the finding was anticipated, as these vegetables are widely consumed in Dar es Salaam (Ombeni et al., 2023). However, in Keko, about 49% of respondents focused on landscaping activities, growing flowers and ornamental plants, while only a small proportion (4%) added food crops such as bananas within their gardens.

The compost users who participated in this study were primarily individuals engaged in horticulture within urban and peri-urban areas of the city. Urban agriculture often involves crop cultivation in unauthorised spaces (Bushesha, 2018). Consequently, most mapped gardens were located close to water sources with the main reason that to ensure easy access to irrigation. These sites were considered fertile, productive, and capable of retaining water for irrigation purposes (A. R. Thomas et al., 2018). Moreover, the establishment of gardens along valleys and near water bodies has been common practice, driven by the high

cost of urban land and the need to maximise both water and fertiliser use efficiency (Price & Heberling, 2020).

It is evident that due to rapid changes in urban areas, the popularity of urban agriculture and its increased acceptance have allowed the emergence of new forms of cultivation over the years for different reasons (Wessels et al., 2024). The increase in urban agriculture is influenced by the social improvement. This was seen by the majority of respondents in each study area being involved in horticulture activities for income generation purposes against those who are growing for family consumption (see Figure 2).

Figure 2
Percent of surveyed respondents involved in horticulture activities and purposes within individual study areas

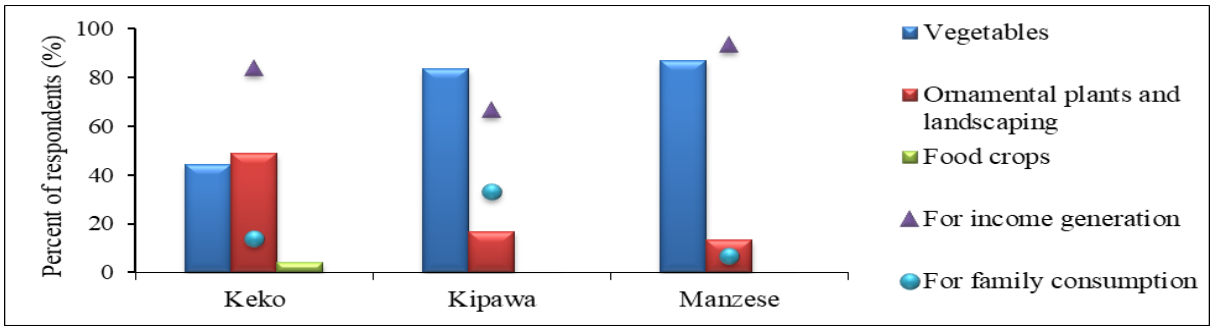


Figure 2 indicates the types of plantation and main reasons that lead farmers into type of plants grown whether it was for income generation or for family consumption. As shown in the figure, vegetables were the most grown product in Kipawa and Manzese while in Keko, more ornamental plants are grown.

For the purpose of agriculture, it is well known that people do farming for income generation as evidently shown in Figure 2. It is difficult for urban farming to be done into a scale of sustaining the family consumption only. This is similar to what Bushesha (2018) identified on the role of agriculture in livelihood. It was found that the improvement of household income was the main factor, among others, towards peoples' engagement in floriculture in Tanzania, as it was supported earlier by (Bishoge et al., 2017).

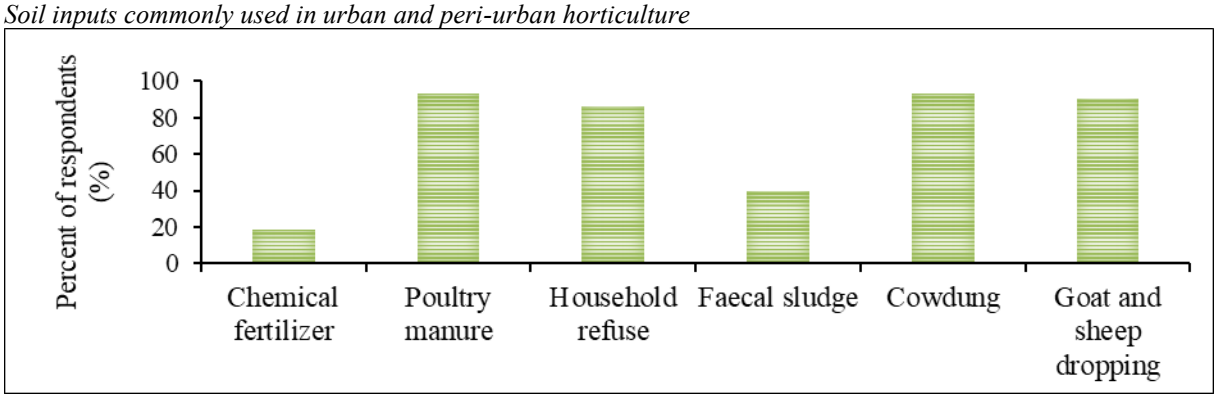
Awareness and experience on application of soil inputs

The analysis of respondents' awareness of the use of soil inputs for the horticulture activities was conducted, and it was found that the general knowledge of composting organic waste for agricultural purposes varied among individuals. The awareness on application of organic compost is still low, whereby from the survey, only 38% of gardeners in three study areas have shown to be aware on production or application of compost (from other organic materials) in urban agriculture. It is suggested from previous studies that farmers' awareness on the type of soil inputs is needed for them to accept, to improve agricultural production and to contribute to urban food security (Zainal & Hamzah, 2018).

The application of different soil inputs as fertiliser and soil conditioners was found in existence while analysed for the acceptance and use among the gardeners. Eighty-three percent (83%) of surveyed gardeners were informed to use different soil inputs either solo or in combination (Figure 3) for an average of 5 years. Four soil inputs that were found to be most preferred or commonly used by the majority include animal droppings (cow dung, sheep and goat droppings), poultry manure and

household refuse. Chemical fertiliser (nitrogen, phosphorus and potassium-based contents) is applied by less than 20% of the gardeners, of which more than half (66%) are vegetable growers, while the rest grow ornamental plants. Chemical fertiliser is reported to be locally available in agricultural shops at an average consumption rate of 35kg per year per gardener.

Figure 3
Soil inputs commonly used in urban and peri-urban horticulture



The preference for animal droppings being mostly applied biosolids in horticulture was due to its easy availability from the nearby livestock keepers at little to no cost. Another reason explained was that due to its longer time impacts given to the soil than other inputs. About 4 to 150 sacks (average 121 sacks) of animal droppings with 50kg capacity each are applied per gardener per year depending on the plot size, type of horticulture involved and the seasons of the farming activities available per year.

Factors influencing the application of soil inputs

Statistical analysis on the driving forces for respondents to use compost was conducted by using Chi-square analysis among the respondents against demographic and non-demographic characteristics. Table 2 presents result on which factors show the influence of gardeners to use soil inputs in their gardens.

Table 2
Results showing factors influencing the application of FSDC in urban agriculture

Variable	Variable category	Application of soil inputs (%)		χ^2-value	p-value
		Yes	No		
Location	Keko	79.1	20.9		
	Kipawa	83.3	16.7	3.688	0.158
	Manzese	100	0		
Gender	Male	82.5	13.3	0.225	0.448
	Female	86.7	15.7		
Age	15-35	85.3	14.7	0.076	0.521
	35-64 years	82.9	17.1		
Garden location	By the house	61.5	38.5	6.322	0.042**
	Communal place	89.3	10.7		
Type of horticulture products	Vegetables	83.3	16.7		
	Food crops	100	0	0.590	0.899
	Ornamental crops	84.0	16.0		
	Vegetables & food crops	100	0		
Purpose of horticulture	Subsistence	54.5	45.5		
	Income generation	89.7	10.3	8.793	0.012**
	Both	100	0		
Accessibility of Chemical	Yes	100	0	0.757	0.518

Variable	Variable category	Application of soil inputs (%)		χ^2-value	p-value
		Yes	No		
fertilizer	No	94.0	6		
Accessibility of soil inputs	Yes	100	0	7.635	0.043**
	No	84.6	15.4		
Availability of household refuse	Yes	88.9	11.1	2.042	0.275
	No	98.1	1.9		

***Statistically significant at p<0.05*

Results presented in table 2 show the three factors; location of the garden, purpose of horticulture and accessibility of soil inputs are statistically significance influencing the gardeners to apply the soil inputs in horticulture system.

Location of urban agriculture gardens

Based on the Chi-square test results, there is a statistically significant association between garden locations (whether within house premises or at communal places) and compost acceptance (χ^2 = 6.322 at p = 0.042). This suggests that farmers are more willing to apply FSDC when the gardening plot is located in the communal area than in residential premises. It was found that the majority of farmers practice it in communal plots; most of them are rented. The renting price varies depending on the size of the plot, its location and the negotiation between the owner and the renter. This has discouraged long-term investments, including the use of soil inputs, including composts, because those renting have no guarantee over land (Kongnso, 2024). Results from this study were different, as the majority (89%) of gardeners in communal plots were found to apply compost. This was further explained to be due to the easy availability and low cost of products, especially animal manure. Another reason is because the plots are old; it is believed that even the soil is no longer productive as it was in the past. So in order to boost the product's yield, the addition of soil amendment products is necessary.

Purpose of horticulture

The purpose of horticulture in the study area was analysed on whether it is practised for income generation, family subsistence or both. There is a statistically significant association between the purpose of horticulture (for income generation or subsistence/family consumption) and compost acceptance (χ^2 = 8.793 at p = 0.012). About 52% of respondents were reported to be involved in horticulture for income generation, especially those who grow vegetables and ornamental plants like flowers and fruit trees. Doing it in a business means the need for a high yield; hence, the application of soil inputs to maintain the needed soil quality is important. In the face of food production and dietary needs, vegetable production in Tanzania is growing in importance in consumption practices as well as for domestic and export markets. Kebede, (2023) pointed out that vegetable production is one of the most important sources of farm income, and their cultivation as such occupies an important place in agricultural development.

It is commonly discussed that one of the common purposes of applying compost to the soil is for its benefits to maintain the humus balance in the soil (Wright et al., 2022). Additionally, compost helps in binding nutrients and ensures the proper circulation of air and water and is thus important for crop growth. In some cases, Zainal & Hamzah (2018) reported multiple dimensions that influence urban farmers on the decisions to engage in urban agriculture, which are the type of urban agriculture, the purposes of urban agriculture, the advantages of urban agriculture and practising urban vegetable production.

Urban agriculture has been a socio-economic survival strategy by influencing the creation of informal jobs and income diversification (Bushesha, 2018). Due to the increase of

entrepreneurship needs and job creation desires, urban agriculture has been advanced to growing more ornamental plants and flowers. Income generation was reported as the main factor influencing most of the people involved in floriculture in the study conducted by Bishoge et al. (2017) in Dar es Salaam.

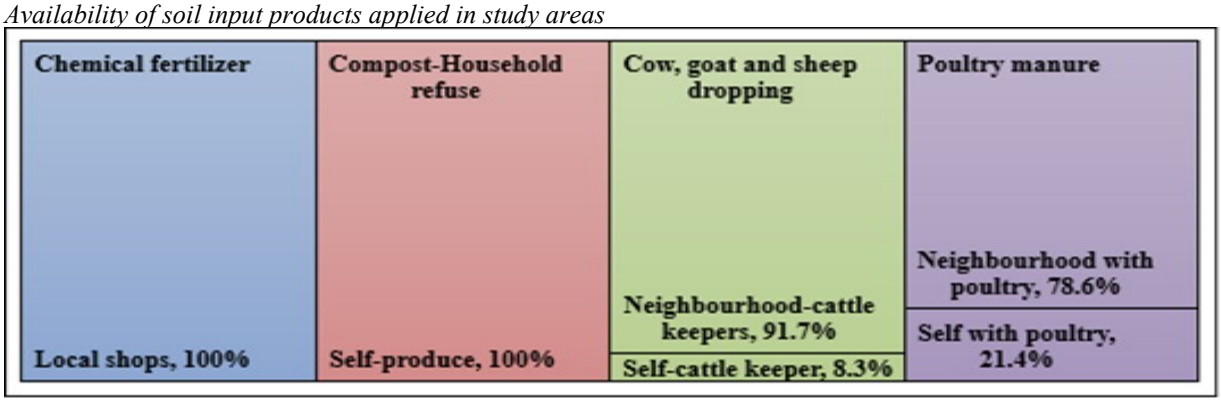
Accessibility of soil inputs

Lastly, the accessibility of soil inputs in the nearby neighbourhood was statistically significant in influencing the application of soil inputs. There is a statistically significant association between accessibility of soil and compost acceptance ($\chi^2 = 7.635$ at $p = 0.043$). Accessibility of soil inputs, including compost, is the ease for urban farmers to obtain and utilise them for gardening, agriculture, or other purposes (Kongnso, 2024; Pan et al., 2022). Findings show that poultry manure and animal droppings were easily accessible in the lower cost or free of charge from the neighborhoods, encouraging those who have gardens to apply for soil amendment.

The access of any reliable product within the geographical area is important. However, the access of compost in urban areas is not easy, whereby 18% of respondents who had experience with compost application obtained it from neighbours for free, 13% from self-livestock keeping and nearly 10% bought it from other livestock keepers for a very low cost. Both '*easy availability'* of the product and '*being available throughout the year'* to cater for different seasons were important factors mentioned by the urban farmers. Figure 4 summarised information on where the soil inputs are obtained from.

Figure 4

Availability of soil input products applied in study areas



As it is shown in figure 4, chemical fertiliser commonly used is urea and easily available in local agricultural shops; that's why 100% of farmers can access them when affordable. Although it is expensive when needed in large amounts, its availability throughout the year made it commonly used. In contrast, the availability of animal droppings depends on whether the user also keeps livestock or not. It has been observed that for those who keep livestock but have no farming activities involved tend to give out the animal waste for free as a process of cleaning animal places. By doing so, it is easier for gardeners to obtain it freely and use it.

Not only is the source considered, but compost quality has also been involved with easy accessibility. In some places, it was found that the accessibility of compost depends on the good quality compost and making it available to small-scale farmers (Bishoge et al., 2017; P. S. Thomas et al., 2021). This also was concurred by a study conducted in emerging cities that analysed the effectiveness of production and application of organic waste in urban agriculture. The study found that almost one-third of the urban farmers do not know the characteristics that need improvement, but only one-fourth of the farmers showed accessibility,

followed by easier handling of the compost (Woldeamanuel et al., 2022).

Urban farmers' awareness and acceptance of FSDC

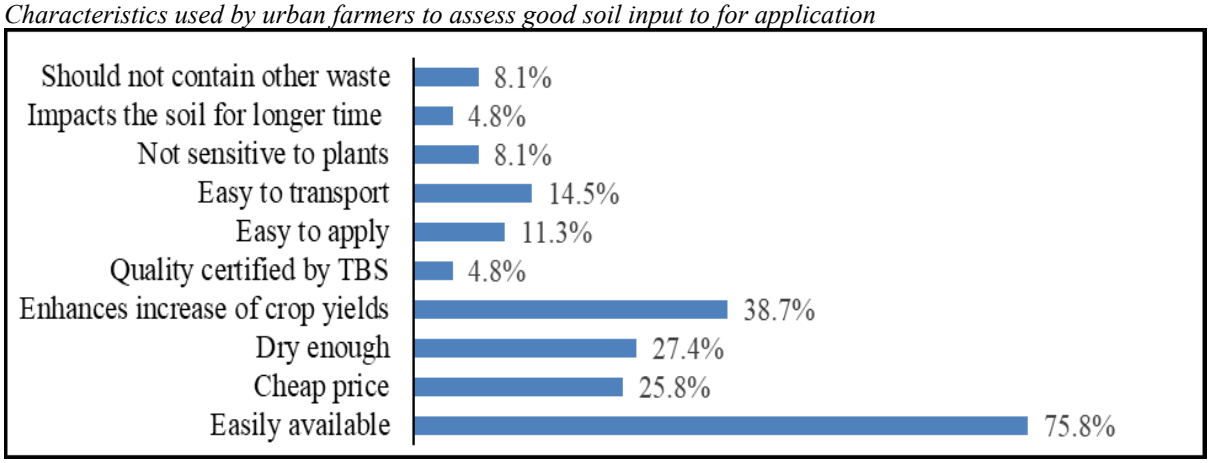
Results show that there is low awareness of FS co-compost application among farmers corresponded to the findings of three related previous studies, which found that a significant proportion of respondents were not aware of the value of FSDC (Singh et al., 2022). In the study of opportunities and constraints of compost use, Kongnso (2024) concluded that lack of experience with and knowledge about using compost and the non-mastery of technical guides are barriers for compost application among users. This is similar to what was found from respondents of this study. The general knowledge on the compost application was there, however, specific to FSDC, majority don't know if the human waste can also be applied to their farms/gardens. Additionally, types of compost available in the study areas found to differ, based on the waste materials ranging from municipal waste to agricultural waste. That is why compost from toilet pits emptied waste was one among soil input materials that no respondents reported using as the soil amendment product.

In a society that experiences the faecal fear like Tanzania, the use of human waste in agriculture would be expected to show not only a lack of knowledge and awareness but also low acceptance of its use due to different reasons, one being the social culture and taboos on human excreta. Mkude et al., (2021) in their study that assessed knowledge, attitude and practices on the faecal derived material, compost included found that respondents showed negative feelings against materials due to both limited knowledge and persisting cultural norms and taboos toward human waste in Tanzania. They were further explainsed that in the lens for religious belief, faeces are waste, since it comes out of our bodies, cannot be taken back for other uses.

Regardless the reported advantages of urban agriculture in Dar es Salaam as presented by (Wessels et al., 2024) that it contributes to locally grown food, creates urban employment, and keeps vacant areas safe and secure through the daily presence of farmers. However, the uptake of FSDC by urban farmers could be limited due to the observed challenges.

Gardeners were further assessed for what have been the main reasons for the continuous applications of compost rather than chemical-based soil inputs, regardless of the reported negative acceptance of faecal-related products (Figure 5). It has been observed that the benefits of any soil input cannot be relevant to all urban farmers. Continuous use of specific soil input is due to the factors that one depends on, from the products' availability to the end of agricultural seasons. Furthermore, the respondents pointed out what would be the characteristics to consider in selecting or categorising the soil input as good fertiliser or soil amendment. Almost all characteristics mentioned are dependent on one another. The majority of the respondents (76%) pointed out that the availability of compost should not only be at a convenient location and at the nearby market to the field but also should be available throughout the farming seasons at the lowest cost (25.8%). This would result in ease of transportation means (14.5%) and lessen the transportation cost.

Figure 5
Characteristics used by urban farmers to assess good soil input to for application



Another interlinked characteristic pointed out by the majority was that the compost should have the capacity of increasing the crop yield when applied (38.7%), which means it should not be sensitive to plants (8.1%), have prolonged positive effects on the soil and not contain other waste (12.9%). The compost quality should not be compromised, including optimal dryness (27.4%) for the urban farmers to apply easily as required (11.3%). In reaching the required quality, certification of a final product is very necessary before it can be applied, as it was suggested by 4.8% of the respondents.

As shown in figure 5, all characteristics of compost assessed are important. The top two ranked characteristics, availability and capability of increasing crop yield, are the sources of the other factors. Both mentioned characteristics are similar to what Kongnso (2024) found from the field surveys conducted in Cameroon: that households in the peri-urban areas wish to use municipal compost but are not certain about its availability when they need it and also identify the high cost of transportation as a barrier.

The capacity of compost to increase the crop yield might not be seen as a direct effect. However, even though compost use requires long-term investments, application of compost to the soil will improve the 'soil health'. At this juncture, soil health is a combination of physical, chemical and biological properties that impact the function and productivity (Wright et al., 2022). Compost increases water holding capacity, total porosity, soil carbon, nitrogen contents, plant available water and so many other important features for plant growth (Woldeamanuel et al., 2022) and hence increases crop yield. This explains why farmers had shown a strong affinity for compost use.

CONCLUSION

This study has identified several key factors influencing consumer acceptance of faecal sludge-derived compost for urban agriculture in Dar es Salaam. The acceptance of faecal sludge-derived compost for urban agriculture in Dar es Salaam is at a small scale, and few urban farmers exist in the city. There is a tremendous challenge in raising awareness of the types of soil inputs available, including faecal sludge-derived compost, especially in edible vegetables and other plants. A Low acceptance of FSDC is driven by limited awareness, accessibility challenges, and socio-cultural barriers. Primary concern is farmers' awareness and understanding of the application and proper use of this type of compost. Many farmers lack adequate experience with compost use, missing its potential advantages, leading to hesitance and limited adoption. Additionally, the application of soil inputs, including faecal sludge compost, is affected by factors such as perceived efficacy, cost, availability, and ease of use.

Application of soil inputs such as compost is important for plant growth and soil health. Three factors were found statistically significant in influencing farmers to apply compost into their plots. The location of the agriculture plots was one factor, whether it is located in a communal place or within the residential premises of the farmer. Another factor was the purpose of the farming, whether it is for income generation or family consumption. Lastly, the accessibility in terms of availability and ease of applying the compost into the plots. Several compost characteristics that farmers are in favour of include easy availability with little to no cost and the capacity to increase crop yield when used, the preferences that are currently lacking.

One major limitation in this study was a reliance of snowball method in obtaining sample size which lead to small number. Nevertheless, results gave big picture on what is done in the ground and the recommendation given here will serve the purpose. It is recommended that several interventions be planned to improve acceptance of this potential soil amendment product, FSDC. To increase awareness and provide experience with compost use, the government entities, particularly the Ministry of Agriculture as well as environmental management authorities, should put efforts into frequent awareness campaigns specific to urban farmers. Research and academic institutes play a vital role in organising hands-on training for farmers while demonstrating production and application methods. These initiatives should focus on building knowledge regarding the needs and advantages of using organic soil inputs and proper production and application techniques of FSDC. Compost producers should ensure they meet the recommended quality of the products set by the Tanzania Bureau of Standards authority to reduce misconceptions and denial of use. In collaboration with non-governmental organisations (NGOs), compost producers can produce and distribute FSDC at subsidized rates. Researchers should make close follow-up and further studies on consumer preferences will ensure the production aligns with local demands.

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REFERENCES

Allen, K., Rodríguez López, E. L., Banwart, S. A., & Evans, B. (2023). A Systematic Review of the Effects of Fecal Sludge Derived Amendments on Crop Growth and Soil Health. *ACS ES and T Engineering*, *3*(6), 746–761. https://doi.org/10.1021/acsestengg.2c00438

Almasi, A., Mohammadi, M., Azizi, A., Berizi, Z., Shamsi, K., & Shahbazi, A. (2019). Assessing the knowledge , attitude and practice of the Kermanshahi women towards reducing , recycling and reusing of municipal solid. *Resources, Conservation & Recycling*, *141*, 329–338. https://doi.org/10.1016/j.resconrec.2018.10.017

Andriessen, N., Kimwaga, R., & Strande, L. (2017). *A Pilot-Scale Faecal Sludge Research Facility in Dar es Salaam , Tanzania*. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/EWM/Treatment_Technologies/A_pilot_scale_FS_research_facility_Nienke_Andriessen.pdf

Badagliacca, G., Testa, G., La Malfa, S. G., Cafaro, V., Lo Presti, E., & Monti, M. (2024). Organic Fertilizers and Bio-Waste for Sustainable Soil Management to Support Crops and Control Greenhouse Gas Emissions in Mediterranean Agroecosystems: A Review. *Horticulturae*, *10*(5). https://doi.org/10.3390/horticulturae10050427

Bazrafshan, E., Zarei, A., Mostafapour, F. K., Poormollae, N., Mahmoodi, S., & Zazouli, M. A. (2016). Maturity and Stability Evaluation of Composted Municipal Solid Wastes. *Health Scope*, *5*(1). https://doi.org/10.17795/jhealthscope-33202

Benito, M., Masaguer, A., & Moliner, A. (2003). Chemical and microbiological parameters for the characterisation of the stability and maturity of pruning waste compost. *Biol Fertil Soils*, *37*, 184–189. https://doi.org/10.1007/s00374-003-0584-7

Bishoge, O. K., Zhang, L., & Suntu, S. L. (2017). Factors Influencing the Growth of Floriculture. A case study of Kinondoni Municipality, Dar es Salaam city in Tanzania. *Journal of Applied and Advanced Research*, *2*(6), 356–363. https://doi.org/10.21839/jaar.2017.v2i6.119

Brandes, K., Schoebitz, L., Kimwaga, R., & Strande, L. (2015). Shit Flow Diagram (SFD) Promotion Initiative Dar es Salaam Tanzania. In *EAWAG/SANDEC-Water and Sanitation in Developing Countries*.

Bushesha, M. . (2018). The Role of Urban Agriculture on Livelihood in Bariadi Township Simuyu Region Tanzania. *Huria: Journal of the Open University of Tanzania*, *25*(2), 96–117.

Ghanad, A. (2023). An Overview of Quantitative Research Methods. *International Journal of Multidisciplinary Research and Analysis*, *06*(08), 3794–3803. https://doi.org/10.47191/ijmra/v6-i8-52

Ho, T. T. K., Tra, V. T., Le, T. H., Nguyen, N. K. Q., Tran, C. S., Nguyen, P. T., Vo, T. D. H., Thai, V. N., & Bui, X. T. (2022). Compost to improve sustainable soil cultivation and crop productivity. *Case Studies in Chemical and Environmental Engineering*, *6*(March), 100211. https://doi.org/10.1016/j.cscee.2022.100211

Jenkins, M. W., Cumming, O., & Cairncross, S. (2015). Pit latrine emptying behavior and demand for sanitation services in Dar Es Salaam, Tanzania. *International Journal of Environmental Research and Public Health*, *12*(3), 2588–2611. https://doi.org/10.3390/ijerph120302588

Kasala, S. E., Burra, M. M., & Mwankenja, T.

S. (2016). Access to improved sanitation in informal settlements: The case of Dar es Salaam. *Current Urban Studies*, *4*(March), 23–35. https://doi.org/10.4236/cus.2016.41003

Kayombo, M., Mayo, A. W., Kimwaga, R., & Gabrielsson, S. (2019). Potential Use of High Rate Algae Ponds for Resource Recovery in the Water-Food-Energy Nexus for Tanzania : A Review. *Tanzania Journal of Engineering and Technology*, *38*(1), 130–151.

Kebede, T. T. (2023). The Role of Vegetables in Ensuring Food Security and Poverty Alleviation: The Case of Ethiopia. *J Nutr Food Sci*, *13*(3), 1–5. https://doi.org/10.35248/2155-9600.23.13.0

Kenne, R. E., Noubep, W. F., Tamfuh, P. A., Mbaveng, D. L., Tchuente, S. A. K., & Enang, R. K. (2023). Agronomic value of composts made from fecal sludge and household waste and effect on maize production in Dschang (West Cameroon). *World Journal of Agricultural Research*, *11*(3), 72–82. https://doi.org/10.12691/wjar-11-3-2

Kongnso, M. E. (2024). Practice of compost use in urban farming: Opportunities and constraints in the West Region, Cameroon. *International Journal of Environment, Agriculture and Biotechnology*, *9*(5), 144–156. https://doi.org/10.22161/ijeab

Lomunyak, G., Osodo, B., Njoka, F., & Kombe, E. (2024). Characterization, optimization and emission analysis of manually-made charcoal dust briquettes with starch, paper and algae binders. *Heliyon*, *10*(24), e40991. https://doi.org/10.1016/j.heliyon.2024.e40991

Mapunda, A. S., Joseph, K. R., & Kasuwi, S. (2023). Impact of Population Dynamics on Solid Waste Generation Trends in Dar Es Salaam Metropolitan. *International Journal of Advanced Research*, *6*(1), 75–87. https://doi.org/10.37284/ijar.6.1.1190

Mkude, I. T., Gabrielsson, S., & Kimwaga, R. (2021). Knowledge, attitudes and practices (KAP) on fecal sludge resource recovery and reuse in dares Salaam, Tanzania. *Journal of Water Sanitation and Hygiene for Development*, *11*(5), 758–770. https://doi.org/10.2166/washdev.2021.249

Niwagaba, C., Mbeguere, M., & Strande, L. (2014). Faecal sludge Quantification, characterization and Treatment objectives. In L. Strande, M. Ronteltap, & D. Brdjanovic (Eds.), *Faecal sludge management: System approach for implementation and operation*. IWA Publishing.

Oladele Idowu. (2012). Gender analysis of land use for urban agriculture and sustainability of livelihoods in Freetown, Sierra Leone. *African Journal of Agricultural Reseearch*, *7*(5). https://doi.org/10.5897/ajar11.1234

Ombeni, S., Mntambo, B., & Millinga, M. (2023). Cities' food synergies: vegetable production and consumption between Morogoro and Dar es salaam, Tanzania. *Frontiers in Sustainable Food Systems*, *7*(May), 1–10. https://doi.org/10.3389/fsufs.2023.1168883

Oranga, J., & Matere, A. (2023). Qualitative Research: Essence, Types and Advantages. *OALib*, *10*(12), 1–9. https://doi.org/10.4236/oalib.1111001

Oyegbami, A., & Lawal, B. O. (2017). International Journal of Agricultural Extension GENDER PARTICIPATION IN URBAN AGRICULTURE IN IBADAN METROPOLIS OF OYO STATE, NIGERIA. *Int. J. Agr. Ext*, *05*(03), 5–8. http://www.escijournals.net/IJAE

Pan, M., Hui, L. C., Man, C., & Law, Y. (2022). Effects of Composting Yard Waste Temperature on Seed Germination of a Major Tropical

Invasive Weed , Leucaena leucocephala. *Sustainability*, *14*(13638).

Price, J. I., & Heberling, M. T. (2020). The Effects of Agricultural and Urban Land Use on Drinking Water Treatment Costs: An Analysis of United States Community Water Systems. *Water Economics and Policy*, *6*(4). https://doi.org/10.1142/S2382624X20500083

Seleman, A., Gabrielsson, S., Mbwette, T. S. A., & Kimwaga, R. (2020). Drivers of unhygienic desludging practices in unplanned settlements of Dar es Salaam, Tanzania. *Journal of Water Sanitation and Hygiene for Development*, *10*(3),

Mbili and Lemala Wards. *Current Urban Studies*, *09*(03), 481–501. https://doi.org/10.4236/cus.2021.93030

Todd, G., Msuya, I., Levira, F., & Moshi, I. (2019). City Profile: Dar es Salaam, Tanzania. *Environment and Urbanization ASIA*, *10*(2), 193–215. https://doi.org/10.1177/0975425319859175

Torgbo, S., Quaye, E. A., Adongo, T. A., & Opoku, N. (2018). The effects of dried faecal sludge and municipal waste co-compost on microbial load and yield of cabbage (Brassica oleracea L. Var. capitata) and lettuce (Lactuca sativa). *Journal of Microbiology, Biotechnology and Food Sciences*, *7*(6), 555–561. https://doi.org/10.15414/jmbfs.2018.7.6.555-561

Wessels, M. T., Veldwisch, G. J., van Vliet, B. J. M., Kyessi, A. G., & Mgana, S. M. (2024). Agriculture and the ideals of urban modernity: the case of Dar es Salaam, Tanzania. *Water International*, *49*(2), 219–237. https://doi.org/10.1080/02508060.2024.2323895

Woldeamanuel, A. A., Tarekegn, M. M., & Balakrishina, R. M. (2022). Production and Application of Organic Waste Compost for Urban Agriculture in Emerging Cities. *International Journal of Agricultural and Biosystems*

512–526. https://doi.org/10.2166/washdev.2020.179

Thomas, A. R., Kranert, M., & Ligy, P. (2018). In-vessel co-composting – a rapid resource recovery option for septage treatment in Indian cities. Journal of Water, Sanitation and Hygiene for Development 08 (4): 688- 697. *Journal of Water, Sanitation and Hygiene for Development*, *08*(4), 688–697.

Thomas, P. S., Kombe, W. J., & Lupala, A. (2021). Dynamics of the Nature and Value of Urban Agriculture in Arusha City, Tanzania: The Case of Daraja

Engineering, *16*(4), 39–47.

Wright, J., Kenner, S., & Lingwall, B. (2022). Utilization of Compost as a Soil Amendment to Increase Soil Health and to Improve Crop Yields. *Open Journal of Soil Science*, *12*(06), 216–224. https://doi.org/10.4236/ojss.2022.126009

Yuan, G. N., Marquez, G. P. B., Deng, H., Iu, A., Fabella, M., Salonga, R. B., Ashardiono, F., & Cartagena, J. A. (2022). A review on urban agriculture: technology, socio-economy, and policy. *Heliyon*, *8*(11), e11583. https://doi.org/10.1016/j.heliyon.2022.e11583

Zainal, M., & Hamzah, S. R. (2018). Urban Agriculture: The Role of Knowledge among Farmer in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *7*(14), 76–85. https://doi.org/10.6007/ijarbss/v7-i14/3653

Zewde, A. A., Li, Z., & Xiaoqin, Z. (2021). Improved and promising fecal sludge sanitizing methods: Treatment of fecal sludge using resource recovery technologies. *Journal of Water Sanitation and Hygiene for Development*, *11*(3), 335–349. https://doi.org/10.2166/washev.2021.268.