The City of Johannesburg Metropolitan Municipality as a Microcosm of Urban Fruit and Vegetable Waste Governance Failure in Low- and Middle-Income Countries: Evidence from Formal and Informal Retailers

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Article

The City of Johannesburg Metropolitan Municipality as a Microcosm of Urban Fruit and Vegetable Waste Governance Failure in Low- and Middle-Income Countries: Evidence from Formal and Informal Retailers

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Abstract

Fruit and vegetable waste (FVW) has become a major sustainability concern due to rapid urbanization and rising demand for fresh produce in low- and middle-income countries (LMIC), creating significant environmental and governance challenges in urban food systems. This study investigates FVW governance by assessing awareness levels and examining FVW management practices among formal and informal fruit and vegetable retailers in Region F of the City of Johannesburg Metropolitan Municipality (COJMM). A quantitative, descriptive design was employed. Data were collected using structured questionnaires that assessed demographic details, awareness of FVW, and current FVW management practices, and analysed using descriptive statistics in SPSS version 30.0. The findings revealed fragmented governance across retail sectors, characterized by limited awareness of municipal waste management by-laws, consistent dependence on disposal-centred practices, and a lack of adoption of FVW valorization strategies. Formal retailers displayed higher awareness, with access to FVW minimization training, but still mainly relied on disposal, whereas informal retailers displayed significant gaps in awareness and FVW training. The study concludes that unsustainable FVW management is mainly influenced by structural governance limitations, emphasizing the need for inclusive and integrated approaches to improve urban FVW governance in LMIC.

Keywords: fruit and vegetable waste; low- and middle-income countries; urban food systems; awareness; practices

1. INTRODUCTION

Urban food systems in low- and middle-income countries (LMIC) are experiencing a rapid transformation due to accelerated urbanization, population growth, and increased demand for fresh produce [8]. Among the diverse categories of food waste generated within cities, fruit and vegetable waste (FVW) accounts for the largest proportion by volume and weight. This is due to their high perishability nature, as they can be vulnerable to high temperature exposure, mechanical damage, and poor storage conditions [29]. Therefore, FVW represent a recognizable and persistent challenge within urban contexts, necessitating proper governance systems that enhance sustainability.

In LMIC cities, FVW is predominantly generated during the distribution and retail phases of the supply chain [3]. The urban fruit and vegetables (FV) retail sector, including both formal and informal retail spaces, is continuously strained and forced to operate under unfavourable conditions

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characterised by limited cold-chain infrastructure, fluctuating daily demand, and constrained storage capacity [28]. These structural limitations greatly exacerbate the likelihood of FVW spoilage, leading to a rapid accumulation of FVW.

Rapid urbanisation has further exacerbated this challenge. The increase of urban populations has widened dependence on the informal retail sector, which poses crucial challenges in terms of food systems' sustainability, including urban food waste [26]. Informal retailers often operate in open-air environments with inadequate infrastructural support, a lack of access to waste collection services, and restricted inclusion in municipal planning. Informal retailers are a vital component of urban food security; therefore, their exclusion from formal waste governance frameworks contributes to ineffective FVW management within retail environments [9].

The City of Johannesburg Metropolitan Municipality (COJMM) represents a crucial node within South Africa's urban food system. As South Africa's economic nucleus, the city is characterized by an extensive formal and informal FV retail activity, including large-scale formal wholesale markets, e.g., Joburg Market, and widespread informal FV retailers [16]. These retailers play a vital role in ensuring food access for a diverse urban population; however, they also generate substantial volumes of FVW daily. The management of FVW within COJMM, therefore, constitutes a significant urban environmental and governance concern.

In many retail environments, there has been evidence of poor waste segregation, informal dumping, or temporary accumulation near stalls and markets [14,17,21]. Inadequate separation at source and insufficient organic waste diversion infrastructure further exacerbate the problem. The COJMM appointed Pikitup to serve as its primary waste management service provider, running with two primary objectives, which are to achieve "Zero waste sent to landfills by 2022" and to "promote recycling". COJMM generates over 1.4 million tons of municipal waste per year, whereby only 13% of the waste undergoes recycling. This provides evidence that Pikitup has not been able to meet the set objectives, signaling a significant waste management failure in the COJMM [19]. These reflect not only operational constraints but also broader weaknesses in urban food waste governance.

Within this context, the COJMM can be recognized as a microcosm of urban FVW governance failure in LMIC. The city exhibits many structural characteristics similar to other LMIC urban environments, including high levels of socio-economic inequality, dependency on informal food systems, infrastructural disparities, and a lack of effective municipal waste management systems [26]. The challenges in waste governance observed in the COJMM, therefore, mirror those experienced in many LMIC cities. This allows the COJMM to be used as a representative case through which broader systemic failures in urban waste governance within LMIC can be examined.

Poor management of FVW poses a critical environmental threat due to its high organic content. When FVW is disposed of in landfills, anaerobic decomposition releases greenhouse gases such as methane (CH_4) and other harmful emissions, including ammonia and volatile organic compounds (VOCs), which lead to climate change and air pollution [4]. The emissions from decomposed FVWs directly impact human health by irritating the respiratory system and affecting multiple organ systems, depending on the gaseous concentrations [27]. Landfill leachate and gases produced from decomposed organic waste can lead to contamination of soil and water resources. This leads to a degradation of the ecosystem and increases the risk of waterborne pollutants entering surface and groundwater [18]. Additionally, FVWs create favourable conditions for vectors, such as flies and rodents, thereby increasing the likelihood of pathogen spread and vector-borne diseases in nearby communities [4]. This underscores the public health importance of effective FVW governance within urban settings.

Despite the significance of FVW within urban food systems, existing research has mostly focused on street vendors' food waste or general organic waste management. Limited empirical attention has been given to FVW governance at the retail level, particularly within contexts where formal and informal food systems coexist. This gap is predominantly evident in African metropolitan cities, where informal trade plays a dominant role in FV distribution.

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Consistent with these findings, this study aims to investigate FVW governance within the COJMM region F, focusing on both formal and informal retailers by assessing their awareness levels regarding FVW and examining their current FVW management practices. The contribution of this study seeks to add to the body of science, enhancing understanding of urban FVW governance failures in LMIC contexts and informing the development of inclusive and sustainable urban waste management strategies.

2. MATERIALS AND METHODS

2.1. Description of Study Area

The study was carried out in the City of Johannesburg Metropolitan Municipality (COJMM) Region F in Gauteng Province. See *Figure 1*. This area covers Johannesburg's inner city and southern suburbs. The research specifically targeted the Central Business District (CBD) because of its high level of commercial activity and dense population.

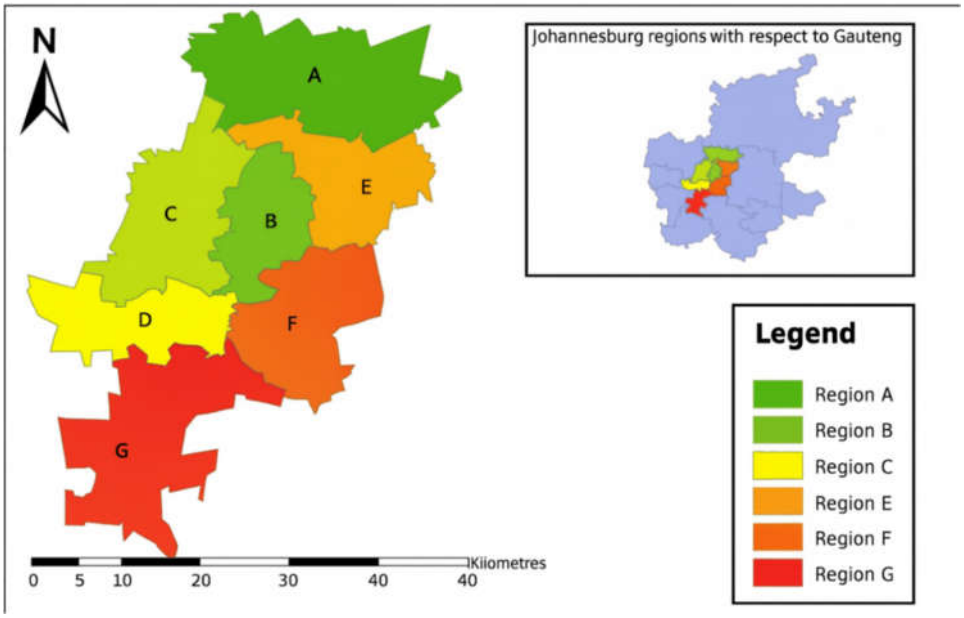

Figure 1. *City of Johannesburg Regions.* [15]

2.2. Study Design

The study employed a quantitative descriptive design, utilizing a non-experimental survey to investigate FVW governance within the COJMM region, focusing on both formal and informal retailers.

2.3. Study Population

In this study, the population refers to formal franchise supermarkets (formal retailers) and informal fruit and vegetable retailers (informal retailers). The targeted population for the study was 61 and 1000 formal and informal retailers, respectively.

2.4. Sampling

Purposive sampling was used to select retailers involved in the daily sale and handling of fruits and vegetables in Region F of the COJMM. This strategy was used because the target population is operationally diverse and not well documented, especially within the informal sector, where most retailers are unregistered, mobile, and not listed in municipal business databases. Therefore, probability sampling was not feasible. The researchers intentionally focused on two groups with

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significant exposure to FVWs generation: informal fruit and vegetable retailers operating in public trading spaces and formal franchise supermarkets in the region. This approach ensured the inclusion of respondents with extensive experience in FVWs management, enhancing the relevance and depth of the findings.

2.5. Sample Size Estimation

Using Epi Info version 7, the following parameters were used to determine the sample size: the confidence level was set to 90% (CL), and the margin of error was set to ±7%. The estimated sample sizes in the study were 121 and 43 for informal and formal retailers, respectively.

2.6. Data Collection

Data was collected using a quantitative questionnaire administered by the researchers to both the formal and informal retailers. The questionnaire was divided into three categories: the first category included demographic characteristics of the respondents. Awareness levels of both formal and informal retailers were assessed in category two, and current practices were assessed in category three. To ensure anonymity in data collection, the respondents were categorized into codes. Formal franchise supermarkets were assigned codes: A; informal retailers were assigned codes: B. The researchers developed the questions based on the research question and objective. The respondents were found at their workplaces during working hours on Mondays to Fridays. When it was impossible to administer a questionnaire at that time, an appointment was set with the respondents at a time that was convenient for them.

2.7. Data Analysis

The data collected from the questionnaires were analysed using IBM SPSS Statistics software, version 30.0. Data extracted from Google Forms was transformed into an Excel spreadsheet and subsequently imported into SPSS. The data was initially cleaned to remove missing values, typographical errors, duplicates, and anomalies. Data cleaning is a crucial step in the analysis process to ensure quality, as it helps eliminate inaccurate data that could lead to unreliable results [7]. Descriptive analysis was employed to present the study findings through frequency distributions and percentages. The results are displayed in tables and graphs.

3. RESULTS

3.1. Section 1 (Informal Retailers)

A. Socio-Demographics of Informal Retailers

The informal retailers who participated in the study were 118. As seen in Table *1*, this study consists of 77 males (65.3%) and 41 females (34.7%). The highest age group observed was between 30 and 49 at (67.8%), while the lowest was between 70 and 89 at 0.8%. The highest educational level for most respondents was primary (39%), and the fewest had a tertiary education (3,4%).

Table 1. Socio-Demographics of Informal Retailers.

Socio-demographic factors		Frequency (n)	Percentage (%)
Gender	Male	77	65.3
	Female	41	34.7

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Age	18-29	24	20.3
	30-49	80	67.8
	50-69	13	11.1
	70-89	1	0.8
Highest educational level	Never went to school	28	23.7
	Primary	46	39
	Secondary	40	33.9
	Tertiary	4	3.4

B. Informal Retailers' Awareness Level.

This subsection explored the awareness of the informal retailers using a Likert scale, as seen in Table 2.

Table 2. Awareness of FVW (informal retailers).

		Agree	Disagree	Neutral	Strongly agree	Strongly disagree	Total
I am aware of the impacts of poor fruit and vegetable waste management	Row N %	39,8%	33,1%	18,6%	1,7%	6,8%	100,0%
Fruit and vegetable waste is a global concern.	Row N %	28,8%	31,4%	17,8%	0,0%	22,0%	100,0%
I am aware of the City of Johannesburg Metropolitan Municipality waste management by-laws.	Row N %	11,0%	54,2%	33,1%	1,7%	0,0%	100,0%

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Disposal of fruit and vegetable waste is the only effective waste management method.	Row N %	83,9%	1,7%	11,0%	3,4%	0,0%	100,0%

Respondents were questioned about their awareness of the impacts of poor FVW management. The majority (39.8%) acknowledged awareness, while 33.1% disagreed. Only a small portion (1.7%) strongly agreed that they understood the impact of mismanaging (FVW). Despite the higher number of respondents who agreed, the nearly equal proportion who disagreed highlights notable gaps in awareness regarding the consequences of poor FVWs management. The respondents were asked whether FVW is a global concern. The majority disagreed with the statement (31.4%), followed by those who agreed (28.8%). 22% of the respondents strongly disagree, increasing the percentage of general disagreement with the statement. while none of the respondents strongly agreed (0%). This indicates limited awareness of the global scale of FVW issues among respondents.

However, when asked whether they are aware of the COJMM's waste management by-laws, the majority (54.2%) disagreed, followed by 33.1% who were neutral, and a minority who agreed. This suggests a very notable gap in awareness of the COJMM waste management bylaws, as it is a requirement for all retailers operating within COJMM to be aware of such bylaws. Respondents were asked whether disposing of FVW is the only effective waste management method. The majority (83.9%) agreed, with 11% being neutral, and none of the respondents strongly disagreed (0%). This signals a significant gap in awareness of FVW's valorization methods instead of disposal, which is an unsustainable method considering the negative impacts FVW has on the environment, economy, and public health.

C. Informal Retailers' FVW Practices

This subsection explored the Informal retailers' FVW practices using a Likert scale, as seen in Table 3.

Table 3. Informal retailers' FVW practices.

		Agree	Disagree	Neutral	Strongly agree	Strongly disagree	Total
I am inducted on ways I can use to minimise fruit and vegetable waste	Row N %	0,0%	81,4%	13,5%	1,7%	3,4%	100,0%
I store my fruit and vegetables in suitable conditions.	Row N %	32,2%	44,9%	12,7%	10,2%	0,0%	100,0%

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Fruit and vegetable waste is mixed with other waste types when disposed of.	Row N %	42,4%	35,6%	20,3%	1,7%	0,0%	100,0%
I am well inducted on proper fruit and vegetable waste disposal.	Row N %	28,8%	44,9%	24,6%	1,7%	0,0%	100,0%

Respondents were asked whether they were inducted on ways they can use to minimise FVW. A large proportion (81,4%) disagreed, followed by 13,5% who were neutral. As only 1,7% strongly agreed, while none (0%) of the respondents agreed. These responses underscore a practice gap among informal retailers regarding waste minimisation strategies, as inductions from authorities can enhance effective FVW management practices. When asked if they store fruit and vegetables in suitable conditions. Most (44.9%) disagreed, followed by 32.2% of respondents who agreed, suggesting a possible gap in effective practices that can impede FVW generation. However, this can also be an indication of a lack of access to appropriate resources, substantiating failure in FVW governance.

Respondents were asked if they mix FVW with other waste types when disposing. A substantial number (42,4%) agreed with the statement, highlighting that the majority of informal retailers do not acknowledge the importance of waste segregation. However, 35.6% of respondents still disagreed, which suggests a possible limited implementation capacity regarding proper waste separation practices and poor enforcement from authorities. The respondents were asked if they were inducted on the proper disposal of FVW. Most respondents disagreed (44.9%), followed by 28.8% who agreed. This mixed response is corroborated by their responses in the *"mixing of waste"* question. This is evidence that most respondents lack understanding of proper waste disposal, verifying a lack of engagement between authorities and informal retailers.

3.2. Section 2 (formal traders)

A. Demographics (formal retailers)

As seen in Table 4. The formal retailers participating in this study totalled 43; this included 25 females (58,1%) and 18 male respondents (41,9%). Most formal retailers were between the ages of 18 and 29 years (60,5%), while the lowest age group was 50 to 65, which had only 1 participant (2.3%). The highest educational level for the majority of the respondents was secondary, at (60.5%). No respondents had "never gone to school" or ended at the primary level. 39,5% ended at the tertiary level.

Table 4. Socio-Demographics of Informal Retailers.

Socio-demographic factors		Frequency (n)	Percentage (%)
Gender	Male	18	41.9
	Female	25	58.1
Age	18-29	26	60.5

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	30-49	16	37.2
	50-65	1	2.3
Highest educational level	Never went to school	0	0
	Primary	0	0
	Secondary	26	60.5
	Tertiary	17	39.5

B. Formal Retailers' Awareness Level.

This subsection explored the awareness of the formal retailers using a Likert scale, as seen in Table 5.

Table 5. Awareness of FVW (formal retailers).

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
I am aware of the impacts of poor fruit and vegetable waste management.	Row N %	46,5%	37,2%	16,3%	0,0%	0,0%	100,0%
Fruit and vegetable waste is a global concern.	Row N %	16,2%	23,3%	14,0%	25,6%	20,9%	100,0%
I am aware of the COJMM waste management bylaws	Row N %	6,9%	27,9%	54%	11,6%	0,0%	100,0%
Disposal of fruit and vegetable waste is the only effective waste management method.	Row N %	32,6%	65,1%	2,3%	0,0%	0,0%	100,0%

Most respondents strongly agreed (46,5%) or agreed (37,2%) that they were aware of the impact of poor FVW management, suggesting that most formal retailers are aware of the consequences of poor waste practices. Respondents were asked whether they perceived (FVW) as a global issue. The responses displayed a considerable variation, with the highest proportion of respondents disagreeing (25.6%), followed by those who agreed (23.3%). Overall, perceptions leaned towards disagreement,

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as an additional 20.9% of respondents strongly disagreed, indicating limited recognition of FVW as a global concern.

Regarding awareness of the COJMM waste management by-laws, more than half of the respondents (54%) reported a neutral position, indicating uncertainty or lack of familiarity. This was followed by respondents who agreed that they were aware of such by-laws (27.9%), while a smaller proportion disagreed (11.6%), reflecting mixed levels of awareness among respondents. This reflects mixed awareness of waste management bylaws, which is notable given that compliance is required for formal businesses.

The majority of respondents agree (65,1%), and there is another majority of respondents who strongly agree (32,6%). This indicates a significant gap in awareness of FVW's valorisation methods, rather than disposal, which is the least friendly method considering the negative impacts FVW have on the environment, economy, and public health. In relation to the disposal of FVW as the only effective waste management method, most respondents indicated agreement (65.1%) and strong agreement (32.6%) with statements reflecting limited knowledge of valorisation methods compared to disposal practices. This suggests that awareness of alternative FVW valorisation options remains low among respondents.

C. Formal Retailers' FVW Practices

The researcher made some amendments to the questions used to determine the formal retailers' FVW management practices. This was because some questions were not relevant to an informal setting; however, they can be addressed in the formal retail sector.

As seen in *Figure 2*, the common practice among formal retailers for disposing of FVW is to use a disposal bin (94%), followed by those who send it to processing plants (4.7%), and then those who donate it (1.3%). This shows a variety of approaches; however, sustainable methods like donation and repurposing are underutilized, indicating limited adoption of eco-friendly disposal options for FVW. This is also supported by the question *"Disposal of fruit and vegetable waste as the only effective waste management method,"* which confirms that disposal is the standard practice in the retail sector when handling FVW.

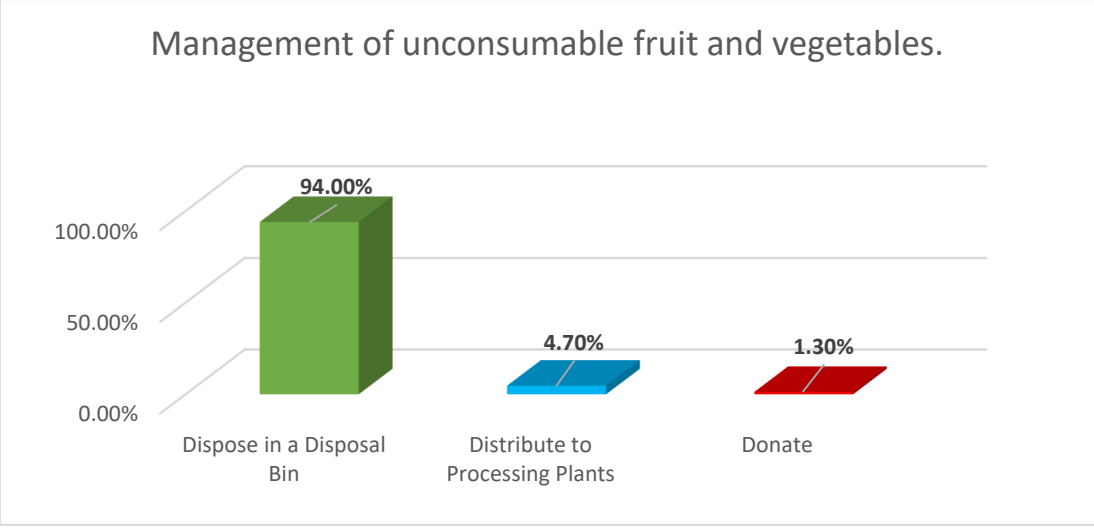

Figure 2. *Management of unconsumable fruit and vegetables.*

Table 6. Formal retailers' FVW practices.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total

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Fruit and vegetable waste is supposed to be mixed with other waste types when disposed of	Row N %	4,7%	0,0%	72,1%	9,2%	14,0%	100,0%
I store fruit and vegetables in suitable conditions	Row N %	55,8%	44,2%	0,0%	0,0%	0,0%	100,0%
I am inducted on ways to minimise fruit and vegetable waste	Row N %	27,9%	69,8%	0,0%	2,3%	0,0%	100,0%

When asked whether FVW should be mixed with other waste types, the majority of respondents selected a neutral response (72.1%), as seen in Table 6: Formal retailers' FVW practicesTable 6. This was followed by respondents who disagreed (9.2%) and strongly disagreed (14%), indicating varied positions regarding FVW segregation practices. A strong consensus was observed regarding storage practices, with most respondents either strongly agreeing (55.8%) or agreeing (44.2%) that fruit and vegetables were stored under suitable conditions. Similarly, most respondents reported having received induction on ways to minimise FVW, with 69.8% agreeing and 27.9% strongly agreeing that such training had been provided as part of corporate policies.

The researchers further administered two questions to formal retailers that were used to corroborate the responses received from the question *"induction on ways to FVW."*

Figure 3 illustrates variability in how stores manage unsold stock. The most common practice was marking down products (37.2%), followed by donation (23.3%), while a smaller proportion returned stock to storage (11.5%). Disposal was reported by 18.6% of respondents, indicating a need for consistent training and government authority involvement to halt an unsustainable culture in retail environments

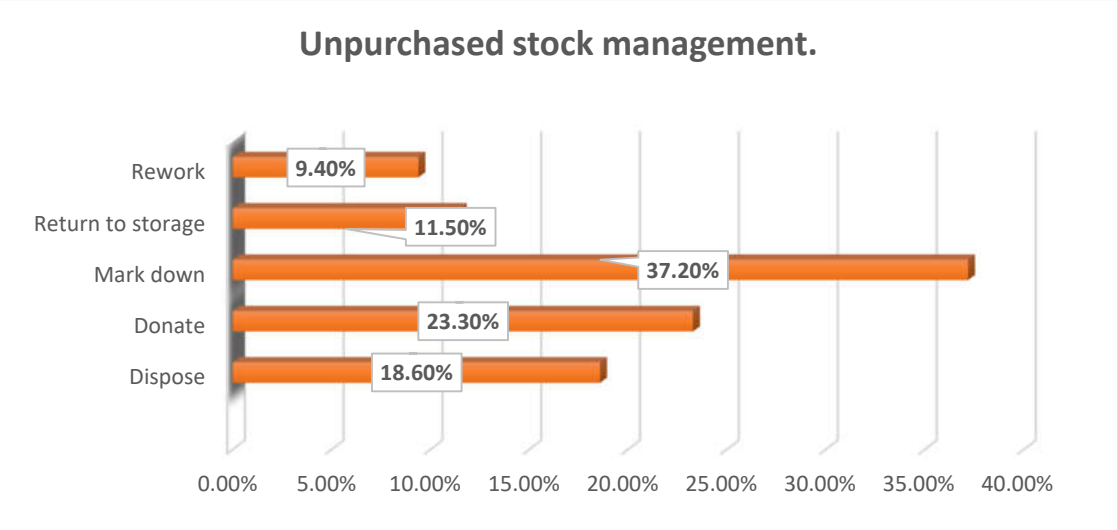

Figure 3. *Unpurchased stock management.*

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Figure 4 shows whether there was a tendency to store more stock than required in stores; over half (55.8%) reported that they stocked only what was needed, while 44.2% indicated that they did overstock. This represents a persistent inventory mismanagement at certain outlets, despite high positive practices.

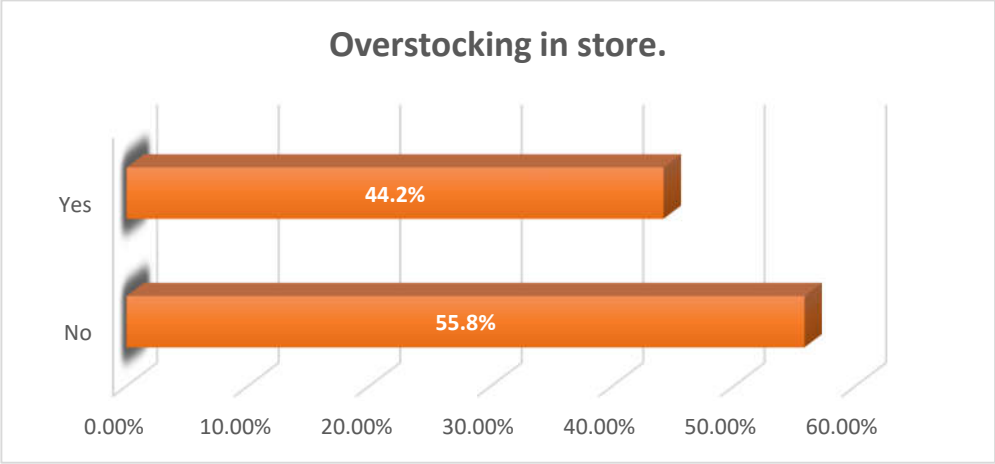

Figure 4. *Overstocking in store.*

4. DISCUSSION

4.1. Demographics of Respondents

The demographic profile observed in this study reflects patterns commonly observed in LMIC urban food systems. The dominance of male participants in the informal sector mirrors gendered labour dynamics reported in studies conducted in South Africa and Bangladesh, where informal street trading is often male-dominated [11,23]. Higher female participation in the formal retail sector is evidence that the formal retail sector offers more structured and accessible employment opportunities. A similar demographic profile was observed in a study conducted in Ghana, whereby females dominated the formal work force [6].

The age distribution of respondents further reflects retail food trade as an important tool in the livelihood of populations in LMIC cities. Informal retailers were mostly middle-aged, relying largely on experiential knowledge, while formal retailers were generally younger and more likely to be exposed to better educational attainments. Previous studies suggest that younger, formally employed workers have a higher degree of environmental concern and environmentally responsible behaviour [2]. This suggests that formal retailers may be more receptive to structured waste management initiatives. However, such exposure does not necessarily guarantee the adoption of sustainable practices in the absence of supportive governance frameworks.

There are observed educational disparities between informal and formal retailers, with informal retailers mostly possessing primary or no formal education, while formal retailers commonly possess secondary or tertiary qualifications. However, the prevalence of disposal-dominated practices among better-educated formal retailers suggests that governance failures are primarily structural rather than individual.

4.2. Fragmentation in FVW Governance Across Retail Systems

The findings show that FVW governance in COJMM is characterised by fragmentation across formal and informal retail systems, a trait commonly reported in LMIC urban contexts [5]. Informal retailers are largely disconnected from municipal waste governance mechanisms, while formal retailers operate within structured corporate and regulatory environments dictated at head office levels. This dichotomy mirrors literature from other LMIC cities where waste governance frameworks tend to favour formal actors, resulting in uneven implementation and ineffective waste management systems [26].

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The reported lack of awareness of COJMM waste by-laws among informal retailers, concurrently with mixed awareness dominated by uncertainty among formal retailers, suggests that regulatory instruments alone are insufficient to ensure effective governance. On-the ground enforcement by authorities is required to ensure a consistent awareness and implementation of these bylaws by retailers. According to a study conducted in Uganda, Kampala, there was a display of how poor communication, limited enforcement capacity, and the exclusion of informal actors undermine urban waste governance outcomes, even where policy frameworks formally exist [22].

4.3. Prevalence of Disposal-Oriented Practices

Regardless of moderate to high awareness of the impacts of poor FVW management, especially among formal retailers, disposal remains the prevalent FVW management approach across both sectors. This awareness–practice gap has been widely highlighted in LMIC food systems research, where structural and institutional constraints limit the adoption of sustainable practices regardless of individual awareness levels [24].

This observed disposal-oriented practice suggests that COJMM's challenges are not primarily behavioural but systemic. A study conducted in Nigeria reported that limited access to waste valorisation infrastructure, weak incentives, and cost-driven operational priorities constrain the ability to move beyond disposal, reinforcing unsustainable waste management pathways [25].

The strong perception among respondents that disposal remains the only effective method for managing FVW reflects a broader governance norm in COJMM, where waste systems remain primarily reliant on collection and landfill disposal. This finding aligns with global assessments indicating that separation and organic waste valorization are less recognized in many LMIC urban settings [20].

The underutilization of donation and repurposing methods among formal retailers when managing FVW further supports evidence that such alternatives are constrained by inadequate institutional support, logistical barriers, and limited coordination between retailers and municipalities. COJMM experience, therefore, reflects structural barriers that are common across LMIC urban food waste systems rather than isolated local failures.

4.4. Informal Retailers and Structural Exclusion from Waste Governance

The evident gaps in induction and training on FVW minimisation practices among informal retailers underscore their ongoing exclusion from formal waste governance structures. Similar patterns have been reported in Kenya and Bangladesh, where informal retailers operate in regulatory grey zones and have limited technical or institutional support for sustainable waste management [26].

Significantly, the observed practices within the informal sector should be interpreted within the context of constrained operating environments. Previous studies highlight that a lack of storage infrastructure, limited access to effective waste management services, and inconsistent municipal support significantly affect waste generation and disposal behaviours in the informal retail sector [20]. These findings imply that failure in governance does not emerge from unwillingness to comply, but from structural neglect within urban waste management systems.

4.5. Persistence of Inefficiencies in Formal Retail Practices

Although formal retailers demonstrated stronger storage practices and reported higher exposure to FVW minimisation training, the continued reliance on disposal and the existence of overstocking practices in a substantial proportion of outlets highlight persistent inefficiencies. Monitoring and support from relevant authorities can translate formal retailers' strong practices and inductions into actions that align with the circular economy principles. A study conducted in Ghana indicated a lack of effective monitoring and supervision from authorities as a driver of ineffective management systems [24].

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The coexistence of internal FVW minimisation policies with disposal-dominated practice reinforces the argument that governance challenges extend beyond individual retailers. This poor governance thereby influences the adoption of unsustainable practices by formal retailers. This supports the argument from studies suggesting that a lack of municipal involvement in store policy implementation or the absence of relevant national policies and regulations is a driver of limited adoption of circular economy practices among formal retailers [12].

4.6. COJMM as a Microcosm of Broader LMIC Urban FVW Governance Failure

Collectively, these findings display that FVW governance challenges in COJMM reflect broader systemic failures commonly observed in LMIC cities. The concurrent existence of policy frameworks, partial awareness, and persistent unsustainable practices across both formal and informal retail sectors underscores the limitations of existing governance systems. The researchers argue that successful FVW governance within a municipality cannot be achieved solely through the existence of policies and supporting systems implemented by municipal authorities. High levels of awareness and the adoption of strong, sustainable practices among retailers are also necessary to ensure an effective FVW governance system.

Previous studies on LMIC urban waste governance accentuate the need for integrated, inclusive, and capacity-sensitive governance approaches that bridge formal–informal disconnect, strengthen municipal–retailer engagement, and expand infrastructure for FVW separation and valorization [1,10,13]. The evidence from COJMM supports this body of literature, situating the city as a representative case through which broader urban FVW governance failures in LMIC can be examined.

5. CONCLUSION

This study investigated FVW governance within the COJMM by assessing awareness levels and management practices of FVW among both formal and informal retailers. The findings highlight that FVW governance in COJMM is characterized by fragmented implementation, limited awareness of municipal waste management by-laws, and a consistent reliance on disposal as a primary practice across both retail sectors. Despite the higher awareness levels and exposure to FVW minimization training displayed by formal retailers, practices such as FVW valorization and donation remained underutilized. Informal retailers displayed significant gaps in awareness and FVW training, accentuating their exclusion from formal waste governance systems. The study contributes to the limited research on FVW governance in the retail sector, particularly within African metropolitan contexts where informal food sectors are fundamental to urban food distribution. The study's focus on both formal and informal retailers offers a more comprehensive understanding of governance dynamics and underscores the need for inclusive and integrated FVW management strategies. Overall, the findings highlight that unsustainable FVW management in COJMM is mostly influenced by structural governance issues, including weak enforcement by authorities, limited institutional involvement, and inadequate FVW diversion infrastructure. These insights position COJMM as a microcosm of broader urban FVW governance challenges experienced by LMIC, underscoring the importance of inclusive, comprehensive, and capacity-aware governance approaches that elevate municipal–retailer engagement and promote sustainability through the adoption of FVW prevention strategies and valorization technologies.

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Abbreviations

The following abbreviations are used in this manuscript:

LMIC	Low- and Middle-Income Countries
FVW	Fruit and Vegetable Waste
FV	Fruit and Vegetables
COJMM	City of Johannesburg Metropolitan Municipality
CBD	Central Business District

References

1. Abdulai, I.A.; Fuseini, M.N.; File, D.J.M.B. Making cities clean with collaborative governance of solid waste infrastructure in Ghana. *Cleaner Waste Syst.* **2024**, *8*, 1100150.
2. Alam, M.M.; Zakaria, A.F.M. A probit estimation of urban bases of environmental awareness: Evidence from Sylhet City, Bangladesh. *arXiv* **2021**.
3. Ambuko, J.L.; Masakhwe, S.M.; Amwoka, E.; Mujuka, E.; Fabi, C. Food loss and waste data gaps in fruit and vegetable value chains: A review of the literature. *Front. Hortic.* **2025**, *4*, 1529040.
4. Batool, F.; Kurniawan, T.A.; Mohyuddin, A.; Othman, M.H.D.; Aziz, F.; Al-Hazmi, H.E.; Goh, H.H.; Anouzla, A. Environmental impacts of food waste management technologies: A critical review of life cycle assessment studies. *J. Clean. Prod.* **2023**, *342*, 130877.
5. Colozza, D. Determinants of food retail outlet choice in an urban food environment: A qualitative study in Indonesia. *BMC Public Health* **2025**, *25*, 3737.
6. Crabbe, M.J.; Acquaah, M. The determinants of service recovery performance in the retail industry in Ghana. *Afr. J. Econ. Manag. Stud.* **2016**, *7*, 54–74.
7. Cunningham, S.A.; Muir, J.A. Data cleaning. In The Cambridge Handbook of Research Methods and Statistics for the Social and Behavioral Sciences: Volume 1: Building a Program of Research; Nichols, A.L., Edlund, J., Eds.; Cambridge University Press: Cambridge, UK, **2023**; pp. 443–467.

 doi:10.20944/preprints202602.1183.v1

8. De Bruin, S.; Dengerink, J.; Van Vliet, J. Urbanisation as driver of food system transformation and opportunities for rural livelihoods. *Food Security* **2021**, *13*, 781–798.
9. Grangxabe, X.S.; Madonsela, B.S.; Maphanga, T.; Gqomfa, B.; Phungela, T.T.; Malakane, K.C. An overview of waste management practices of street vendors in sub-Saharan Africa: A meta-analysis. *SSRN* **2024**.
10. Hossain, I.; Haque, A.K.M.M. A systematic and bibliometric review on urban governance and circular economy pathways for municipal solid waste management in South Asia. *Discover Cities* **2026**, *3*, 13.
11. Hossen, M.T.; Ferdaus, M.J.; Hasan, M.M.; Lina, N.N.; Das, A.K.; Barman, S.K.; Paul, D.K.; Roy, R.K. Food safety knowledge, attitudes and practices of street food vendors in Jashore region, Bangladesh. *Food Sci. Technol.* **2021**, *41*, 226–239.
12. Kadhila, T.; de Wit, M.P.; Schenck, R. A conceptual framework for sustainable waste management in small municipalities: The cases of Langebaan, South Africa and Swakopmund, Namibia. *Environ. Sci. Pollut. Res.* **2023**, *30*, 125088–125103.
13. Kala, K.; Bolia, N.B. Empowering the informal sector in urban waste management: Towards a comprehensive waste management policy for India. *Environ. Dev.* **2024**, *49*, 100968.
14. Kalitanyi, V. Assessing green practices awareness among fruit and vegetable street vendors in Johannesburg. *J. Contemp. Manag.* **2021**, *19*, 399–420.
15. Letlape, B.; Trynos, D. The role of innovations in municipal solid waste management to attaining sustainable cities: Case of City of Johannesburg. In Proceedings of the SAPI Conference 2016, Johannesburg, South Africa, **2016**; University of Johannesburg
16. Malungane, M.; Wegerif, M.C.A. The Johannesburg fresh produce market: An analysis of its operations and contribution to the food system. *Front. Sustain. Food Syst.* **2025**, *9*, 1557007.
17. Maphanga, T.; Madonsela, S. Evaluating waste management practices of street vendors in the informal settlement of Cape Town: A case study of Khayelitsha. Master's Thesis, University of the Western Cape, Bellville, South Africa, **2023**.
18. Meegoda, J.N.; Chande, C.; Bakshi, I. Biodigesters for sustainable food waste management. *Waste Manag.* **2021**, *134*, 145–157.
19. Mgwenya, A. Joburg's landfills almost at capacity. *Wits Vuvuzela* **2023**. Available online: https://witsvuvuzela.com/2023/12/20/joburgs-landfills-almost-at-capacity/ (accessed on 28 January 2026).
20. Mmereki, D.; David, V.E.; Brownell, A.H.W. The management and prevention of food losses and waste in low- and middle-income countries: A mini-review in the Africa region. *Waste Manag. Res.* **2024**, *42*, 287–307.
21. Mpanang'ombe, W.; Mallory, A.; Tilley, E. Poverty, politics and plastic: Organic waste sorting in Blantyre's public markets. *J. Urban Manag.* **2021**, *10*, 192–204.
22. Muheirwe, F.; Kombe, W.J.; Kihila, J.M. Solid waste collection in the informal settlements of African cities: A regulatory dilemma for actor participation and collaboration in Kampala. *Int. J. Urban Sustain. Dev.* **2023**.
23. Ndhlovu, T.; Tabit, F.T. An investigation of the food safety knowledge of street food vendors and sanitary conditions of their vending sites. *Int. J. Environ. Res. Public Health* **2024**, *21*, 212.
24. Obuobi, B.; Zhang, Y.; Adu-Gyamfi, G.; Nketiah, E.; Grant, M.K.; Adjei, M.; Cudjoe, D. Fruits and vegetable waste management behavior among retailers in Kumasi, Ghana. *J. Retail. Consum. Serv.* **2022**, *67*, 102971.
25. Omokaro, G.O.; Michael, I.; Efeni, O.S.; Adeyanju, O.I.; Obomejero, J. Waste management in Nigeria: Systemic failures, circular economy pathways and sustainable solutions. *Environ. Dev.* **2025**.
26. Pedrotti, M.; Fattibene, D.; Antonelli, M.; Castelein, B. Approaching urban food waste in low- and middle-income countries: A framework and evidence from case studies in Kibera (Nairobi) and Dhaka. *Sustainability* **2023**, *15*, 3293.
27. Rudziak, P.; Batung, E.; Luginaah, I. The effects of gases from food waste on human health: A systematic review. *PLoS ONE* **2024**, *19*, e0300801.
28. South African research warns of declining municipal market share. *FreshPlaza* **2026**. Available online: https://www.freshplaza.com/asia/article/9790528/south-african-research-warns-of-declining-municipal-market-share/ (accessed on 28 January 2026).
29. WWF South Africa. *Food Loss and Waste: Facts and Futures*; WWF South Africa: Cape Town, South Africa, 2017. Available online: https://www.wwf.org.za/food-loss-and-waste-facts-and-futures (accessed on 29 January 2026).

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