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Research Article

Urban Agriculture Waste Management Practices and Community Environmental Perceptions in Osun State, Nigeria

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ABSTRACT

This study assessed the waste management practices among urban farmers and explored the perceptions of residents on environmental changes associated with nearby farms in Osun State, Nigeria. The study adopted a mixed methods approach that included data from 390 urban farms and 310 nearby residents. Descriptive and inferential statistics were used to analyse quantitative data, while thematic analysis was used to analyse qualitative data. The findings highlight a structural infrastructural deficit. Dedicated waste disposal facilities are only present in 12.6% of farm neighbourhoods with near-zero adequacy and condition index scores (FAI = 0.30 and FCI = 0.26, respectively). Consequently, urban farmers resort to informal waste collection systems (55.6%), open dumping (35.4%), burning (33.3%), and most significantly, water body disposal (22.8%). The results of the Chi-square analysis showed that waste disposal practices are uniform with the exception of government refuse vans utilisation, which showed a significant variation across urban centres (x^2 = 8.963, df = 2, p = 0.011 < 0.05). Residents perceive an overwhelming negative impact of farms on the environment (66.8%), with 60.3% reporting that air quality has worsened, and 65.5% identifying waste management as the most critical environmental issue related to proximate farms. The study reveals that urban agriculture waste governance in Osun State is beset by institutional neglect, regulatory invisibility, and infrastructure deficiency. Mandatory farm registration, the provision of dedicated waste infrastructure, improving local waste collection, and enforcing environmental standards are recommended as policy measures to mitigate the uneven distribution of the environmental costs of urban agriculture.

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1 Introduction

Urban agriculture has emerged as an important and growing land use phenomenon across urban centres in sub-Saharan Africa, driven by rapid urbanisation, increasing food insecurity, unemployment and intensifying informality of urban economies (Kiribou et al., 2024; Nasser & Adam, 2024). In Nigerian cities specifically, agriculture has grown beyond a mere survival means and has transitioned into a sophisticated livelihood strategy encompassing crop farming, animal rearing, aquaculture, horticulture and mixed farming (Wahab et al., 2018; Akinnagbe & Ipinmoye, 2022). These activities improve household food security, income generation, and local food value chains (Ola, 2020; Onyenekwe et al., 2025). The sector's expansion has been particularly prominent in secondary Nigerian cities, where peri-urban farming space, proximity to urban markets and limited formal jobs intersect to provide enabling settings for urban agriculture as a primary or supplementary livelihood activity (Hatzenbuehler et al., 2023).

Although productive contributions and food security benefits of urban agriculture in Nigeria have been explored, Okafor and Mgbenwelu (2023) argue that its environmental management components, especially waste management concerns, have received less analytical focus. As noted by Nigussie et al. (2015), urban farms produce significant amounts of waste such as animal manure, carcase waste, feed residue, wastewater effluent, plastic packages and crop residues. In the absence of proper waste management infrastructure and regulatory control, these waste streams pose serious environmental health concerns to farming communities and neighbouring residents (Hallett et al., 2016).

Waste disposal practices such as open dumping, uncontrolled burning, drainage discharge and disposal into water bodies have been documented in urban farming settings across African urban centres (Menyuka et al., 2020). These practices contribute to particulate pollution, groundwater contamination, and disease vector breeding. This has resulted in environmental degradation with a disproportionate burden to low-income residential communities closest to the farm sites (Okwoyo et al., 2019).

Community perception of these environmental impacts is a critical but less researched facet of urban agriculture governance (Okafor & Mgbenwelu, 2023). The environmental costs and benefits of agricultural activities are borne by nearby residents, but their experiences and perceptions are rarely systematically recorded or included in planning processes (Battersby & Watson, 2020).

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Understanding the perception of communities to farm-related waste and environmental changes is significant in designing socially legitimate governance interventions grounded in the community context. This helps in tackling the equity component of neighbourhood-level effects of urban agriculture.

In Osun State, Nigeria, urban agriculture takes place primarily with limited regulatory oversight, as the majority of farmlands are not approved by the government authorities or have no specific waste management systems or environmental compliance mechanisms (Gasu et al., 2025). There is substantial and increasing number of urban farming practices across different urban centres of the state, including Osogbo, Iwo and Ile-Ife. These urban centres vary in administrative status (Osogbo is the state capital, while Iwo and Ile-Ife are lesser cities), economic base and urban structure, offering a critical comparative framework to understand how local context influences waste management practices and environmental outcomes. Thus, this study seeks to assess waste management practices of urban farms and community perceptions of these practices across the three cities.

The study aims to fill the identified knowledge gap by exploring these research objectives:

i. identify the availability, adequacy and condition of waste management infrastructure in urban farm neighbourhoods in the three urban centres;
ii. examine the waste storage and disposal methods used by urban agriculture practitioners;
iii. determine if there is a significant difference in waste disposal practices across cities; and
iv. assess residents' perceptions of waste-related environmental changes linked to proximate farming activities.

Drawing on primary data gathered from 390 urban farms and 310 proximate residents across the three cities, the study offers a comparative analysis, adding empirical evidence to existing literature on urban agriculture and environmental governance in Nigerian cities.

2 Materials and Methods

2.1 Study Area

The study was carried out across three urban centres in Osun State, southwestern Nigeria, namely Osogbo, Iwo and Ile-Ife (Figure 2). Osun State is located between latitudes 7°30'N and 8°00'N and longitudes 4°00'E and 4°45'E with a total land area of about 9,251 square kilometres, and an estimated population of 4.7 million (City Population, 2026). Osun state (Figure 1) predominantly belongs to the Yoruba speaking ethnic tribe and is characterised by a tropical climate with varying wet and dry seasons that majorly determine the nature of urban agricultural activities (Lasisi et al., 2017).

Osogbo, the state capital, functions as the administrative, commercial and cultural centre of the State. With a projected population of more than 400,000 people, Osogbo is the most urbanised city in the state, and home to the highest density of civil servants, market traders and informal sector operators who are involved in supplementary farming (Oyetoro & Adewole, 2025).

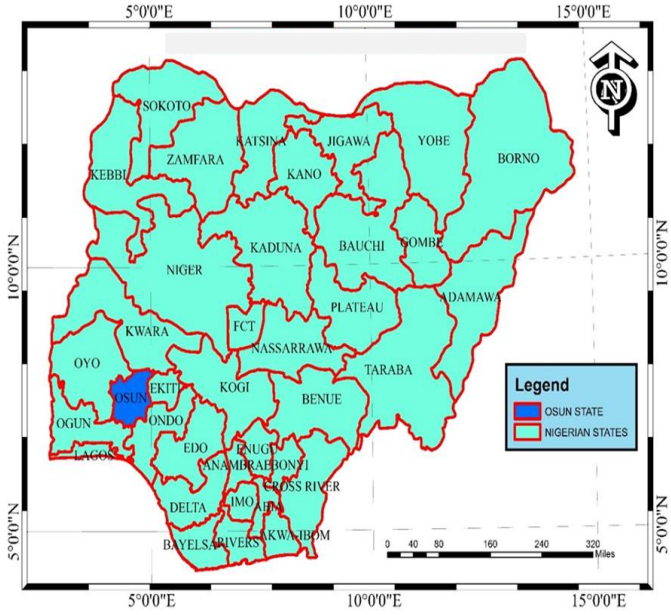

Figure 1: Osun State within the context of Nigeria
Source: National Space Research and Development Agency (NASRDA), 2023

Iwo is a historic town located about 55 kilometres northwest of Osogbo, with a great tradition of commercial agricultural activities. The urban agricultural sector is characterised by high animal husbandry operation density (especially poultry and goat farming). Ile-Ife, located about 90 kilometres southeast of Osogbo, is a University City and the home of the ancestral spirits of the Yoruba people. The urban agricultural system is also influenced by the presence of Obafemi Awolowo University, which draws institutional demand for food products and also supports a relatively better-educated farming populace. The three cities were purposively selected to cover the diversities of urban context in Osun State, one from each senatorial district, which would provide meaningful comparative analysis of waste management practices across the diversities of urban typologies.

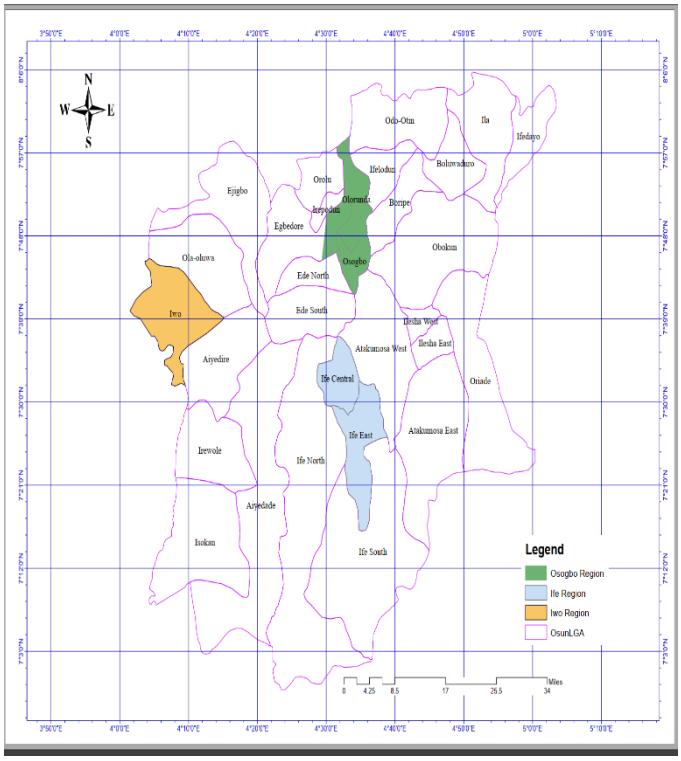

Figure 2: Selected urban centres within the context of Osun State

Source: NASRDA, 2023

2.2 Research Design and Data Collection

The study employs a mixed-methods research design, which combines quantitative survey data with qualitative findings from focus group discussions and key informant interviews. The mixed methods approach was deemed suitable for this study owing to the dual analytical focus on practitioner waste management practices suitable for quantitative measurement, and the lived perceptions by residents, which necessitated qualitative exploration to provide depth, nuances, and context to community experience (Creswell & Creswell, 2018).

The study population consisted of two groups: urban agriculture practitioners operating in the three urban centres and proximate residents who live close to the urban farm sites. The sampling frame was drawn from urban farm registers maintained by the ten urban agricultural associations recognised by the Osun State Ministry of Agriculture and Food Security, from which a systematic random sample of 15% was selected, resulting in a total sample of 390 urban farms across the three cities of Osogbo, Iwo, and Ile-Ife, with 139,131, and 120 farms, respectively. A stratified random sampling method was used for proximate residents. Distance from farm site was used as a criterion for stratification with households e stratified into three distance zones: 0–50 metres, 51–150 metres, and 151–350 metres, respectively, yielding a total of 310 residents across the 3 cities, Osogbo (n = 105), Iwo (n = 121), and Ile-Ife (n = 84).

Quantitative data were gathered from practitioners using structured questionnaires. The questionnaire contained closed-ended questions on socio-economic characteristics, waste storage methods, waste disposal practices, and facility availability. Qualitative data were gathered through six focus group discussions (FGDs) with 8–10 participants each (total n = 54), and six key informant interviews (KIIs) with community leaders and resident association executives, purposively selected based on farming experience (≥3 years) and knowledge of farm-community relations. The FGD and KII contained open-ended questions on motivations, constraints, waste management, and environmental perceptions.

2.3 Data Analysis

Quantitative data were analysed using IBM SPSS Statistics version 25. Descriptive statistics, including frequencies, percentages, and cross-tabulations, were computed for waste management variables. Chi-square tests of association were performed to assess if there was a significant difference in waste disposal methods across the three urban centres at 5% significance level.

Thematic analysis was used to analyse the qualitative data obtained from FGDs and KIIs, and followed the 6-phase framework of Braun and Clarke (2006): data familiarisation, initial code generation, theme development, theme review, definition and naming of themes, and report production. Thematic analysis was manually conducted with themes developed inductively from data rather than imposed from a predetermined framework. This ensured that analytical components were grounded in participants' own conceptual language and experience. Qualitative findings are reported as illustrative quotes embedded in the results and discussion and used to explain and elaborate on the quantitative results.

3 Results

3.1 Waste Management Infrastructure in Urban Farm Neighbourhoods

Assessment of available infrastructure to support environmentally appropriate waste handling was done as a prerequisite to understand waste management practices among urban agriculture practitioners. The availability of selected waste management-related facilities in the three urban centres is presented in Table 1, while the computed Facility Adequacy Index (FAI) and Facility Condition Index (FCI) is presented in Tables 2 and 3, respectively.

Table 1 reveals that water supply and drainage facilities are available across majority of farm neighbourhoods (95.9% and 93.8% respectively), while sanitary facilities are present in 69.2% of farm sites. In contrast, about nine out of ten urban farms in the three cities do not have any facilities for waste storage or disposal, with only 12.6% equipped with dedicated facilities.

Table 1: Availability of Waste Management-Related Facilities in Urban Farm Neighbourhoods

S/N	Facility	Yes	%	No	%	Total
1	Drainage facilities	366	93.8	24	6.2	390
2	Sanitary facilities	270	69.2	120	30.8	390
3	Water supply	374	95.9	16	4.1	390
4	Waste disposal facilities	49	12.6	341	87.4	390

According to the results of the four facilities assessed, water supply has the highest adequacy score (FAI = 2.64), followed by drainage facilities (FAI = 2.05), sanitary facilities (FAI = 1.81), and drainage facilities (FAI = 1.76). However, none of the three FAI scores are above the five-point midpoint scale. This shows that that even the most available facilities are considered less than satisfactory for farm operational requirements. Waste disposal facilities have the lowest FAI of all facilities (0.30), owing to the almost universal lack of these facilities.

Table 2: Facility Adequacy Index (FAI) of Waste Management-Related Facilities

S/N	Facility	VA(5)	A(4)	IN(3)	I(2)	VI(1)	SWV	FAI
1	Drainage facilities	38	128	33	114	53	801	2.05
2	Sanitary facilities	37	39	26	114	54	707	1.81
3	Water Supply	51	54	37	134	98	1030	2.64
4	Waste disposal facilities	9	4	19	10	7	118	0.30

Note: VA = Very Adequate, A = Adequate, IN = Indifferent, I = Inadequate, VI = Very Inadequate SWV = Sum of Weighted Values, FAII = Facility Adequacy Index (scale 0–5)

The FCI results shown in Table 3 are similar. Here, water supply recorded the highest condition score (FCI = 2.53), flowed by drainage facilities (FCI = 1.97), sanitary facilities (FCI = 1.63) while waste disposal facilities (FCI = 0.26) recorded the lowest score. Notably, water supply has the relatively highest scores for both adequacy and condition but its FCI is still below the 50 percentiles on scale, meaning even this best available facility has only moderate physical condition among farm neighbourhoods. None of the waste-related infrastructure categories in the study area records an adequate or good standard as shown by all four facilities having FAI and FCI values below 3.00.

The findings from the focus group discussions corroborate the quantitative finding of infrastructure. Lack of waste collection facilities and disposal equipment were repeatedly noted by residents as a major factor contributing to environmental issues they had with the nearby farms. In an FGD with a community development association in Osogbo, one of the residents said:

"The farm in this area do not have a facility to put the waste properly. No government bin, no collection. So, they just burn it or throw it anywhere. The smell is what wakes us up in the morning."

Table 3: Facility Condition Index (FCI) of Waste Management-Related Facilities

S/N	Facility	VG(5)	G(4)	F(3)	P(2)	VP(1)	SWV	FCI
1	Drainage facilities	70	72	44	124	56	768	1.97
2	Sanitary facilities	35	43	22	96	74	635	1.63
3	Water Supply	51	54	37	134	98	985	2.53
4	Waste disposal facilities	8	5	11	20	5	101	0.26

Note: VG = Very Good, G = Good, F = Fair, P = Poor, VP = Very Poor SWV = Sum of Weighted Values, FCII = Facility Condition Index (scale 0–5)

3.2 Waste Storage Methods

Table 4 presents the waste storage methods utilised by urban agriculture practitioners in Osun State. Sacks are the most common waste storage method across all three cities with 71.3% of practitioners using them. This dominance is uniform across Osogbo (74.1 %), Ile-Ife (71.7 %) and Iwo (67.9 %), where sack-based storage is a near universal baseline practice irrespective of the context of these cities. In addition to sacks, more than half (63.3%) of the practitioners use waste bins, followed by concrete bunkers (60.0%) and drums (58.2%).

Open buckets are used by 54.6% of practitioners across the 3 cities which is a huge ecological concern owing to it open structure. This is due to the fact that open containers also serve as breeding sites for flies, rodents and insects, and produces odours from decomposing organic material, posing a spillage and runoff problem during rainfalls. The percentage of open bucket adoption is highest in Osogbo (58.3%) reflecting a high proportion of animal husbandry operations that produce huge amount of liquid organic wastes.

Adoption rates for baskets and manure pits are almost the same (46.7% and 46.4%, respectively). Baskets are more widely used in Iwo (51.9%), highlighting the urban centre's higher proportion of crop and mixed farming practices where solid organic waste are collected using baskets. Manure puts recorded higher utilisation in Ile-Ife (49.2%), and Osogbo (48.2%) than in Iwo (42%). This is in line with the higher proportion of large animal husbandry operations in these cities, which produce larger amounts of manure liquid waste.

Compost heaps record the lowest adoption rate of all eight storage methods (41.3%), with Iwo recording the weakest uptake (35.1%) and Osogbo the highest (46.8%). The low adoption of composting in all three cities is a noteworthy result because composting is the most ecologically sound approach to storing and transforming waste providing soil-fertilizing inputs, while minimising odour, runoff and vector attraction, but usually require high farming skills and efforts.

Table 4: Waste Storage Methods Used by Urban Agriculture Practitioners

Waste Storage Method		Osogbo	Iwo	Ile-Ife	Total
Sacks	Frequency	103	89	86	278
	% within category	74.1	67.9	71.7	71.3
	% across categories	37.1	32.0	30.9	100.0
Waste Bins	Frequency	94	78	75	247
	% within category	67.6	59.5	62.5	63.3
	% across categories	38.1	31.6	30.4	100.0
Concrete Bunkers	Frequency	84	79	71	234
	% within category	60.4	60.3	59.2	60.0
	% across categories	35.9	33.8	30.3	100.0
Drums	Frequency	82	72	73	227
	% within category	59.0	55.0	60.8	58.2
	% across categories	36.1	31.7	32.2	100.0
Open Bucket	Frequency	81	68	64	213
	% within category	58.3	51.9	53.3	54.6
	% across categories	38.0	31.9	30.0	100.0
Basket	Frequency	55	68	59	182
	% within category	39.6	51.9	49.2	46.7
	% across categories	30.2	37.4	32.4	100.0
Manure Pits	Frequency	67	55	59	181
	% within category	48.2	42.0	49.2	46.4
	% across categories	37.0	30.4	32.6	100.0
Compost Heaps	Frequency	65	46	50	161
	% within category	46.8	35.1	41.7	41.3
	% across categories	40.4	28.6	31.1	100.0
Total	Frequency	631	555	537	1723
	% within category	100.0	100.0	100.0	100.0
	% across categories	36.6	32.2	31.2	100.0

Note: Percentages exceed 100% as respondents could select multiple methods

Plate 1: An example of a drum at a rabbit farm serving as waste storage facility in Osogbo

Plate 2: An example of a sack serving as waste storage facility in a poultry farm in Ife

Plate 3: An open bucket serving as a waste storage facility in a fish farm in Iwo

Plate 4: A concrete bunker serving as a waste storage facility in a fish farm in Iwo

3.3 Waste Disposal Methods

The disposal methods employed by urban agriculture practitioners across the three urban centres is shown in Table 5. The most prevalent disposal method is informal waste collected adopted by 55.6% of practitioners, and is equally prevalent in the three urban centres (56.8% in Osogbo, 55.0% in Iwo, and 55.0% in Ile-Ife). The widespread adoption of Informal waste collectors for most farmers in the study area indicates the informal operating status of urban farms, making them inaccessible to formal municipal waste collection services.

Table 5: Waste Disposal Methods Used by Urban Agriculture Practitioners

Waste Disposal Method		Osogbo	Iwo	Ile-Ife	Total
Informal Waste Collector	Frequency	79	72	66	217
	% within category	56.8	55.0	55.0	55.6
	% across categories	36.4	33.2	30.4	100.0
Designated Refuse Dumps	Frequency	67	59	62	188
	% within category	48.2	45.0	51.7	48.2
	% across categories	35.6	31.4	33.0	100.0
Open Space / Vacant Plots	Frequency	47	43	48	138
	% within category	33.8	32.8	40.0	35.4
	% across categories	34.1	31.2	34.8	100.0
Bushes Along Roadsides	Frequency	39	38	33	110
	% within category	28.1	29.0	27.5	28.2
	% across categories	35.5	34.5	30.0	100.0
Road Median	Frequency	43	32	28	103
	% within category	30.9	24.4	23.3	26.4
	% across categories	41.7	31.1	27.2	100.0
Burning	Frequency	49	42	39	130
	% within category	35.3	32.1	32.5	33.3
	% across categories	37.7	32.3	30.0	100.0
Government Refuse Van	Frequency	71	47	39	157
	% within category	51.1	35.8	32.5	40.3
	% across categories	45.2	29.9	24.8	100.0
Inside Drainage	Frequency	52	51	48	151
	% within category	37.4	38.9	40.0	38.7
	% across categories	34.4	33.8	31.8	100.0
Water Bodies	Frequency	32	28	29	89
	% within category	23.0	21.4	24.2	22.8
	% across categories	36.0	31.5	32.6	100.0
Total	Frequency	479	412	392	1283
	% within category	100.0	100.0	100.0	100.0
	% across categories	37.3	32.1	30.6.	100.0

Note: Percentages exceed 100% as respondents could select multiple methods

The second most environmentally structured formal dispose option available to practitioners is designated refuse dumps (48.2%). The highest rate of designated dump use is recorded in Ile-Ife (51.7%) while Iwo have the lowest (45.0%). Also, dumping waste inside drainage was used as a method by 38.7% of practitioners with similar patterns in Osogbo (38.7%), Iwo (38.9%), and Ile-Ife (40%). Furthermore, 40.3% of practitioners access government refuse van services but there is significant variation in this by city, with Osogbo (51.1%), Iwo (35.8%), and Ile-Ife (32.5%). The higher uptake in Osogbo may be due to the increased accessibility of formal municipal waste collection services in the capital city. Iwo and Ile-Ife, on one hand, however, show that there is a systematic difference in the provision of government waste collection service between the three cities, indicating poor waste collection service in lesser cities.

Open space and vacant plot dumping is adopted by 35.4% of practitioners, with Ile-Ife recording the highest rate (40.0%), followed by Osogbo (33.8%) and Iwo (32.8%). Also, one in three farmers (33.3%) practice burning, with Osogbo recording the highest rate (35.3%), followed by Ile-Ife (32.5%) and Iwo (32.1%). Open burning creates air pollution in the form of particulates and toxic smoke into

the air that impacts the air quality in neighbourhoods that surround the farms.

Waste disposal in bushes along roadsides is practiced by 28.2% of practitioners with similar rates in Osogbo (28.1%), Iwo (29.0%), and Ile-Ife (27.5%). The overall reported rate of road median dumping is 26.4%, with Osogbo reporting the highest rate (30.9%) followed by Iwo (24.4%) and Ile-Ife (23.3%). These activities destroy neighbourhoods' appearance and pose public health risks.

Most seriously, there were 89 farms in the study area that dispose of waste directly into water bodies (22.8% of the total number of practitioners). This distribution is uniform, with Osogbo (23.0%), Iwo (21.4%) and Ile-Ife (24.2%) cities all having similar rate. Water body disposal is the least common disposal method, but has the greatest potential environmental impacts of all the disposal methods identified in this study. Agriculture effluents can pollute drinking water sources, cause ecological harm to water bodies and pose risks of water borne diseases to the communities downstream.

The chi square analysis in Table 6 test the variation of waste disposal methods across the three urban centres

Table 6: Chi-Square Results — Association between City and Waste Disposal Methods

Waste Disposal Method	Chi-square Value	df	p-value	Significance
Informal Waste Collector	0.412	2	0.814	Not significant
Designated Refuse Dumps	1.243	2	0.537	Not significant
Inside Drainage	0.381	2	0.826	Not significant
Open Space/Vacant Plots	2.847	2	0.241	Not significant
Government Refuse Van	8.963	2	0.011	Significant*
Burning	0.624	2	0.732	Not significant
Bushes Along Roadsides	0.184	2	0.912	Not significant
Road Median	4.127	2	0.127	Not significant
Water Bodies	0.312	2	0.856	Not significant

*Note: * Significant at $p < 0.05$ Source: Authors' Field Survey, 2025*

The chi-square analysis indicates that waste disposal practices are uniform across the three cities with the exception of only government refuse vans utilisation, showing a significant variation across urban centres ($\chi^2 = 8.963$, df = 2, $p = 0.011 < 0.05$). This significant difference highlights differential accessibility to formal municipal waste collection infrastructure across the three cities, with Osogbo showing a significantly higher proportion of government vans utilisation, probably due to its administrative function as the state capital. All the other eight remaining disposal methods present similar non-significant results which implies that disposal behaviour is not unique to a city but a uniform and systematic disposal behaviour in waste disposal among urban agriculture practitioners.

Qualitative evidence obtained from key informant interviews gives important contextual information in understanding the disposal patterns observed. One of the most consistent themes from practitioners during the key informant sessions was the lack of convenient and affordable formal disposal methods as a key contributor to harmful disposal practices. "In Iwo, one urban farmer association leader commented:

"We don't want to dump garbage in the bush or burn it, but what alternatives do we have? I do not have access to waste garbage truck, some people who need waste come to pack it, but they do not come all the time! When the waste accumulates, you need to do something with it!"

This qualitative finding is important because it re-frame harmful disposal as not a behavioural or attitudinal issue, but rather a structural one due to lack of infrastructure and formal disposal services.

3.4 Community Environmental Perceptions of Urban Farm Waste Impacts

Residents' viewpoints on environmental changes related to local urban farming operations in the three urban centres is presented in this section.

3.4.1 Overall Perceived Environmental Impact

Table 7 presents general resident perceptions of the environmental impact of proximate urban farms. Overall, 66.8% of residents feel that the environmental impact of nearby farms is negative or very negative, 18.7% rated it as positive or very positive, while 14.5% are neutral. Osogbo records the highest negative perception (70.4%), while Ile-Ife (67.8%), and Iwo (62.8%) also show majority negative views.

Table 7: Residents' Overall Perceived Environmental Impact of Urban Farms

Urban Centre		Very Positive	Positive	Neutral	Negative	Very Negative	Total
Osogbo	Frequency	7	10	14	39	35	105
	% within category	6.7%	9.5%	13.3%	37.1%	33.3%	100.0%
	% across categories	35.0%	26.3%	31.1%	34.2%	37.6%	33.9%
Iwo	Frequency	7	17	21	46	30	121
	% within category	5.8%	14.0%	17.4%	38.0%	24.8%	100.0%
	% across categories	35.0%	44.7%	46.7%	40.4%	32.3%	39.0%
Ile-Ife	Frequency	6	11	10	29	28	84
	% within category	7.1%	13.1%	11.9%	34.5%	33.3%	100.0%
	% across categories	30.0%	28.9%	22.2%	25.4%	30.1%	27.1%
Total	Frequency	20	38	45	114	93	310
	% within category	6.5%	12.3%	14.5%	36.8%	30.0%	100.0%
	% across categories	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

3.4.2 Perceived Changes in Air Quality

As shown in Table 8, 60.3% of residents claimed they have noticed changes in air quality in their neighbourhood due to the nearby urban farm. The highest air quality concern is in Iwo (64.5%), Osogbo (59.0%) and Ile-Ife (56.0%). For those who experienced changes in air quality frequently, the most common factor mentioned was unpleasant odours from animal waste and decomposing organic matter. One of the residents of Osogbo said:

"It is the smell from the pig farm that usually affects our neighbourhood: it is difficult to stay out of the house, particularly during the morning and when it rains."

Another Iwo resident commented:

"There is a strong odour from the poultry farm behind our house and we don't open the windows sometimes."

Table 8: Residents' Perceived Changes in Air Quality

Urban Centre		Yes	No	Total
Osogbo	Frequency	62	43	105
	% within category	59.0%	41.0%	100.0%
	% across categories	33.2%	35.0%	33.9%
Iwo	Frequency	78	43	121
	% within category	64.5%	35.5%	100.0%
	% across categories	41.7%	35.0%	39.0%
Ile-Ife	Frequency	47	37	84
	% within category	56.0%	44.0%	100.0%
	% across categories	25.1%	30.1%	27.1%
Total	Frequency	187	123	310
	% within category	60.3%	39.7%	100.0%
	% across categories	100.0%	100.0%	100.0%

3.4.3 Perceived Changes in Water Quality and Availability

Table 9 indicates that 34.2% of residents noticed changes in water quality and availability linked to nearby farms. The highest water quality concern (41.9%) is in Osogbo, while Iwo has the lowest (28.9%). For group of people who indicated that water availability changed, the most common problem was 'less water during dry season', which was attributed to water use by farming operations from shared water sources. In Osogbo, a resident during an FGD said:

"The farm is irrigated from the stream and during the dry season, water levels are low and difficult to get water for our domestic use."

Table 9: Residents' Perceived Changes in Water Quality and Availability

Urban Centre		Yes	No	Total
Osogbo	Frequency	44	61	105
	% within category	41.9%	58.1%	100.0%
	% across categories	41.5%	29.9%	33.9%
Iwo	Frequency	35	86	121
	% within category	28.9%	71.1%	100.0%
	% across categories	33.0%	42.2%	39.0%
Ile-Ife	Frequency	27	57	84
	% within category	32.1%	67.9%	100.0%
	% across categories	25.5%	27.9%	27.1%
Total	Frequency	106	204	310
	% within category	34.2%	65.8%	100.0%
	% across categories	100.0%	100.0%	100.0%

3.4.4 Perceived Changes in Biodiversity

As shown in Table 10, 55.5% of residents observe biodiversity changes linked to nearby urban farms, with Ile-Ife (59.5%) and Iwo (58.7%) having higher level of awareness compared to Osogbo (48.6%). The qualitative evidence showed perceptions of both positive and negative biodiversity. Some residents reported increases in bird species attracted to farm areas as positive. Iwo resident reported:

"More birds come to the farm since the farm was established, including weavers, doves and some hawks".

But negative observations were more frequent. Some residents reported a loss of native species due to the encroachment of farms on the land that had been vegetated. One of the residents of Iwo commented:

"The farmers clear everything, the wild herbs we used for medicine are being lost."

Table 10: Residents' Perceived Changes in Biodiversity

Urban Centre		Yes	No	Total
Osogbo	Frequency	51	54	105
	% within category	48.6%	51.4%	100.0%
	% across categories	29.7%	39.1%	33.9%
Iwo	Frequency	71	50	121
	% within category	58.7%	41.3%	100.0%
	% across categories	41.3%	36.2%	39.0%
Ile-Ife	Frequency	50	34	84
	% within category	59.5%	40.5%	100.0%
	% across categories	29.1%	24.6%	27.1%
Total	Frequency	172	138	310
	% within category	55.5%	44.5%	100.0%
	% across categories	100.0%	100.0%	100.0%

3.4.5 Perceived Waste Management Issues

Table 11 shows that 65.5% of residents reported environmental change associated with waste management issue due to the nearby urban farm. This finding remains constant in all the three cities (68.6% in Osogbo; 66.1% in Iwo and 60.7% in Ile-Ife). The most frequently mentioned waste related issue was improper disposal of organic wastes such as rotting vegetables, crop residues and animal manure. An Osogbo resident during an FGD noted that:

"The farmers dump the vegetable waste by the roadside, where

it stays for weeks, and is infested with flies and rats."

A participant at Ile-Ife went also said:

"No government waste collection here, the farmers have no place to dispose of their waste so they dispose of it everywhere."

Table 11: Residents' Perceived Waste Management Issues

Urban Centre		Yes	No	Total
Osogbo	Frequency	72	33	105
	% within category	68.6%	31.4%	100.0%
	% across categories	35.5%	30.8%	33.9%
Iwo	Frequency	80	41	121
	% within category	66.1%	33.9%	100.0%
	% across categories	39.4%	38.3%	39.0%
Ile-Ife	Frequency	51	33	84
	% within category	60.7%	39.3%	100.0%
	% across categories	25.1%	30.8%	27.1%
Total	Frequency	203	107	310
	% within category	65.5%	34.5%	100.0%
	% across categories	100.0%	100.0%	100.0%

3.4.6 Perceived Soil Degradation or Erosion

Table 12 indicates that 39.4% of residents perceive soil degradation or erosion linked with urban agricultural practices in the neighbourhood as a problem. Notably, the distribution is very similar across the three cities (Osogbo: 39.0%, Iwo: 39.7%, Ile-Ife: 39.3%) indicating a consistency of soil quality concerns across different city farming typologies and settings. Erosion on sloped farm land was the most common soil issue reported among those who said they experienced soil issues. An Ile-Ife's residents claimed:

"The pig farm is on a slopping land and whenever there is rain, the soil washes to our compound there we have to sweep it off every time."

Table 12: Residents' Perceived Soil Degradation or Erosion

Urban Centre		Yes	No	Total
Osogbo	Frequency	41	64	105
	% within category	39.0%	61.0%	100.0%
	% across categories	33.6%	34.0%	33.9%
Iwo	Frequency	48	73	121
	% within category	39.7%	60.3%	100.0%
	% across categories	39.3%	38.8%	39.0%
Ile-Ife	Frequency	33	51	84
	% within category	39.3%	60.7%	100.0%
	% across categories	27.0%	27.1%	27.1%
Total	Frequency	122	188	310
	% within category	39.4%	60.6%	100.0%
	% across categories	100.0%	100.0%	100.0%

3.4.7 Perceived Changes in Noise Levels

As seen in Table 13, 48.4% of residents notice noise level changes. The patter is more or less the same in all three cities, Osogbo (47.6%), Iwo (48.8%) and Ile-Ife (48.8%). The most frequently cited sources of noise disturbance were animal noises (especially poultry and pig operations). One Iwo resident described:

"There are thousands of birds on the poultry farm and they make a lot of noise, early in the morning and late at night. "It is hard to get some sleep near the poultry farm".

Notably, a minority of residents had a more complex opinion of farm noise. One of the participants responded:

"Yes, the farm is noisy sometimes. But it is better than the abandoned plot that was there before which had criminals and mosquitoes."

Table 13: Residents' Perceived Changes in Noise Levels

Urban Centre		Yes	No	Total
Osogbo	Frequency	50	55	105
	% within category	47.6%	52.4%	100.0%
	% across categories	33.3%	34.4%	33.9%
Iwo	Frequency	59	62	121
	% within category	48.8%	51.2%	100.0%
	% across categories	39.3%	38.8%	39.0%
Ile-Ife	Frequency	41	43	84
	% within category	48.8%	51.2%	100.0%
	% across categories	27.3%	26.9%	27.1%
Total	Frequency	150	160	310
	% within category	48.4%	51.6%	100.0%
	% across categories	100.0%	100.0%	100.0%

4 Discussion

The results from this study generally indicate a structural waste management problem in urban agricultural practice. The lack of proper disposal facilities in farm neighbourhoods is not a side issue in farm management but a basic condition that makes it structurally unavoidable for standard waste disposal practices. Practitioners have no formal disposal options other than open dumping, burning and drainage discharge, necessitating local response to fill the governance gap. This finding aligns with Okwoyo et al. (2019), who posited that waste management practices in African urban farming systems are driven mainly by infrastructure availability, rather than practitioners' behaviour. This shifts analytical responsibility from individual farmers to the institutional mechanism needed for proper urban agricultural operations.

The uniformity of harmful disposal practices in all three cities, as backed by non-significant chi-square results, is theoretically important. It exposes that the waste governance failures in urban agriculture are not due to the specific conditions of the city (administrative capacity, population density, economic base or culture), but are due to regulatory gaps at the state level. These findings question the concept of treating waste management as a neighbourhood-based problem that can be solved by local governments, and instead reinforces Battersby and Watson's (2020) assertion that urban agriculture environmental externalities should be tackled through systemic institutional reform at the broader policy and regulatory level, rather than incremental community-based interventions.

The near-universal availability of drainage but general lack of waste disposal facilities is particularly instructive. It indicates that the challenge is not just of infrastructural shortage, but an institutional design failure, which has provided general utilities without the specialised infrastructure required for urban farming. Drainage channels designed for stormwater management become de facto waste channels, as no other infrastructure is available, increasing environmental risk. This reinforces the infrastructure deficit argument presented by Abera et al. (2017), showing that general-purpose infrastructure can harm the environment when applied in place of

purpose-built waste management systems.

The perception results of this governance failure show the human impacts as a result of these failures. The overall environmental assessment was predominantly negative, further highlighting that the environmental externalities of urban agriculture are not theoretical risks but a lived reality that impacts residents' quality of life. The quantitative finding is complemented by the qualitative findings, which show that odour, accumulation of waste, water competition and noise disturbance are not an occasional or seasonal nuisance, but a constant feature of urban farming neighbourhood life that people adapt to every day without formal recourse. This experiential component, which may not be captured by numerical data, provides context to the equity issue around urban governance. As Kanosvamhira and Tevera (2020) noted, urban agriculture is a social justice issue that can be summarised as the unequal distribution of farming benefits and burdens between the urban agrarian population and the surrounding neighbours, which has not been addressed by urban development frameworks.

The low composting adoption among practitioners despite major environmental and agronomic benefits suggests a gap in knowledge and/or incentive that has not been addressed through agricultural extension services. Urban farming literature consistently notes composting as the most sustainable waste transformation method for small-scale urban farmers. Yet, its adoption rate remains low even in cities with a high amount of organic waste (Abera et al., 2017). This indicates that awareness programmes are not enough, and that structural incentives such as subsidised equipment, guaranteed markets for compost products and including compost as part of farm registration criteria are important to change practice on a larger scale. The comparatively high government refuse van usage in Osogbo is an indication that formal service provision is possible even in a system where there is no institutional re-engineering, indicating the practicality to scale up to urban farm sites, if there is deliberate investments and political commitment.

5 Conclusion

Urban agriculture waste management in Osun State highlights a governance system that has set a perfect condition for environmental harm through institutional neglect, regulatory invisibility and infrastructural deficiency. The intersection of quantitative evidence and community perception evidence establishes compelling evidence to conclude that the environmental costs of this governance failure are disproportionately being borne by low-income residential communities, with limited ability to relocate and no formal mechanism to provide redress. These cannot be fixed by the current incremental approach, but rather by a systemic change in the way urban agriculture is managed, from informal tolerance to formal regulation, from municipal services exclusion to intentional inclusion, and from farm-level management advice to state-level environmental standards enforcement.

Based on the analytical evidence presented, six policy recommendations emerge. Firstly, priority focus must be on designing a mandatory urban agriculture registration and environmental compliance procedure, which requires basic waste management guidelines for registration. This registration provides a channel for state-level waste collection services, agricultural extension and land use protection. Without addressing the regulatory invisibility of farms, no other intervention can achieve significant scale or sustainability.

Second, dedicated waste management infrastructure must be provided by the state government near urban farm sites as public environmental investment. Individual urban farmers do not have the capital funds or technical expertise to construct manure pits or to build compost bays, so urban agriculture must become part of the state's agricultural support programmes to subsidise these facilities.

Third, there should be expansion of municipal waste collection to registered urban farm sites with an explicit service level agreement between the Osun State Waste Management Agency and the farm operators. The unevenness in government refuse van access by cities shows that institutionalisation of formal refuse collection is possible and that the divide between Osogbo and the other two cities is a policy challenge and not a resource issue.

Fourth, it is essential to have clear environmental regulations with clear penalties for open burning and water body disposal, regular compliance checks and community reporting systems.

Fifth, composting needs to become a routine practice and not an optional method. This can be achieved by extension training, equipment subsidies, and incorporating composting requirements into farm registration criteria, adding a valuable agricultural input to an under-utilised waste stream. Sixth, environmental monitoring mechanisms should be formalised within the community, providing a structured pathway for residents to raise concerns about waste issues. This is to ensure that community lived experience is considered in the continuous decision-making process.

Overall, this study provides empirical reflections from a Nigerian context where urban agriculture has been under-researched at the state level and further adds to the current literature on urban agriculture environmental governance in Nigeria. Prospective studies should explore typology-specific waste management practices that can

help determine the most harmful waste stream generated by farm types. Also, longitudinal studies can be carried out to evaluate outcomes of governance interventions, which will be valuable in supporting evidence-based urban agriculture policy in Nigeria and other similar contexts.

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