RESILIENCE AND LIVABLE CITIES IN A WARMING WORLD

A FESTSCHRIFT IN HONOUR OF

TPL. DR. JOSHUA ADEWUMI ADEBISI FNITP, RTP



EDITED BY

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CHAPTER 06

ASSESSING THE SPATIAL PATTERNS OF URBAN AGRICULTURE IN IBADAN, NIGERIA: INTEGRATING SATELLITE IMAGERY INTO LAND USE PLANNING STRATEGIES FOR ENHANCED FOOD SECURITY

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Abstract
This study examines the spatial patterns of urban agriculture in Ibadan, Nigeria, emphasizing its importance for food security amid rapid urbanization. Despite the critical role urban agriculture plays in enhancing local food production and livelihoods, there is a significant gap in understanding its spatial dynamics, which hampers effective land use planning. The primary aim is to assess these patterns through satellite imagery and Geographic Information Systems (GIS). A mixed-methods approach was employed, combining spatial analysis of satellite data from 2000, 2018, and 2025 with field surveys of 145 households across five local government areas. Findings reveal a concerning decline in agricultural land from 13.96% in 2000 to 4% in 2025 due to urban expansion, while built-up areas increased significantly. The research identifies key agricultural practices, including vegetable farming (84.8%) and cassava cultivation (57.2%), which contribute to local food systems. The study concludes that urban agriculture can enhance food security and community resilience, but is threatened by urban growth. Recommendations include integrating urban agriculture into land use planning, promoting community engagement, and leveraging educational programs to foster sustainable practices.

Keywords: Urban Agriculture, Food Security, Land Use Planning, Satellite Imagery and Ibadan

1.0 Introduction

Urban agriculture has increasingly become a critical strategy to address the pressing challenges of food security in rapidly urbanizing regions, especially in developing countries such as Nigeria. In this context, Ibadan, one of Nigeria's largest cities, exhibits a rich tapestry of agricultural activities interwoven within its urban and peri-urban landscapes. These activities play a vital role in bolstering local food production, improving nutritional outcomes, and promoting sustainable livelihoods for urban populations (Adediran & Afolabi, 2022). However, a significant gap exists in understanding the spatial patterns of urban agriculture in Ibadan. This lack of comprehensive spatial analysis impedes effective land use planning and informed policy development.

The incorporation of satellite imagery emerges as a powerful tool for mapping and assessing land use patterns, providing essential data that can guide urban planning efforts focused on optimizing land for agricultural purposes, even amidst competing

urban development demands (Ekunsanmi & Adekunle, 2023). Through the utilization of remote sensing technologies, stakeholders can gain valuable insights into the locations, types, and extents of urban agricultural activities. This understanding can facilitate better integration of urban agriculture within broader urban development frameworks, ultimately supporting improved food security in Ibadan and similar urban settings. Despite the recognized importance of urban agriculture in enhancing food security and livelihoods in Ibadan, comprehensive spatial analyses that elucidate the distribution and characteristics of these agricultural endeavours are conspicuously lacking. Most existing research relies heavily on anecdotal evidence or qualitative assessments that fail to adequately capture the dynamic spatial patterns of urban agriculture, as well as potential conflicts arising from urban development initiatives (Ijeoma & Ogbonna, 2024).

As urban areas continue to expand and intensify, it becomes increasingly essential for land use planners and policymakers to understand these patterns. A nuanced comprehension is vital for promoting sustainable urban agriculture that does not compromise urban growth or encroach on other critical land uses, especially given Nigeria's rapidly growing urban population and the mounting pressures on foods (Gbadamosi & Akanmu, 2023). Consequently, the aim of this study is to assess the spatial patterns of urban agriculture in Ibadan, Nigeria. To accomplish this aim, the study pursued the objectives that consist of mapping and analyzing the spatial distribution of urban agriculture in Ibadan utilizing satellite imagery; evaluating the kinds of agricultural practices prevalent in various parts of Ibadan and their contributions to local food systems; assessing the effects of urban growth on urban agricultural land in Ibadan; identifying areas of potential conflict and opportunity and, developing land use planning strategies that incorporate urban agriculture into the urban development framework of Ibadan.

2.0 Literature Review

2.1 Conceptual Review

Urban agriculture has gained recognition as a multifaceted phenomenon that intersects agricultural production, urban planning, and food security. It incorporates various agricultural practices occurring in urban or peri-urban environments, often including gardening, farming, and livestock rearing (Moussa & El Boukili, 2022). The concept encompasses economic, environmental, social, and health dimensions, suggesting that urban agriculture can enhance food security, foster community engagement, and contribute to environmental sustainability (Pérez et al., 2023). Scholars argue that urban agriculture serves as a vital component in diversifying the urban food system, particularly in developing countries like Nigeria, where food insecurity remains a pressing issue (Adediran & Afolabi, 2022).

In the urban context, land becomes a limited resource due to competing demands for housing, infrastructure, and commerce, leading to challenges in effectively integrating agriculture within urban landscapes (Binns & Binns, 2025). This integration requires a clear understanding of spatial patterns and dynamics, which can be achieved through advanced technologies like satellite imagery. By visualizing land use and

agricultural distributions, planners can identify optimal areas for urban agriculture and propose sustainable land use policies (Ekunsanmi & Adekunle, 2023).

2.2 Theoretical Review

Several theoretical frameworks can be applied to understand urban agriculture and its implications for food security. The "Sustainable Livelihoods Framework" emphasizes the importance of local resources and capacities in enabling households to meet their basic needs (Mahmoud & Dabo, 2025). According to this framework, urban agriculture can enhance food security by providing alternative income sources and improving access to fresh produce in urban areas. Additionally, "Systems Theory" helps in conceptualizing urban agriculture as part of a broader socio-ecological system, highlighting the interconnections between urban environments, agricultural practices, and social dynamics (Ijeoma & Ogbonna, 2024). This theory underlines the importance of multidisciplinary approaches in studying urban agriculture, indicating that understanding spatial patterns is not only a matter of land use but also involves socio-economic factors, cultural practices, and policy implications.

Furthermore, the "Social-Ecological Systems (SES)" framework is particularly relevant in assessing how urban agriculture interacts with urbanization processes. The SES framework illustrates how agricultural practices can both influence and be influenced by urban development, suggesting a reciprocal relationship between the two (Ogunbode et al., 2022).

2.3 Review of Empirical Studies

Empirical studies have underscored the importance of understanding spatial patterns in urban agriculture. For instance, research conducted in metropolitan areas has shown that urban agriculture contributes significantly to local food production, with community gardens and peri-urban farms enhancing food access for low-income residents (Khan & Ali, 2024). Similarly, studies have documented how integrating satellite imagery and Geographic Information Systems (GIS) facilitates the identification of agricultural hotspots within urban areas, optimizing land use planning for food security (Asante & Owusu, 2023).

In the context of Ibadan, recent studies have pointed to a growing interest in urban agriculture as a viable strategy to combat food insecurity. A study by Ogunsesan, Tejuosho, Animashaun & Adeleke (2026); Gbadamos & Akanmu (2023); Adediran and Afolabi (2022) highlighted that urban agricultural practices in Ibadan significantly contribute to local food supply and serve as an important source of income for urban residents. Nevertheless, Ijeoma and Ogbonna (2024) argue that despite the apparent benefits, there is a significant gap in data concerning the spatial distribution and characteristics of urban agriculture in the city, which hampers effective planning.

Moreover, research conducted by Ekunsanmi and Adekunle (2023) demonstrated the potential of employing remote sensing to evaluate land use changes and their implications for urban agriculture. Their findings indicated that leveraging satellite imagery can effectively reveal trends and patterns of urban agricultural activities, which are essential for making informed policy decisions that support urban food systems.

3.0 Materials and Methods

3.1 Study Area

The study area for this research is Ibadan comprising of eleven Local Government areas.

3.2 Methodology

The methodology for assessing the spatial patterns of urban agriculture in Ibadan, Nigeria, employs a mixed-methods approach that combines both quantitative and qualitative techniques. This comprehensive strategy aims to enhance the understanding of urban agricultural practices while utilizing advanced technological tools such as satellite imagery and Geographic Information Systems (GIS). The research adopts a descriptive and exploratory design. The descriptive aspect focuses on mapping and analyzing the spatial distribution of urban agriculture, while the exploratory component delves into the socio-economic and cultural factors influencing agricultural practices across different local government areas in Ibadan. Meanwhile, spatial data were gathered using satellite imagery. High-resolution images from sources like Sentinel and Landsat satellites were selected for their ability to capture land use changes. Images from the years 2000, 2018, and 2023 were analyzed to observe trends over time. The satellite images underwent preprocessing to eliminate atmospheric disturbances and enhance agricultural features, employing tools like ENVI or ArcGIS for image processing.

Also, in order to ensure accuracy, ground-truthing was conducted through field surveys. Structured questionnaires were administered to farmers and urban agriculture practitioners in selected neighborhoods across various local government areas in Ibadan. Eleven local governments were categorized into five urban and six rural areas, from which two urban and three rural local governments were randomly selected. Households were sampled by selecting every fifth house on either side of the road within chosen neighborhoods, resulting in ten households per neighborhood. The data analysis consisted of both quantitative and qualitative methods. In addition, the processed satellite imagery was classified using supervised classification techniques, such as Maximum Likelihood Classification, to identify urban agricultural areas. GIS tools were employed to analyze and visualize the spatial distribution of urban agriculture in Ibadan. Additionally, spatial metrics were calculated to assess land fragmentation, connectivity, and changes in land use patterns over time. Therefore, descriptive statistics summarized data from field surveys regarding agricultural practices and their contributions to food security. Correlation analysis was performed to explore relationships between urban growth patterns and the availability and distribution of urban agricultural land.

Table 1: Selected Households for Study

Local Governments		Wards		Selected Neighbourhood	Sampled Households
1	Ibadan North	1	Ward I N2	Kannike	10
		2	Ward II, N3	Inalende	10
		3	Ward III, N4	Adeoyo	10
		4	Ward IV, N5a	Total Garden	10
		5	Ward IX, (N6b Part I)	Mokola	10
		6	Ward V, N5b	Bashorun	10
		7	Ward VI, N6a Part I	Sabo	10
		8	Ward VII, N6a Part II	Oremeji	10
		9	Ward XII N6a Part III	Ijokodo	10
		10	Ward XN6b Part II	Bodija	10
		11	Ward XI, NW8	Samonda	10
		12	Ward XII, NW8	Barika	10
				Sub-total	120
2	Ibadan Southwest	1	Ward 08 SW7	Sharp Corner	10
		2	Ward 1 C2	Ayoola compound	10
		3	Ward 10 SW8 Ii	Oke-Ado	10
		4	Ward 11 SW9(1)	Oluyole Estate	10
		5	Ward 12 SWa II	GCI Apata	10
		6	Ward 2 SW1	Bola Street	10
		7	Ward 3 SW2	Idigba	10
		8	Ward 4 SW3a & 3b	Odo-Ona	10
		9	Ward 5 SW4	Ifoko	10
		10	Ward 6 SW5	Oke-Foko	10
		11	Ward 7 SW6	Iyaganku	10
		12	Ward 9 SW8 (1)	Ajangbe	10
				Sub-Total	120
3	Akinyele	1	Ajibade/Alabata/Elekuru	Ajibade	10
		2	Akinyele/Isabiyi/Irepodun	Akinyele	10
		3	Arulogun/Eniosa/Aroro	Arulogun	10
		4	Ijaye/Ojedeji	Ijaye	10
		5	Ikereku	Ikereke	10
		6	Iroko	Iroko	10
		7	Iwokoto/Talontan/Idi-oro	Iwokoto	10
		8	Ojo-emo/Moniya	Ojo-emo	10
		9	Ojoo/Ajibode/Laniba	Ojoo	10
		10	Olanla/Oboda/Labode	Olanla	10
		11	Olode/Amosun/Onidundu	Olode	10
		12	Olorisa-oko/Okegbemi/Mele	Olorisa-oko	10
				Sub-Total	120
		1	Akanran ward	Akanran	10
		2	Araro ward	Araro	10

4	Ona-Ara	3	Olunloyo ward	Olunloyo	10
		4	Amuloko	Amuloko	10
		5	Olorunsogo ward	Olorunsogo	10
		6	Gbedun ward	Gbedun	10
				Total	60
5	Ido	1	Ilaju Ward	Alabata	10
		2	Akufo Ward	Akufo	10
		3	Akinwaare Ward	Idi-osan	10
		4	Apete Ward	Ogbere	10
		5	Idi-Iya Ward	Idi-Ayunre	10
		6	Erinwusi Ward	Elenusonso	10
		7	Owode	Owode	10
				Sub-Total	70
				Total	490

4.0 Results and Discussion

4.1 Land Use Changes and Spatial Growth in Ibadan

The analysis of satellite imagery and land use data for Ibadan, Nigeria, reveals significant insights into the spatial patterns of urban agriculture and the effects of urban growth on land resources (Figure 1, Figure 2 & Figure 3). This study emphasizes the integration of satellite imagery into land use planning strategies, demonstrating its potential to enhance food security in the region. The findings indicate a notable increase in urban growth, with built-up areas rising from 48.6% in 2000 to a projected 50% by 2025. This expansion highlights the ongoing urbanization in Ibadan, where urban infrastructure is increasingly encroaching on agricultural and vegetative land. Also, agricultural land has seen a dramatic decline, decreasing from 13.96% in 2000 to a concerning 4% by 2025. This reduction raises alarms about the encroachment of urbanization on vital agricultural spaces, posing a threat to local food security, especially as urban populations continue to grow.

Meanwhile, vegetation cover has also diminished, falling from 36.18% in 2000 to 31% in 2025. The loss of green spaces can lead to environmental degradation, increased heat, and reduced biodiversity. This further undermining the capacity for sustainable urban agriculture. Also, the dense vegetation is projected to increase to 10% by 2025, indicating potential efforts to incorporate green spaces into urban planning (Table 1, Table 2 & Table 3). This is in conformity with the findings of Akanmu, Gbadamosi & Omole (2022) on the changing land use and spatial attributes in Lagos.

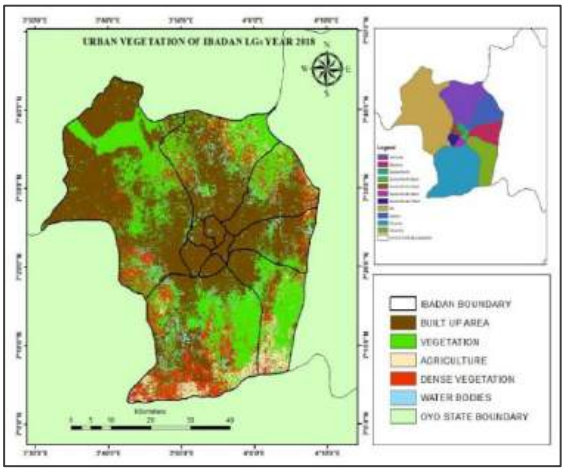


Figure 1: Classified Satellite Imagery of Ibadan, 2000 Ibadan, 2018 *Source:* Landsat 8 OLI, 2000 OLI, 2018

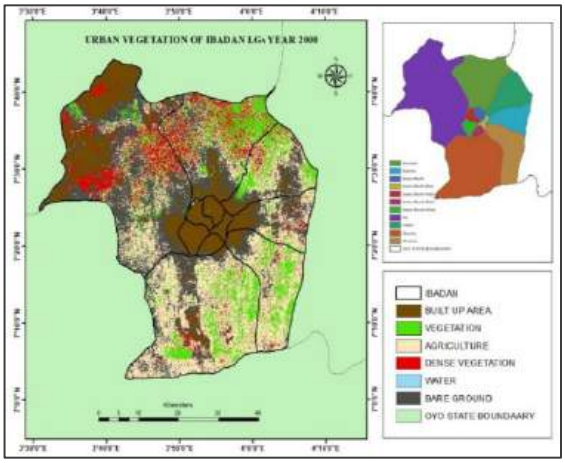


Figure 2: Classified Satellite Imagery of *Source:* Landsat 8

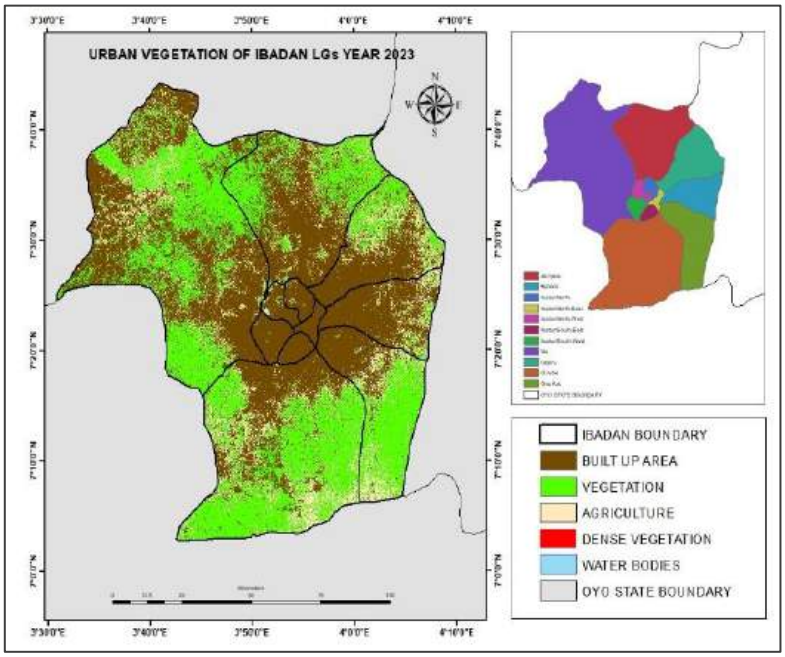


Figure 3: Classified Satellite Imagery of Ibadan, 2025
Source: Landsat 8 OLI, 2025

Table 1: Features Detailing Their Land Mass in Metres and their Percentage for the Year 2000

Feature	Area(m)	Percentage (%)
Built-up area	1558990.231731	48.632
Vegetation	1159810.024115	36.181404
Agriculture	447410.632219	13.957586
Dense vegetation	10040.674004	0.313418
Water	29270.675813	0.913317

Source: Author's Fieldwork, 2025

Table 2: Features Detailing Their Land Mass in Metres and their Percentage for the Year 2018

Feature	Area(m)	Percentage (%)
Built-up area	1558990.231731	48.632
Vegetation	1159810.024115	36.181404
Agriculture	447410.632219	13.957586
Dense vegetation	10040.674004	0.313418
Water	29270.675813	0.913317

Source: Author's Fieldwork, 2025

Table 3: Features Detailing Their Land Mass in Metres and their Percentage for the Year 2025

Feature	Area(m)	Percentage (%)
Built-up area	1592400.289972	50
Vegetation	1000060.527564	31
Agriculture	139930121114	4
Dense vegetation	335580.000557	10
Water	335580.000557	4

Source: Author's Fieldwork, 2025

4.2 Socio-Economic Characteristics of Respondents

The socio-demographic characteristics of respondents presented in Table 4 reveal significant trends. Sixty percent were male, indicating a gendered dimension to urban agriculture participation. A substantial 63.4% were married, likely influencing household decisions related to agricultural practices and food security. The age distribution showed that 50.3% of respondents were between 41 and 60 years old, suggesting that a mature demographic is involved in urban farming, potentially affecting the types of practices adopted based on their experience. Furthermore, 33.8% of respondents graduated from higher education, indicating that education levels may positively impact on the adoption of innovative agricultural techniques. Occupational insights showed that 28.9% of respondents were engaged in farming, highlighting its significance as a primary occupation in an urbanizing context. Additionally, the presence of individuals in civil service and trading (22.8% and 28.3%, respectively) reflects a diverse economic base that can support agricultural activities. Also, the income levels varied, with 35.8% earnings between 151,000 and 200,000, which may allow for investment in urban agriculture. However, 11.8% of households earned 50,000 or below, indicating economic disparities that could impact food security and agricultural investment.

Regarding housing, 36.5% of respondents lived in face-to-face housing, which can foster community interactions beneficial for urban agriculture. The presence of traditional compounds (14.5%) may also enhance communal agricultural practices. Hence, the findings highlight the critical relationship between socio-economic characteristics and urban agricultural practices in Ibadan. As urban areas expand, competition for land intensifies, posing threats to agricultural spaces. This underscores the need for integrating satellite imagery into urban planning to protect vital agricultural lands, while the demographic data also suggests opportunities for community-based agricultural initiatives, leveraging the knowledge of the mature and educated population.

Table 4: Socio-Economic Characteristics of Respondents

Variables	Category	Frequency	Percentage
Gender	Male	87	60.0%
	Female	58	40.0%
	Total	145	100%
Marital Status	Married	92	63.4%
	Divorced	1	0.7%
	Widowed	23	15.8%
	Single	21	14.4%
	Separated	8	5.5%
	Total	145	100%
Age Distribution	18- 40	52	35.9%
	41- 60	73	50.3%
	60 and above	20	13.8%
	Total	145	100%
Highest Educational Qualification	No Formal Education	31	21.4%

	Primary Education	23	15.9%
	Secondary Education	26	17.9%
	Graduate	49	33.8%
	Postgraduate	16	11.0%
	Others	16	11.0%
	Total	145	100%
Major Occupation	Civil Service	33	22.8%
	Food Processing	23	15.9%
	Farming	42	28.9%
	Trading	41	28.3%
	Others	6	4.1%
	Total	145	100%
Monthly Income	50,000 and below	17	11.8%
	51,000 – 100,000	21	14.5%
	101,000 – 150,000	31	21.4%
	151,000 – 200,000	52	35.8%
	Above 200,000	24	16.5%
	Total	145	100%
Housing Characteristics	Face-to-Face	53	36.5%
	Flat	32	22.1%
	Blocks of Flats	8	5.5%
	Duplex	5	3.5%
	Traditional Compound	21	14.5%
	Others	26	17.9%
	Total	145	100%

Source: Author's Fieldwork, 2025

4.3 Types of Urban Agriculture Practised by Respondents

On the various types of urban agriculture practiced by respondents in the study area, results presented in Table 5 reveal that vegetable farming is the most prevalent type of urban agriculture, with 84.8% of respondents engaged in this activity. This strong preference for vegetables is likely due to their quick growth cycles, nutritional benefits, and high demand in local markets. Following closely is cassava, cultivated by 57.2% of respondents, which is a staple food in Nigeria and vital for food security. Maize is also significant, with 48.2% of respondents growing it, highlighting its versatility as both a food source and cash crop. In terms of livestock farming, goat farming leads with 37.2% of respondents, valued for its meat and milk production. Other livestock practices include sheep farming (33.7%) and poultry farming (29.6%), indicating a diverse approach to livestock rearing.

Additionally, fish farming (15.8%) and rabbit farming (9.6%) represent smaller yet noteworthy segments, reflecting interest in alternative protein sources. Pig farming, practiced by 7.5% of respondents, is relatively low, possibly due to cultural preferences or space limitations. The diversity of agricultural practices suggests a multifaceted approach to urban farming, which can enhance food security by providing multiple food

sources and income streams. This engagement in vegetable and root crop farming underscores a focus on nutrition, particularly in urban areas where access to fresh produce may be limited. Economically, the prevalence of both crop and livestock farming presents significant opportunities for urban residents, contributing to income stability and reducing vulnerability to market fluctuations. The variety of practices affirmed the findings of Gbadamosi & Akanmu (2023) on the potential for sustainable agricultural methods within urban environments, contributing to environmental health and resilience.

Table 5: Types of Urban Agriculture Practised by Respondents

Types of Agriculture	Frequency	Percentage
Poultry	43	29.6
Pig	11	7.5
Rabbit	14	9.6
Fish	23	15.8
Goat	54	37.2
Sheep	49	33.7
Maize	70	48.2
Cassava	83	57.2
Yam	46	31.7
Vegetables	123	84.8

Source: Author's Fieldwork, 2025

N.B. Percentage greater than 100 due to multiple responses

4.4 Impact of Urban Agriculture on the Well-Being of the Households

Meanwhile, Table 6 provides insights into the perceived impacts of urban agriculture on household well-being in Ibadan, based on a field survey conducted in 2024. The findings reveal several key benefits associated with urban farming practices. Firstly, a significant 72.4% of respondents believe that urban agriculture enhances food security, highlighting its role in providing access to fresh, locally grown food and reducing reliance on external sources. Additionally, 51.7% of respondents indicated that urban agriculture contributes to income generation, suggesting that farming activities not only supply food but also serve as vital livelihoods, enhancing economic stability for many households.

Also, approximately 36.5% of respondents recognize health benefits stemming from urban agriculture, which may be linked to increased consumption of fresh vegetables and healthier foods, thereby improving nutrition and overall health. Environmental benefits are acknowledged by 32.4% of respondents, who note improvements in air quality, biodiversity, and urban green space management, contributing to a healthier urban ecosystem. Social cohesion is also highlighted, with 29.6% of respondents feeling that urban agriculture fosters stronger community ties through collaboration and resource sharing among neighbors. Additionally, 20.6% perceive educational opportunities related to urban agriculture, encompassing learning about sustainable practices, nutrition, and agricultural techniques that empower individuals and communities. The implications of these findings are significant including emphasizing the multifaceted benefits of urban agriculture, aligning with the study's objectives to explore its broader implications for household well-being. The

recognition of social and educational benefits points to urban agriculture as a platform for community engagement and development, potentially fostering collective farming efforts. The perceived environmental and health benefits reinforce the notion that urban agriculture can contribute to sustainable urban development, making cities more livable and resilient.

Table 6: Perceived Impact of Urban Agriculture on the Well-Being of the Households in Ibadan

Perceived Impact	Frequency	Percentage
Improve Food Security	105	72.4
Income Generation	75	51.7
Health Benefits	53	36.5
Environmental Benefits	47	32.4
Social Cohesion	43	29.6
Educational Opportunities	30	20.6

Source: Author's Fieldwork, 2025

N.B. Percentage greater than 100 due to multiple responses

4.5 Effect of Urban Growth on Urban Agriculture

Results of the analysis presented in Table 7 provides insightful responses regarding the effects of urban growth on urban agriculture in various wards of Ibadan, based on data from 145 households. A significant concern among respondents is the loss of agricultural land, with 75% in Ward I N2 and 66.7% in Ward II reporting such losses. This trend illustrates the encroachment of urban development on vital agricultural spaces, endangering local food production and security. Additionally, many respondents (100% in Ward III and Ward V) acknowledged increased urbanization as a critical impact of urban growth on agriculture, indicating a rapid expansion of urban infrastructure that often displaces agricultural land. This consensus highlights the urgent need for integrated land use planning that accommodates agricultural needs.

Also, concerns about pollution and environmental degradation were also prevalent, with 25% to 100% of respondents across different wards noting these issues. In areas like Ibadan Southwest and Akinyele, pollution was identified as a significant factor affecting urban agriculture, suggesting that urban growth not only reduces the availability of agricultural land but also deteriorates the quality of the remaining land. Moreover, respondents indicated growing competition for land, particularly in Ward 1 (Ayoola compound) and Ward 4 (Odo-Ona), where 100% acknowledged this challenge. This competition complicates urban farmers' ability to maintain their practices amidst increasing housing and commercial developments. Therefore, the findings underscore the varied impacts of urban growth on urban agriculture across different local governments and wards, indicating that responses differ based on specific contexts.

Table 7: Responses of the Effect of Urban Growth on Urban Agriculture

Local Governments	Wards	Selected Neighbourhood	Sampled Households	Response on Effect of Urban Growth on Urban Agriculture	Freq.	%
Ibadan North	1	Ward I N2 (Kannike)	4	Loss of Agricultural Land	3	75.0%
				Increased Urbanization	2	50.0%
				Pollution and Environmental Degradation	1	25.0%
	2	Ward II (Inalende)	3	Loss of Agricultural Land	2	66.7%
				Increased Competition for Land	1	33.3%
	3	Ward III (Adeoyo)	3	Increased Urbanization	3	100.0%
				Pollution and Environmental Degradation	1	33.3%
	4	Ward IV (Total Garden)	1	Loss of Agricultural Land	1	100.0%
	5	Ward IX (Mokola)	0	N/A	0	0.0%
	6	Ward V (Bashorun)	2	Increased Urbanization	2	100.0%
				Loss of Agricultural Land	1	50.0%
	7	Ward VI (Sabo)	4	Pollution and Environmental Degradation	1	25.0%
	8	Ward VII (Oremeji)	0	N/A	0	0.0%
	9	Ward XII (Ijokodo)	1	Increased Competition for Land	1	100.0%
	10	Ward X (Bodija)	6	Loss of Agricultural Land	4	66.7%
				Increased Urbanization	3	50.0%
	11	Ward XI (Samonda)	3	Pollution and Environmental Degradation	2	66.7%
	12	Ward XII (Barika)	3	Increased Competition for Land	2	66.7%
	Total		30			
Ibadan Southwest	1	Ward 08 (Sharp Corner)	3	Loss of Agricultural Land	2	66.7%
				Increased Urbanization	1	33.3%
	2	Ward 1 (Ayoola compound)	3	Increased Competition for Land	3	100.0%
	3	Ward 10 (Oke-Ado)	2	Pollution and Environmental Degradation	1	50.0%
	4	Ward 11 (Oluyole Estate)	2	Loss of Agricultural Land	2	100.0%
	5	Ward 12 (GCI Apata)	4	Increased Urbanization	3	75.0%
	6	Ward 2 (Bola Street)	3	Pollution and Environmental Degradation	2	66.7%
	7	Ward 3 (Idigba)	5	Loss of Agricultural Land	4	80.0%

	8	Ward 4 (Odo-Ona)	6	Increased Competition for Land	5	83.3%
	9	Ward 5 (Ifoko)	4	Pollution and Environmental Degradation	3	75.0%
	10	Ward 6 (Oke-Foko)	7	Increased Urbanization	2	28.6%
	11	Ward 7 (Iyaganku)	1	N/A	0	0.0%
	12	Ward 9 (Ajangbe)	2	Loss of Agricultural Land	1	50.0%
	Total		42			
Akinyele	1	Ajibade/Alabata/ Elekuru	5	Pollution and Environmental Degradation	2	40.0%
	2	Akinyele/Isabiyi/Irepodun	4	Loss of Agricultural Land	3	75.0%
	3	Arulogun/Eniosa/ Aroro	4	Increased Urbanization	3	75.0%
	4	Ijaye/Ojedeji	3	Increased Competition for Land	1	33.3%
	5	Ikereku	3	Pollution and Environmental Degradation	1	33.3%
	6	Iroko	4	Loss of Agricultural Land	3	75.0%
	7	Iwokoto/Talontan /Idi-oro	4	Increased Urbanization	3	75.0%
	8	Ojo-emo/Moniya	0	N/A	0	0.0%
	9	Ojoo/Ajibode/Laniba	0	N/A	0	0.0%
	10	Olanla/Oboda/Labode	1	Loss of Agricultural Land	1	100.0%
	11	Olode/Amosun/Onidundu	1	Increased Competition for Land	1	100.0%
	12	Olorisa-oko/Okegbemi/Mele	6	Pollution and Environmental Degradation	5	83.3%
	Total		35			
Ona-Ara	1	Akanran ward	4	Loss of Agricultural Land	3	75.0%
	2	Araro ward	3	Increased Urbanization	2	66.7%
	3	Olunloyo ward	3	Pollution and Environmental Degradation	1	33.3%
	4	Amuloko	3	Increased Competition for Land	1	33.3%
	5	Olorunsogo ward	2	N/A	0	0.0%
	6	Gbedun ward	4	Loss of Agricultural Land	3	75.0%
	Total		19			
Ido	1	Ilaju Ward	2	Increased Urbanization	1	50.0%
	2	Akufo Ward	1	Pollution and Environmental Degradation	1	100.0%
	3	Akinwaare Ward	3	Loss of Agricultural Land	2	66.7%

	4	Apete Ward	3	Increased Competition for Land	2	66.7%
	5	Idi-Iya Ward	1	N/A	0	0.0%
	6	Erinwusi Ward	2	Loss of Agricultural Land	1	50.0%
	7	Owode	7	Increased Urbanization	5	71.4%
	Total		19			
Overall Total			145			

Source: Author's Fieldwork, 2025

5.0 Conclusion and Recommendations

The integration of multi-temporal satellite data with localized household surveys confirms that urban agriculture in Ibadan serves as a vital socio-economic safety net, directly protecting 72.4% of practitioners from food insecurity. However, this essential food system is undergoing a severe geographic contraction due to rapid, unregulated urban expansion. As market forces favour the conversion of flat, accessible agricultural spaces into residential and infrastructural zones, active farmlands have collapsed to a critical low of 4.00%. Without deliberate policy intervention, the continuous erosion of close-range food supply lines leaves Ibadan increasingly vulnerable to food price volatility, supply shocks, and environmental degradation.

Based on the spatial metrics and field insights generated from this study, the following actions are recommended:

i. Institutionalize GIS-Driven Green Belts: Land-use planners must formally integrate satellite imagery and Geographic Information Systems (GIS) into Ibadan's master plans. This will allow authorities to accurately identify remaining high-yield agricultural clusters and establish protected green-belt zones to insulate them from unchecked real estate development.

ii. Enact Strict Urban Agricultural Zoning: Given that areas like Oluyole Estate, Olanla, and Ayoola compound face up to 100% agricultural land loss or severe land competition, municipal laws must introduce dedicated zoning protections. These protections should legally restrict the conversion of designated urban farmlands into residential or commercial structures.

iii. Support Multi-Sectoral Farming Frameworks: Since the majority of urban farmers are highly literate and balance farming with other professional occupations (such as civil service and trading), the local government should provide specialized extension services. These should focus on space-efficient vertical farming, micro-livestock management, and safe urban vegetable cultivation tailored to small residential plots like flats and traditional compounds.

iv. Mitigate Infrastructure Pollution in Peri-Urban Zones: Environmental monitoring agencies must enforce stricter regulations on construction companies operating in expanding peripheral zones like Olorisa-Oko to prevent heavy pollution and environmental degradation from destroying adjacent crop and livestock systems.

References

Abiola, F. A., & Nwokocha, H. I. (2023). Assessing urban growth and its impact on agricultural land: A spatial analysis in Ibadan. *Sustainable Cities and Society*, *82*, 103868. https://doi.org/10.1016/j.scs.2022.103868

Adediran, O. S., & Afolabi, A. A. (2022). Urban agriculture: A key ingredient for sustainable food systems in Nigeria. *Journal of Urban Food Systems*, *10*(3), 45-60. https://doi.org/10.1016/j.jufs.2022.03.014

Akanmu, A. A., Gbadamosi, K. T. & Omole, F. K. (2022). The Nexus between City Livability and Transportation in Lagos Metropolis, Nigeria. *Logistics, Supply Chain, Sustainability and Global Challenges,* 13(1), 1-18. https://doi.org/10.2478/jlst-2023-0001.

Asante, W., & Owusu, P. (2023). The role of GIS in urban agriculture assessment: Insights from Ghana. *African Journal of Agricultural Research*, *18*(2), 78-95.

Bello, D. O., & Chukwuma, U. O. (2025). Integrating satellite imagery into urban agriculture policy: A framework for enhancing food security in Ibadan. *Journal of Agriculture and Urban Development*, *15*(2), 123-138. https://doi.org/10.1080/21924962.2025.7618352

Binns, J., & Binns, T. (2025). Urban agriculture and land use planning: Challenges and opportunities. *Urban Planning Review*, *29*(1), 11-28.

Ekunsanmi, T. A., & Adekunle, A. A. (2023). Remote sensing applications in mapping urban agriculture: A case study of Ibadan. *International Journal of Environmental Science and Technology*, *20*(5), 3101-3115. https://doi.org/10.1007/s13762-023-00457-x

Gbadamosi, K. T. & Akanmu, A. A. (2023). Food security and population growth in Nigeria: The urban agriculture perspective. In Olorunfemi Oriola, E, O, et al. Population and Sustainable Development. A festschrift for Professor Olorunfemi Jacob Funsho. Department of Geography, University of Ilorin, Nigeria.

Ijeoma, I., & Ogbonna, A. (2024). Land use planning for urban agriculture: Challenges and policy recommendations for Nigerian cities. *Urban Planning International*, *39*(1), 97-112. https://doi.org/10.1016/j.upi.2024.01.005

Ijeoma, M., & Ogbonna, D. (2024). Understanding spatial patterns of urban agriculture in Nigeria: A systematic review. *Nigerian Journal of Agriculture*, *41*(1), 22-39.

Khan, M., & Ali, R. (2024). Urban agriculture and food security: Lessons from metropolitan areas. *International Journal of Urban Development*, *39*(2), 150-173.

Mahmoud, H., & Dabo, K. (2025). Sustainable livelihoods and urban agriculture in developing countries: A review of the literature. *Journal of Development Studies*, *61*(3), 230-245.

Moussa, S., & El Boukili, M. (2022). Urban agriculture: A conceptual framework for smallholder farming in cities. *Sustainability*, *14*(12), 7036.

Ogunbode, T., David, F., & Ismail, A. (2022). Social-ecological systems and urban agriculture: A case study of community gardens. *Urban Ecosystems*, *25*(4), 775-789.

Ogunsesan, A. S., Tejuosho, I. E., Animashaun I. O. & Adeleke, A. Y. (2026). Sustainable urban agriculture as a flood mitigation strategy in Ibadan, Nigeria: Residents' experiences. In Alade, A., Okesoto, J. O., Agamah, F. U. & Iyanda, O. (eds). Urban and regional planning, physical and transportation development policy. A festschrift in honour of TPL Dr Mobolaji Abubakar Olaseni fnitp, 323-353, The Olaseni Centre for Human, Physical and Socio-Economic Sustainable Development, Lagos. ISBN: 978 – 978 – 61863 – 8 – 2.

Pérez, R., Turner, J., & Caceres, A. (2023). Food systems and urban agriculture: A comprehensive review of challenges and innovations. *Global Food Security*, *35*, 100725.