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# Urban Agriculture (UA) and Soil Quality and Management in Owerri, Imo State, South Eastern Nigeria

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**Abstract**: Urban Agriculture is vital ecosystem services, offering multifunctional solution that addresses not only food security, but also broader socioeconomic and environmental goals. This study assessed the effect of urban agriculture in soil quality and management, focusing on evaluating the soil management practices of urban farmers and their effects on soil quality and food crop production, with a view to providing evidence-based recommendations for sustainable soil management and improved agricultural productivity in urban areas. It identified soil management practices employed by urban farmers, assessed soil quality used by urban farmers, investigated food crop production patterns and yields among urban farmers in Owerri, and examine the socio-economic and institutional factors influencing soil management practices in urban agriculture. The study employed mixed research design, utilizing both survey and laboratory experiment to generate and collect data. Primary data was solely used for the study. 384 copies of questionnaire and six soil samples were collected and analyze to generate the primary data. Farmland on river banks, road sides and vacant plots were systematically sampled from both urban and suburban locations in the study area. The soil properties analyzed are the textural properties, chemical properties and heavy metal concentration in the sampled farm locations. The research identified that 50% of the farmers farm on farmlands that is less than 0.5 hectares, and 50.3%, farm on a rented land. About 47.4% of farmlands in Owerri is located on the river bank, and majority (55.5%), farm both for family consumption and for commercial purposes. There is a variation both positive and negative in the soil texture, chemical properties, and heavy metal concentration in farmlands on River banks, road sides and vacant plots in both urban and suburban farm locations in Owerri. The F value of 0.52, 0.079, 0.006 and 0.016 respectively shows that there is no interaction between urban and suburban farmers, no significant difference in soil quality across farm locations, no significant difference in soil quality in urban and suburban areas and no significant effect on soil qualities in Owerri. The correlation coefficient of 0.517 shows a strong positive relationship between soil amendment and crop yield. farm size and type of soil amendment contributed 63.7% of crop yield in the study area. The study revealed that soil quality is a major factor affecting crop yield. The study recommends among others that urban farmers should be provided with soil testing services at low cost, training on composting and other soil amendment methods, and financial institutions like ADB and others should grant farmers loan at no or low interest rate

## INTRODUCTION

Urbanization has become one of the most defining demographic trends of the 21st century, significantly shaping social, economic, and environmental landscapes worldwide. As of 2023-2025 and estimates given, more than half of the global population now resides in urban areas, with projections indicating that this proportion will rise dramatically, particularly in Sub-Saharan Africa (O'Sullivan, 2023; Ayeni et al., 2025). By 2100, it is anticipated that the world's 101 largest urban agglomerations will house between 1.6 and 2.3 billion people, representing up to 23% of the global population (Hoornweg & Pope, 2016). This rapid urban expansion, often occurring faster than urban infrastructure and planning capacities can keep pace, leads to substantial challenges, including food insecurity, rising poverty, and environmental degradation (Ayeni et al., 2025; Brown, 2024).

The complex interplay of these factors has made urban agriculture (UA) a critical focus for sustainable urban development, particularly in rapidly urbanizing regions of the Global South. UA encompasses the cultivation, processing, and distribution of food and other products within and around cities, providing a means to enhance food security, reduce household food expenditures, and contribute to local economic resilience (Orsini et al., 2020). Furthermore, UA contributes vital ecosystem services, including waste recycling, urban green infrastructure, and microclimate regulation, which help mitigate the negative environmental effects of urbanization (Ilieva et al., 2022; Mwetulundila and Indongo, 2025). UA offers a multifunctional solution that addresses not only food security but also broader socio-economic and environmental goals. However, its sustainability is heavily contingent upon the quality of the urban soil upon which it relies, a resource that is often compromised by urban pressures such as pollution, compaction, and contamination (Aslanidis & Golia, 2022; Stasio et al., 2025).

The sustainability of UA practices is closely tied to soil quality, which in urban settings is typically far from optimal. Urban soils are frequently altered and degraded due to factors such as industrial activities, construction, transportation, and improper waste disposal (Aslanidis & Golia, 2022; Zandybay et al, 2024). These soils are typically heterogeneous, often compacted by urban infrastructure, and frequently contaminated with heavy metals such as lead (Pb), cadmium (Cd), and zinc (Zn), which can undermine soil fertility and pose significant risks to human health through bioaccumulation in crops (Rai et al., 2019; Gao et al., 2025). The soil degradation in urban areas is further compounded by the presence of harmful substances, such as pesticides and pathogens, which may accumulate through waste products and pollutants entering the soil system. These contaminants not only threaten the environment but also endanger the health of urban dwellers who rely on locally grown produce.

Soil management in urban farming is uniquely challenging due to these factors. While UA is a vital response to food security and environmental degradation in cities, urban farmers often face difficulties managing soils that have been altered by long-term anthropogenic influences. Farmers in urban areas frequently lack access to formal agricultural inputs, extension services, and knowledge about sustainable farming techniques. Consequently, they often resort to informal practices, such as using raw or partially composted organic amendments like municipal solid waste, poultry manure, or untreated wastewater for irrigation (Olarewaju et al., 2025). Although these practices provide immediate benefits in terms of soil fertility and crop productivity, they can exacerbate contamination levels and contribute to the long-term degradation of the soil. As such, there is an urgent need to understand the implications of these practices on soil health and sustainability in urban agriculture (Gao et al., 2025; Rai et al., 2019).

Owerri is characterized by rapid urban expansion, which has led to increased land-use change, environmental stress, and a rise in informal settlements. These settlements are often situated in areas with poorly managed infrastructure and contaminated soils, which can significantly affect agricultural practices. The city's growing population, along with its lack of adequate planning for urban agriculture, creates both opportunities and challenges for sustainable urban farming (Ayeni et al., 2025). Yet, despite the widespread practice of

UA, limited attention has been paid to understanding the relationship between farmer practices and the management of soil quality in these urban settings. As a result, farmers in Africa as opined by Mesele et al, (2025), continue to face challenges in improving soil fertility and productivity due to the poor condition of the soil, which is often compounded by a lack of access to formal soil management resources and knowledge.

The practice of UA in Owerri is primarily informal, and the urban soil environment is often used in ways that can exacerbate contamination. For example, the use of untreated waste, unregulated water sources, and overuse of chemical fertilizers can lead to the accumulation of heavy metals in soils and crops, which is a critical public health concern (Ayozie-Samuel et al, 2023). Given the rapid pace of urbanization in Owerri, it is essential to better understand how urban agriculture interacts with urban soils, how farmers manage these soils, and the potential implications for food safety and public health. This research will focus on evaluating the role of UA in soil quality management within the city, examining how farmer practices influence the condition of urban soils, and providing insights into sustainable soil management strategies that could enhance both soil quality and food security. Globally, the benefits of UA are widely recognized, but its sustainability is deeply intertwined with the quality of urban soils. The need for further studies, particularly in rapidly urbanizing African cities like Owerri, is paramount to bridging the knowledge gap and improving the management of urban soils in UA systems.

Despite its growing importance, urban agriculture in Owerri faces considerable challenges related to the quality of the urban soil, which is central to agricultural productivity and sustainability. The soils in many urban areas, including Owerri, are often compromised by factors such as contamination from industrial activities, auto mechanic workshops, traffic emissions, poor waste management, and rapid urban expansion (Okon et al., 2021). These factors result in soils that are not only nutrient-deficient but also increasingly polluted with heavy metals and other toxic substances. The consequences of such soil degradation can be severe, as it directly affects crop yields, increases the risk of food borne illnesses, and poses long-term environmental health risks to urban populations who depend on locally grown produce.

Despite the growing recognition of the socio-economic benefits of urban agriculture, especially in urbanizing areas of Sub-Saharan Africa, there is a notable gap in research regarding the specific impacts of urban agricultural practices on soil quality. The relationship between farming practices and soil health has not been systematically studied in Owerri, particularly with regard to key soil quality indicators such as pH, organic carbon content, nutrient levels, and heavy metal concentrations. This gap in knowledge is particularly concerning, as it hinders the development of evidence-based policies and interventions that could guide safe and sustainable soil management practices for urban farmers in the city. Moreover, the socio-economic constraints faced by urban farmers, such as limited access to formal agricultural inputs, extension services, and knowledge about sustainable practices, are not well understood in the Owerri context. These constraints, coupled with the lack of formal oversight and regulation of urban farming activities, may contribute to poor decision-making regarding soil management, further exacerbating the degradation of urban soils. As urbanization accelerates in Owerri, it is crucial to understand how these practices interact with soil health and how they can be improved to ensure the long-term sustainability of urban food production.

The type of urban agriculture examined in this study is specifically soil-based crop production, which represents the most predominant and widespread form of urban farming practiced across Owerri's informal farming landscapes. Within this, the study focuses on the cultivation of leafy and vegetable crops, fruits, cassava and yam which are the most commonly grown food crops in urban Owerri. These crops are selected because they are intensively cultivated on urban soils, have short growing cycles that demand frequent soil inputs and amendments, are consumed directly by urban residents with minimal processing, and are consistently identified in the literature as among the highest accumulators of heavy metals from contaminated urban soils, thereby posing the most direct and significant risk to public health and food safety in the city (Rai et al., 2019; Ayozie-Samuel et al., 2023; Rashid et al., 2023). Without a focused understanding of how current soil management practices affect the soils on which these specific crops are grown, the potential benefits of urban agriculture, particularly in the areas of food security and environmental health, may be seriously undermined, jeopardizing the health and livelihoods of urban populations in Owerri and similar Nigerian cities. Thus, this study aims to fill this critical gap by providing a contextual, evidence-based foundation for improving soil quality management in urban crop production in Owerri, which will ultimately contribute to the sustainability and safety of urban food systems in Nigeria. The study therefore identified the soil management practices employed by urban farmers, assessed the soil quality used for food crop production in the urban and suburban areas, assessed the food crop production pattern and yield, as well as identifying the key challenges to improving soil quality management in urban agriculture

## STUDY AREA AND METHODOLOGY

### The Study Area

The study area is Owerri urban seen on figure 1.0 and 2.0. Owerri is the capital city of Imo State in southeastern Nigeria. It is located approximately between Latitudes 5°20′N and 5°45′N, and Longitudes 6°45′E and 7°05′E.

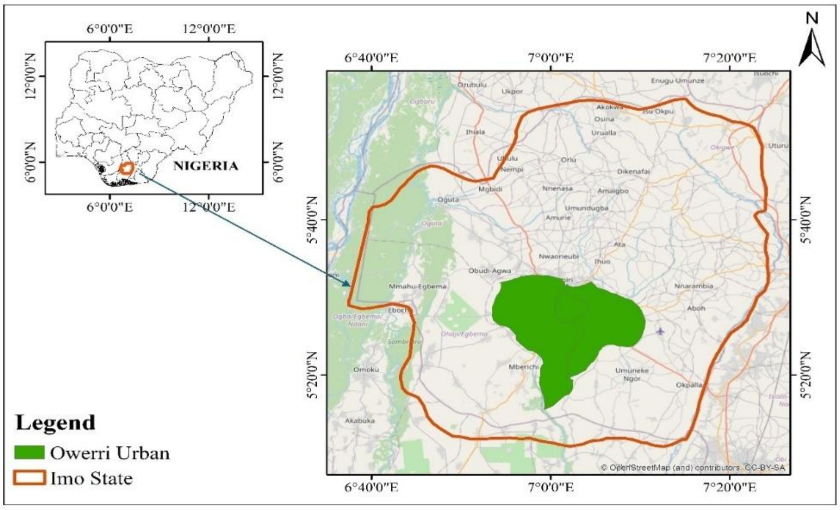


**Figure 1: Location of Imo state on the map of Nigeria.**

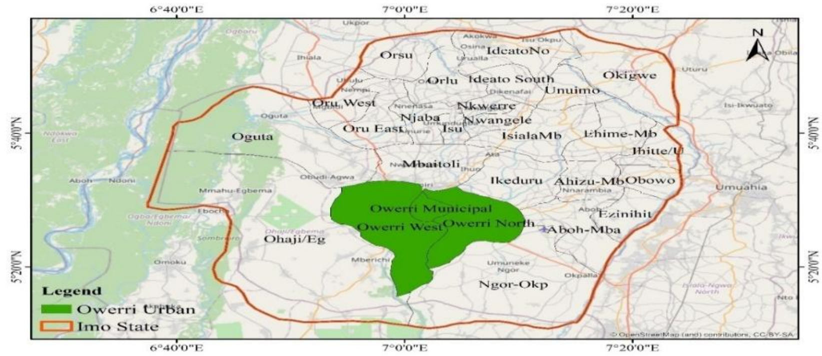


**Figure 2: Location of Owerri Urban on the Map of Imo State.**

As an urban center, Owerri functions as the political and commercial hub of the state, drawing population from surrounding rural areas. The city's administrative boundaries encompass several local government areas, including Owerri Municipal, Owerri North, and Owerri West, which together form the core of the Owerri Urban area.

Owerri experiences a tropical monsoon climate, typical of the Niger Delta region. It is characterized by distinct wet and dry seasons driven by the interplay of the tropical maritime and tropical continental air masses. The wet season spans from April to October, with a characteristic double rainfall maxima. The first peak occurs in June or July, followed by a brief period of reduced rainfall known as the "August break," and a second peak in September. Annual rainfall totals are high, ranging from 1,600 mm to 2,900 mm. The dry season lasts from November to March, dominated by the dry and dusty harmattan winds from the Sahara Desert. Temperatures are uniformly high throughout the year, with a mean annual temperature of approximately 26-28°C, and high relative humidity, often exceeding 80% during the wet season. The natural vegetation is tropical rainforest, characterized by tall, broad-leaved trees, but significant clearing for urbanization, infrastructure, and agriculture has resulted in a predominantly derived savanna landscape with secondary forest regrowth and widespread farmland (Iwuji et al., 2025).

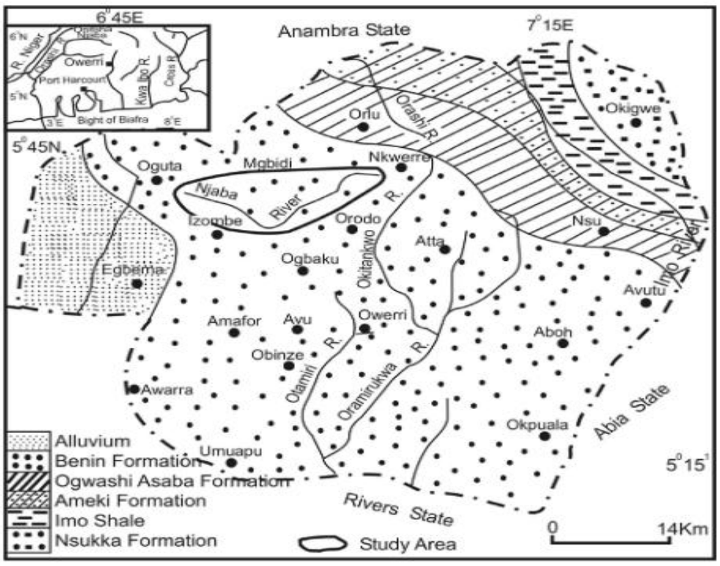


**Figure 3: Geology Map of Imo State**

Geologically, Owerri is situated within the Benin Formation (Miocene to Recent), a major litho-stratigraphic unit in the Niger Delta Basin as depicted in the geologic map of Imo State (figure 3) This formation is composed predominantly of friable, coarse-grained sands and sandstones, with intercalations of claystones and shales (Chibo and Fashae, 2025). The geology gives rise to deep, porous, and generally well-drained soils. The topography is predominantly undulating lowlands, with gentle slopes and occasional isolated hills. The underlying geology heavily influences the local hydrology, contributing to a shallow water table in many areas, which farmers often exploit for irrigation. However, the same porous nature of the soils can facilitate the rapid downward movement of contaminants from surface activities, posing a risk of leaching and groundwater pollution (Ayozie-Samuel et al., 2023, Chibo, 2022).

The economy of Owerri is primarily driven by public administration, commerce, and services. The city hosts numerous government ministries, parastatals, and educational institutions, which are major employers. Commercial activities are vibrant, with large open markets serving as hubs for the distribution of foodstuffs, manufactured goods, and imported items. The service sector, including banking, hospitality, and telecommunications, is also rapidly growing. Agriculture plays a significant but often under-recognized role in the urban economy. Urban and peri-urban farming provides a source of livelihood for many low-income households, supplementing family income and reducing food expenditure. Key agricultural activities include the cultivation of vegetables like fluted pumpkin (*Telfairia occidentalis*), waterleaf (*Talinum triangulare*), plantain, banana and some other fruits, as well as the rearing of small livestock such as cat fish, poultry, goats, and pigs. The proximity to urban markets provides farmers with direct access to consumers, making urban agriculture a commercially viable, albeit informal, enterprise (Okon et al., 2017).

## Methodology

A mixed-methods research design was adopted to investigate urban agriculture and soil quality and management in Owerri. This is because the research problem is inherently multifaceted, requiring both the objective measurement of biophysical soil properties and a holistic understanding of the human decisions, perceptions, and socio-economic realities that shape those properties. The qualitative assessment provides the contextual depth and interpretive necessary to give full meaning to the quantitative soil properties generated through the instrument of questionnaire. The quantitative component employs two complementary instruments, namely a structured questionnaire survey and a cross-sectional soil sampling and laboratory analysis. These together generate the numerical data necessary to test the study's hypotheses and address the research objectives. The research classified Owerri into two sections - Urban and Sub Urban areas. Reconnaissance survey carried out exposed that farming activities in Owerri is carried out in three different locations (River banks, Road sides and vacant plots). Therefore, soil samples were collected from these farm location from both urban and sub urban farmlands. A total of six (6) soil samples were collected - three from urban and three from sub-urban farmlands located along river banks, road sides and vacant plots. These soil samples were tested for textural properties, chemical properties and heavy metal concentration. Laboratory analysis were conducted for soil textures, pH, Soil Organic Carbon, total nitrogen, available phosphorus and concentrations of lead and cadmium as the primary heavy metal contaminants of concern in the urban farming context. In addition, 384 copies of questionnaire were distributed to urban and sub-urban farmers to get primary information on farmers demographics, soil management practices, crops produced, soil quality perceptions, and challenges faced in the course of urban farming.

The quantitative data generated from both the soil laboratory analysis and the structured questionnaire survey were entered, coded, and analyzed using the Statistical Package for the Social Sciences software (SPSS). Descriptive statistics - means, standard deviations, and frequency distributions were used to present the generated data. Inferential statistical techniques - Pearson Correlation Analysis, Multiple Regression Analysis and Two Way Analysis of Variance were employed to examine the relationships and differences between soil quality indicators, soil management practices, and food crop production outcomes in the urban and sub-urban farmland in Owerri.

## PRESENTATION AND DISCUSSION OF RESULTS

### Location of Farm in Owerri urban and Suburban Areas

Information obtained from the respondents showed that there are three locations where these farming activities takes place in Owerri Urban and suburban area, and these three locations are seen in Table 1

**Table 1: Location of Farmlands in Owerri Urban**

| Category | Frequency | Percentage (%) |
|---|---|---|
| **Riverbank** | 182 | 47.4 |
| **Roadside** | 101 | 26.3 |
| **Residential compound** | 61 | 15.9 |
| **Vacant plot** | 40 | 10.4 |
| **Total** | 384 | 100.0 |

Source: Field Survey Data, 2026

As observed from the information in Table 1, 47.4% of the farms, were located along riverbanks. This is followed by roadside farms with 101respondents or 26.3% of the sample population. This distribution raises important soil quality concerns, since riverbank and roadside locations are typically exposed to sediment-borne contaminants and vehicular pollution. Only about 10.4% of the urban farms are found in vacant plots n the study area

### Main Crop Cultivated by Urban Farmers in Owerri

The main crops cultivated by farmers in Owerri Municipal is presented in Table 4.10. The major crops cultivated by the farmers is presented in Table 4.10

As presented in Table 2, maize was identified to be the most widely cultivated crop in urban and suburban of Owerri. This the view of 145 respondents, or about 37.8% of the sample population. This is followed closely by cassava, as indicated by 33.3% of the sample population. The next is plantain (74, 19.3%), and vegetables (37, 9.6%). This pattern reflects farmers' preference for staple food and cash crops that are relatively tolerant of variable urban soil conditions.

**Table 2: Main Crop Cultivated**

| Main Crops Cultivated | Scientific Name | Frequency | Percentage (%) |
|---|---|---|---|
| **Vegetables** | | 37 | 9.6 |
| **Plantain** | *Musa Paradisiaca* | 74 | 19.3 |
| **Maize** | *Zea Mays* | 145 | 37.8 |
| **Cassava** | *Manihot Esculente* | 128 | 33.3 |
| **Total** | | 384 | 100.0 |

Source: Field Survey Data, 2026

The Study went further to investigate the type of vegetables cultivated by the farmers, and the information obtained is presented in Table 3

**Table 3: Main Vegetable Cultivated in the Study Area**

| Main Vegetable Cultivated | Scientific Name | Frequency | Percentage (%) |
|---|---|---|---|
| Fluted pumpkin | *Telfairia Occidentalis* | 144 | 37.5 |
| Waterleaf | *Talinum Frutocosum* | 192 | 50.0 |
| Scent leaf | *Ocimum Gratissimum* | 48 | 12.5 |
| Total | | 384 | 100.0 |

Source: Field Survey Data, 2026

Information in Table 3 shows that waterleaf was the most commonly cultivated vegetable, as indicated by 192 respondents or 50.0% of the sample population. This is followed by fluted pumpkin (144, 37.5%) and scent leaf (48, 12.5%). These leafy vegetables are known to be fast-growing and heavily dependent on frequent soil amendment, which has direct implications for Objective 1 of this study.

### Soil Quality used for Farming in Owerri Urban and Suburban Areas

#### *Soil Textural Properties and Heavy Metal Concentration of Soils in Owerri Suburban Farmlands*

The information in Table 4 shows the quality of soils used for farming in Owerri sub-urban locations

The textural soil properties in the sub-urban farming locations, showed that the soil comprised of loamy sand and sandy loam. The percentage sand composition of the soil in Owerri West ranged from 63 - 80%, while in Owerri North, it ranged from 62 - 72%, with an average sandy composition of 70%. The silt composition of farmlands in Owerri North ranged from 15% - 22%, with the highest obtained from roadside farm, and the least, from farmland on vacant plot. By implication, the averagely high silt composition showed that the soils in the farmland is relatively more compatible. The percentage clay composition of the soil ranged from 5-12%, with least found in the vacant plot, and the highest seen in the farmlands on the roadside. For farmlands in Owerri North, the silt composition ranged from 19%-28%, with soil in the roadside having the highest composition, while that in the vacant plot have the lowest silt composition. This is an indication that soil along the roadside is more fertile than soil in other two locations. The soil porosity, was observed to be highest in the roadsides farms in the two Local Government areas (LGAs). The least value was found in the vacant. The average sand, silt and clay respectively for suburban farmlands are 66.5%, 22.5 and 11% for River bank, 62.5, 26.5 and 11.5% for Road side farmlands, and 78%, 17% and 5% for farmlands in vacant plots. This by implication means that farmlands in Riverside and Roads sides are Sandy loam, those in Vacant plots are loamy sand, indicating farmlands in vacant plots are relative more fertile than those in the other two locations. This reason for this can be attributed to disposal of most domestic wastes on vacant plots around residential buildings.

**Table 4: Results of Soil Textural, Chemical Properties and Heavy Metals Metal Concentration for Owerri West and Owerri North (Sub-urban Farming)**

| Parameters | Units | Owerri West | | | Owerri North | | | Average | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | River Bank | Road Side | Vacant Lot | River Bank | Road Side | Vacant Lot | River Bank | Road Side | Vacant Lot |
| **Sand** | % | 68 | 63 | 80 | 65 | 62 | 76 | 66.5 | 62.5 | 78 |
| **Silt** | % | 22 | 25 | 15 | 23 | 28 | 19 | 22.5 | 26.5 | 17 |
| **Clay** | % | 10 | 12 | 5 | 12 | 10 | 5 | 11 | 11 | 5 |
| **Texture** | - | Sandy loam | Sandy loam | Loamy Sand | Sandy loam | Sandy loam | Loamy Sand | Sandy loam | Sandy loam | Loamy Sand |
| **Porosity** | % | 43.8 | 46.8 | 40.0 | 45.3 | 48.8 | 42.0 | 44.55 | 47.8 | 41 |
| **Organic carbon** | % | 0.02 | 0.32 | 0.08 | 0.03 | 0.28 | 0.04 | 0.025 | 0.3 | 0.06 |
| **pH** | mg/kg | 6.1 | 6.30 | 7.28 | 5.1 | 5.3 | 7.1 | 5.6 | 5.8 | 7.19 |
| **Nitrogen** | mg/kg | 3687.5 | 10062.5 | 3062.5 | 3686.6 | 11012.6 | 3554.6 | 3637.5 | 10537.6 | 3612.1 |
| **Phosphorus** | mg/kg | 595.0 | 325.0 | 122.5 | 585.0 | 335.0 | 198.5 | 590 | 330 | 160.5 |
| **Lead** | mg/kg | 8.06 | 8.47 | 4.37 | 8.09 | 8.27 | 4.21 | 8.08 | 8.37 | 4.29 |
| **Cadmium** | mg/kg | 4.69 | 1.01 | 1.4 | 4.60 | 1.03 | 1.3 | 4.65 | 1.02 | 1.35 |
| **Zink** | mg/kg | 75.8 | 78.48 | 22.32 | 76.6 | 79.41 | 22.11 | 76.2 | 78.9 | 22.22 |

The concentration of the Organic Carbon (OC) varies from 0.02% - 0.32% for farmlands in Owerri west, with the highest value obtained for soils at road side. For Owerri North, the organic Carbon(OC) concentration ranges from 0.03% - 0.28%, with the highest value found in the farmlands located at the road side. The high of the OC at farmlands on the roadside might be as a result carbon emission from vehicles that ply these roads. The values of the OC were also observed to the least around farmlands located at the river banks, and this might be attributed to the dilution effects of water and the sequestration of most of the carbons by plants and trees found around the river banks. The pH value of the soil indicated that the soil in the farmlands ranged from slightly acidic to highly alkaline. The soils in the river banks and roadside farms are acidic, the soils in vacant plots are basic. The Nitrogen concentration in the soils of the farmlands were observed to be very high. The concentration of this chemical nutrient in farmland ranged from 3062.5mg/kg to 11012.6kg. The highest Nitrogen concentrations for farmland in the both Local Government were found along road sides. The least amount of Nitrogen found in the farmland were observed at Riversides farms for the both LGAs. On the average, the amount of Nitrogen found in the farmland for the sampled farmlands were observed to be 5929.1mg/kg. The Phosphorous

(K) content of the soils in the various farmlands from the area were found to high, with the highest value observed for farmlands along the Riverside followed by road sides and the least, on vacant lots. The mean phosphorous composition of the soils were computed to be 360.2mg/kg. The high concentration of Nitogen and phosphorus found in these soils might not be unconnected by the soil management practices adopted by the farmers in the study area. The Lead (Pb) concentration of the soils in ranged from 4.37mg/kg to 8.06mg/kg for Owerri West, and 4.21mg/kg to 8.27mg/kg for Owerri North. From both LGAs, the highest Lead concentration was observed in farmlands on Roadside, while the least was observed in farmland on the vacant lots. Cadmium (Cd) concentration showed that this heavy metal in the soil ranges from 1.01mg/kg- 4.69mg/kg, and 1.03mg/kg to 4.60mg/kg for Owerri west and Owerri North LGAs respectively. The result exposed that the highest concentration was observed on soils around the Riverside and the least were found on soils along the Roadsides. The last heavy metal observed from farmland in suburban soils was Zink (Zn). The Zn concentration ranged from 22.32mg/kg to 78.48mg/kg for soils in Owerri West, and 22.11mg/kg to 79.41mg/kg for the soil in Owerri North. The highest concentrations of Zink was found in the soils from farmlands located on the Roadsides

***Soil Textural Properties and Heavy Metal Concentration of Soils in Owerri Municipals LGA and Mbieri (Urban Farmlands)***

The information in Table 5 represents the soil textural properties and heavy metal concentration in the selected farmlands in urban locations of the study area

**Table 5: Results of Soil Textural Properties and Heavy Metals for Owerri Municipal and Mbieri (Urban Farming)**

| Parameters | Units | Owerri Municipal | | | Mbieri | | | Average | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | River Bank | Road Side | Vacant Lot | River Bank | Road Side | Vacant Lot | River Bank | Road Side | Vacant Lot |
| **Sand** | % | 82.0 | 60.0 | 65.0 | 80.0 | 61.0 | 67.0 | 81.0 | 60.5 | 66.0 |
| **Silt** | % | 13.0 | 25.0 | 25.0 | 15.0 | 23.0 | 15.0 | 14.0 | 24.0 | 20.0 |
| **Clay** | % | 5.0 | 15.0 | 10.0 | 5.0 | 16.0 | 18.0 | 5.0 | 15.5 | 14.0 |
| **Texture** | - | Loamy Sand | Sandy loam | Sandy loam | Loamy Sand | Sandy loam | Sandy loam | Loamy Sand | Sandy loam | Sandy loam |
| **Porosity** | % | 40.0 | 47.5 | 45.6 | 42.0 | 46.2 | 43.5 | 41.0 | 46.9 | 45.0 |
| **Organic carbon** | % | 0.03 | 0.48 | 0.04 | 0.03 | 0.44 | 0.05 | 0.03 | 0.46 | 0.04 |
| **PH** | mg/kg | 6.2 | 7.3 | 6.27 | 5.9 | 7.4 | 6.13 | 6.05 | 7.35 | 6.2 |
| **Nitrogen** | mg/kg | 4875.0 | 2187.5 | 6000.0 | 4761.0 | 2217.5 | 5820.0 | 4818.0 | 2202.5 | 5910 |
| **Phosphorus** | mg/kg | 520.0 | 225.0 | 975.0 | 515.0 | 230.0 | 980.0 | 517.5 | 227.5 | 977.5 |
| **Lead** | mg/kg | 45.63 | 609.36 | 63.07 | 51.55 | 600.32 | 60.07 | 48.59 | 622.22 | 61.57 |
| **Cadmium** | mg/kg | 0.65 | 1.44 | 0.66 | 0.60 | 1.45 | 0.79 | 0.63 | 1.45 | 0.72 |
| **Zink** | mg/kg | 102.42 | 59.74 | 37.18 | 104.42 | 57.75 | 39.14 | 103.42 | 58.75 | 38.16 |

The textural soil properties in the urban farmland locations, showed that the soil comprised of loamy sand and sandy loam. The loamy sand was found in the farmlands located in the riverside, while the sandy loam was observed at roadside and vacant lot farmlands, indicating more fertile land was observed in river bank farmlands. The percentage sand composition of the soil in Owerri Municipal ranged from 60% - 82%, while in Mbieri, it ranged from 61% - 80%, with an average sand composition of 69%. The silt composition ranged from 13% - 22%, with the highest obtained from both roadside and vacant lots farm, and the least from farmland on riverside. The high silt composition showed that the soils in the farmland in urban locations is relatively compatible and may not vulnerable to soil erosion (Chibo, et al 2026). The percentage clay composition of the soils in urban farmlands ranged from 5-18%, with least found in the riverside farms, and the highest seen in the farmlands on the vacant plots. The clay composition of soils in the farmlands in Mbieri has a composition which ranged from 5% - 18% with the highest seen in vacant plot and least observed for riverside farms. The porosity of the soil indicated the water retention capacity of the soils were observed to be highest in the farmlands on the roadsides, while the least were found in the vacant plots. The average sand, silt and clay respectively for urban farmlands in the study area are 81%, 14% and 5% for River bank, 60.5%, 24.0% and 14.5% for Road side farmlands, and 66%, 20% and 14% for farmlands in vacant plots. This means that while most of the farmlands on vacant plots and Roads sides are Sandy loam, those in River bank plots are loamy sand, indicating farmlands in River banks plots are more fertile than those in the other two locations

The concentration of the Organic Carbon (OC) varies from 0.03% - 0.48% for farmlands in Owerri Municipal, with the highest value obtained for soils at road side. For Mbieri, the organic Carbon (OC) concentration ranges from 0.03% - 0.44%, with the highest value found in the farmlands located at the road side. The high of the OC in farmlands on the roadside in urban farmlands, might be as a result carbon emission from vehicles that ply these roads. The values of the OC were also observed to the least around farmlands located at the river banks, and this might be attributed to the dilution effects of water and the sequestration of most of the carbons by plants and trees found around the river banks. The pH value of the soil indicated that the soil in the farmlands ranged from slightly acidic to highly alkaline, with soils in the river banks and vacant farms being acidic, and the soils in roadsides, highly alkaline. The concentration of Nitrogen ranged from 2187mg/kg to 6000kg. The highest Nitrogen concentrations were found in farmland located in vacant plots, and the least concentration found in the farmland located at Roadsides. The average Nitrogen concentration was observed to be 4176.83mk/kg. The Phosphorous (K) concentration was found to be high, with the highest value observed for farmlands along the vacant plots, followed by river banks and the least, on the road sides. The mean phosphorous composition of the soils were computed to be 574.16mg/kg in the urban farm locations. The Lead (Pb) composition ranged from 45.63mg/kg to 609.36mg/kg for Owerri Municipal, and 51.55mg/kg to 600.32mg/kg for Mbieri. In urban area, the highest Lead concentration was observed in farmlands on Roadside, while the least was observed in farmland on the riversides. The Average lead concentration for all the farmlands was 244.12mg/kg. The Cadmium (Cd) concentration in Owerri urban farmlands in the farmlands ranged from 0.65mg/kg-1.44mg/kg, and 0.60mg/kg to 1.45mg/kg for Owerri Municipal and Mbieri, respectively. The highest concentration was seen on soils around the roadside and the least was found on soils along the River banks. The mean Cd concentration of the soils in the farmlands of the area was 3.8mg/kg. The Zn concentration ranged from 37.18mg/kg to 102.42mg/kg for soils in Owerri Municipal, and 39.14mg/kg to 104.42mg/kg for the soil in Owerri Mbieri. The average Zn concentration in soils from urban farmlands in Owerri is 66.78mg/kg. The average heavy metal concentration of the soils from farmlands in various farms in Owerri Urban for riverbank, road sides and vacant plots respectively are as follows - OC (0.03%, 0.34% and 0.04%); N (4818mg/kg, 2202.5mg/kg and 5910mg/kg); P(51.7mg/kg, 227.5mg/kg and

597.5mg/kg); Pb (48.59mg/kg, 622.22mg/kg and 61.57mg/kg); Cd (0.63mg/kg, 1.15mg/kg and 0.72mg/kg); and Zn (103.42mg/kg, 8.7mg/kg, and 38.16mg/kg)

***Variations in Soil Textural Properties and Heavy Metals in Urban and Sub-Urban Farming Locations***

The information in Table 6 showed the variations in soil textural, chemical properties and heavy metals concentrations in Suburban and Urban Farmlands in Owerri

**Table 6**

| **Parameters** | **Units** | **Urban** | | | **Sub-Urban** | | | **Variations** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | River Bank | Road Side | Vacant Lot | River Bank | Road Side | Vacant Lot | River Bank | Road Side | Vacant Lot |
| Sand | % | 81.0 | 60.5 | 66.0 | 66.5 | 62.5 | 78.0 | 14.5 | -2.5 | -12 |
| Silt | % | 14.0 | 24.0 | 20.0 | 22.5 | 26.5 | 17.0 | -8.5 | -2.5 | 3.0 |
| Clay | % | 5.0 | 15.5 | 14.0 | 11.0 | 11.0 | 5.0 | -6.0 | 4.5 | 9.0 |
| Porosity | % | 41.0 | 46.9 | 45.0 | 44.55 | 47.8 | 41.0 | -3.55 | -0.9 | 4.0 |
| Organic carbon | % | 0.03 | 0.46 | 0.04 | 0.025 | 0.3 | 0.06 | 0.0 | 0.16 | -0.02 |
| PH | | 6.05 | 7.35 | 6.2 | 5.6 | 5.8 | 7.19 | 0.45 | 1.55 | -0.99 |
| Nitrogen | mg/kg | 4818.0 | 2202.5 | 5910 | 3637.5 | 10537.6 | 3612.1 | 1180.5 | -8335.1 | 2297.9 |
| Phosphorus | mg/kg | 517.5 | 227.5 | 977.5 | 590 | 330 | 160.5 | -72.5 | -102.5 | 817.0 |
| Lead | mg/kg | 48.59 | 622.22 | 61.57 | 8.08 | 8.37 | 4.29 | 40.51 | 63.85 | 57.28 |
| Cadmium | mg/kg | 0.63 | 1.45 | 0.72 | 4.65 | 1.02 | 1.35 | -4.02 | 0.43 | -0.63 |
| Zink | mg/kg | 103.42 | 58.75 | 38.16 | 76.2 | 78.9 | 22.22 | 27.22 | -20.15 | 15.94 |

A significant variation exists in soil properties in urban and suburban farmlands in Owerri. some of the variations are positive in some areas, and negative in others. The sand composition of the soil from Urban farmland is higher than the suburban farm. More sands are found in roadside and vacant plots in the soil in suburban farmland, than soils in roadside and vacant plots in urban farmlands. Silt composition is higher for soils in vacant plots in urban farmlands than vacant plots in suburban farmlands, and it is less in river banks and roadside in urban than suburban farmlands. The variation between clay composition in the Urban and suburban farmland is 6% for roadside farms, and for River bank and vacant lots, are 4.5% and 9.0% respectively. The Soils in the River bank and road side of suburban farmland are more porous than those in the urban farmland with a variation of 3.55% and 0.9% respectively. Soil porosity was observed to be higher in the vacant plot of the urban farmland with a variation of 4% than that of the suburban farmland.

For chemical properties and heavy metals concentrations among the soil in urban and suburban locations of Owerri, variations also exists. There was a highly basic soil (pH = 7.35) from roadside farmland in urban area, and a slightly acidic soil (pH = 5.8), from same location in suburban areas. The variations that exists in pH of soils in urban and suburban farmlands as follows; River bank farmlands (0.45), Road side farmlands (1.55), Vacant plot farmlands (-1.99). The greatest variations in Nitrogen concentration in urban and sub urban farmlands was observed in roadside farmland, with a variation of 8335.1mg/kg. The Nitrogen concentration variations of 1180.5mg/kg and 2297.9mg/kg respectively for River banks and vacant plots. The variations in the concentration of phosphorus for River bank, road side and vacant plots respectively are -72.5mg/kg, -102.5mg/kg and 817.0mg/kg. The phosphorus concentration is higher by 72.5mg/kg in River bank farms in suburban than urban farmlands. In Road side farms, phosphorus concentration is higher in suburban farmland than in urban farmland by 102.5mg/kg, and in Vacant plot, higher in urban than in suburban farmlands by 817.0mg/kg. The lead (Pb) concentrations were higher in all the farmlands in urban than suburban locations, with 40.51mg/kg in river bank, 63.85mg/kg in roadside and 57.28mg/kg in vacant plots farmlands. The Cadmium (Cd) concentration is higher in suburban areas on farmland located on river banks and vacant plots by 4.02mg/kg and 0.63mg/kg respectively, and higher in urban farmlands located on road side by 0.43mg/kg. The variation in Zink (Zn) concentration exposed that this heavy metal is higher in urban locations on farmland located on River banks and vacant plots, while it is higher in suburban areas in farmlands located on road side by 20.15mg/kg.

### Soil Management Practices of Urban Farmers

The soil management practices, type and source of organic amendments, frequency of amendment applications and use of inorganic fertilizer is presented in Table 7.

**Table 7: Soil Management Practices used by Urban Farmers in Owerri**

| **Type of soil Amendment used** | | | **Source of Organic Amendment** | | | **Frequency of Organic amendment application** | | | **Type of Inorganic Fertilizer** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | F | % | Source | F | % | Frequency | F | % | Type | F | % |
| Poultry Droppings | 134 | 34.9 | Poultry Farm | 181 | 47.1 | Every Season | 265 | 69.0 | NPK | 346 | 90.1 |
| Compost Manure | 96 | 25.0 | household Waste | 136 | 35.4 | Once a year | 85 | 22.1 | Urea | 38 | 9.9 |
| Kitchen Waste | 77 | 20.1 | commercial Vendor | 67 | 17.6 | Once in 2 years | 34 | 8.9 | | | |
| Chemical Fertilizer | 58 | 15.1 | | | | | | | | | |
| Ash/burnt Biomass | 19 | 4.9 | | | | | | | | | |
| Total | 384 | 100 | Total | 384 | 100 | Total | 384 | 100 | Total | 384 | 100 |

Poultry droppings were the most widely used soil amendment (34.9%) by the urban farmers, followed by compost manure (25.0%) and kitchen waste (20.1%), while chemical fertilizer (15.1%) and ash/burnt biomass (4.9%) were not very common to the farmers. Therefore, there is a strong reliance on organic and locally sourced amendments among urban farmers in Owerri. Personal poultry farms were the most common source of organic amendments (47.1%), followed by household waste (35.4%) and commercial vendors (17.4%). The substantial use of household and market-derived waste as farm input raises potential concerns about the presence of contaminants in the amendments applied to urban soils. Greater number of the respondents (69.0%) applied soil amendments every farming season, while 22.1% applied once a year, and 8.9% applied it once every two years. This relatively high and consistent application frequency suggests active soil management effort among urban farmers, although it also raises questions about possible over-application, particularly of organic waste-based amendments.. Among respondents who used inorganic fertilizer, NPK fertilizer was overwhelmingly preferred (90.1%), compared to urea (38, 9.9%). This reflects the wide availability and familiarity of NPK fertilizer among Nigerian smallholder farmers.

## CONCLUSION

Based on the questionnaire survey and laboratory results analyzed in this study, it can be concluded that urban agriculture in Owerri is a well-established, experience-driven livelihood activity that plays a significant role in household food security and income generation. Farmers actively manage their soils, relying predominantly on organic amendments and manual practices, and they clearly recognize the central importance of soil quality to their crop production outcomes. There is variations in soil textural, chemical properties and heavy metal contaminants in urban agricultural farmlands in Owerri. However, this active management is undermined by insecure land tenure, heavy reliance on potentially contaminated water and organic waste sources, an almost complete absence of formal soil testing, and very limited access to agricultural extension services and credit. These gaps represent the key institutional and technical constraints that must be addressed to secure and improve soil quality management in urban agriculture in the study area. A fuller and more definitive conclusion, particularly regarding the actual biophysical condition of the soils being farmed, will be possible once the laboratory soil analysis results are incorporated into this study.

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