Review of Urban Agriculture Practice to Enhance Food Security in Nigeria: Significance of Geospatial Technology

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ABSTRACT

In low- and middle-income countries, the rapid urbanisation poses a significant challenge to food security and nutrition for their inhabitants. Urban poverty is a global issue and is particularly noticeable in Africa, where 61 per cent of urban residents live in slums. Urban poverty is caused by several factors, including structural adjustment programmes, low salaries, unemployment, and the general economic crisis that nations like Nigeria are experiencing. For this reason, policymakers find it important to guarantee food security in the city. Undoubtedly, it is optimal to view food security as a causal, interconnected chain that spans multiple domains, from production to processing, consumption, and distribution. Urban agriculture is a key strategy for ensuring food security in urban areas. Thus, this paper aims to review urban agriculture practice to improve food security in Nigeria, emphasising the importance of geospatial technology. The study focused on the opportunities and challenges of urban agriculture in Nigeria. The findings showed that many city dwellers are drawn to urban farming to obtain food, cash, and other necessities for their homes due to the growing demand for jobs and sustenance among urban dwellers. However, Nigeria's urban agriculture industry faces numerous obstacles, such as unstable land tenure, a lack of government support, limited market accessibility, restricted access to factors that contribute to productivity, and inequality concerns.

I

INTRODUCTION

The annual population growth rate worldwide has declined for the past fifty years. However, absolute annual increases were constant until recently, when they started to decrease (FAO, 2017). Despite the overall decline in global population, some regions will experience population growth well past 2050 and possibly into the following century. Most people on the planet lived in rural areas many decades ago. Nevertheless, the balance between urban and rural areas has shifted, with slightly over half of the world's population (54 per cent) now living in urban areas. Furthermore, United Nations (UN) estimates of 2014 suggest that over 60 per cent of the world's population may reside in cities by 2050, with population growth in African cities expected to double in just ten years.

One of humanity's biggest problems today has been the rapid urbanisation occurring, especially in the global South. Compared to the 1960s and 1970s, Nigeria's urban population growth rate has been steadily rising. Approximately 47 per cent of the nation's population currently resides in urban areas like Lagos, Ibadan, Kaduna, Kano, Portharcourt, Ointsha, and Aba, among others. The population of these centres is expected to rise in the near future. Naturally, this will impact the capacity to supply

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wholesome food and guarantee food security (Akinnagbe and Ipinmoye., 2022). Consequently, increasing urban agriculture is crucial because it can help with food availability, especially for those who live in cities (Adeyemo et al., 2017). Urban agriculture (UA) is growing in popularity to address various issues in many urban areas worldwide. UA comprises producing, processing, and selling food and other products within and around cities. Put another way, most nations in the world, especially those in Africa, now acknowledge the significance of UA. It enhances the city climate by adding more green space (Sarker et al., 2019), promotes innovative recycling of organic waste from the city, and lowers the city's energy footprint (Yang et al., 2014).

Nigeria's urban population is growing quickly these days, bringing with it the related challenges. Nigeria's increasing food insecurity rate is linked to the most obvious socio-economic problems associated with urban expansion. Greater demand for food is created by densely populated areas, particularly in the slums, where a significant portion of people's income is spent on food. Consequently, Nigeria's urban areas are typically very vulnerable to food supply shock (Fudjumdjum et al., 2019).

To mitigate the aforementioned problem, creative approaches that facilitate the provision of locally grown and fresh food to towns are needed. In general, agriculture has occupied a unique role due to its centrality in the growth process and its redistribution being the largest contributor to employment in most developing economies (Misra et al., 2018). Specifically, agriculture produces raw materials, fuel, fibres, and food—all essential for human survival. Its influence on the socio-economic and industrial components of any country means that it will always be the key to growth, employment, and the reduction of poverty. In particular, urban agriculture improves economic prospects by increasing the variety of foods available, creating jobs, and generating some revenue from the sale of excess produce.

This study reviews urban agriculture to enhance food security in Nigeria, emphasising the significance of geospatial technology application. To achieve this, we collected relevant literature from reputable academic databases, including Scopus, Web of Science, etc. The paper is structured into eight sections. Section II provides an overview and dimensions of food security. The main issues about food security in Nigeria are dealt with in Section III. Section IV reviews the concept of urban agriculture. Section V is concerned with the prospects of urban agriculture in Nigeria. The constraints to urban agriculture in Nigeria are reviewed in Section VI. Section VII discusses the process of improving urban agriculture in Nigeria. Section VIII presents the application of geospatial technology for urban agriculture, and the final section concludes the research work.

II

OVERVIEW AND DIMENSIONS OF FOOD SECURITY

Getting enough food for the world's growing population is one of the main problems today. Thus, food security has become a major worldwide concern in the modern era. The idea of food security is complicated, and it is frequently impacted by

geography, culture, and the environment. During the world food crisis in the early 1970s, the idea of food security came into being. Priority was initially placed on ensuring that adequate food was available and the price of basic foods remained stable in times of volatility of agricultural commodity prices (Berry et al., 2015). Food security has undergone numerous definitions since its inception (see Peng and Berry, 2019; Afza et al., 2023). At the 1974 World Food Conference, "food security" was defined as the constant availability of sufficient global food supplies to support a continuous growth in food consumption while mitigating variations in prices and production. The social emphasis was added to the definition in "The State of Food Insecurity in the World 2001". It was acknowledged that while tackling poverty is essential, it is not enough to accomplish this aim on its own. The concept was then given its final revision at the 2009 World Summit on Food Security when the fourth dimension (stability) was added. Also, there has been a suggestion to incorporate sustainability as a fifth dimension in addition to the long-term time dimension (Berry et al., 2015).

When everyone always has physical, social, and financial access to enough healthy food, there is food security. Numerous governmental, nongovernmental, national, and international organisations and a wide range of academic disciplines like economics, nutrition, agriculture, anthropology, and sociology have been actively involved in it. Of course, for man to lead an active and healthy life, food security satisfies their dietary needs and preferences (Food and Agriculture Organization, 2016; Perez-Escamilla et al., 2017). Even though the definition of food security initially identified four primary dimensions, a fifth dimension has surfaced (see Figure 1).
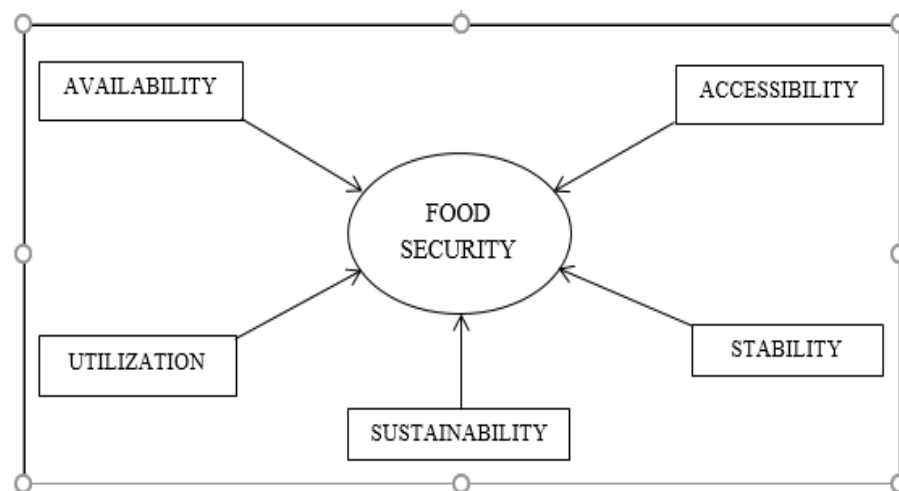

Figure 1: Dimensions of Food Security

i.   Availability: Food availability, which deals with the "supply side" of food security, is influenced by net trade, stock levels, and the sum of food produced.
ii. Accessibility: The food is available to customers with sufficient funds. In addition to being physically and financially accessible, the food must be socio-culturally acceptable.
iii. Utilisation: To live a long and healthy life, a person needs to be able to eat enough food in both quantity and quality. Water and food must be pure and safe.
iv. Stability: The capacity of a country, a community, or an individual to tolerate shocks to the food chain system, whether brought on by man-made (e.g., economic crises, wars) or natural (e.g., climate, earthquakes) disasters.
v.   Sustainability: long-term time dimension to food security, which will affect the food security of future generations.

Sustainability includes elements related to socio-cultural, economic, biodiversity, climate change, and supranational/regional ecological levels (Berry et al., 2015). Notably, each dimension needs to be present for complete food security.

III

MAIN ISSUES ABOUT FOOD SECURITY IN NIGERIA

Africa's prevalence of malnutrition increased from 17.6 per cent in 2014 to 19.1 per cent in 2019, indicating that the continent is still not on track to eradicate hunger by 2030 (FAO, 2019). Many Nigerian government administrations have continued to view the issue of adequate food security as critical (Ejikeme et al., 2017; Osabohien et al., 2020a). About 90 per cent of Nigeria's agricultural production is by small-scale farmers (Ayinde et al., 2020), most of whom cannot provide for their families and themselves. The leading causes of the low productivity are fragmented landholding, excessive reliance on agriculture fed by rain, climate change, limited access to farm input, and a weak economic foundation. The fact remains that prompt action is required in response to Nigeria's alarming rise in food insecurity. According to Osabohien et al. (2020b), acute food scarcity affected 21.4 per cent of Nigerian families in 2020. Nigeria is now viewed as the most impoverished nation in the world, surpassing India. According to Otekunrin et al. (2019), Nigeria's fast population growth exacerbates the country's food insecurity, and by 2050, the country's population will reach 400 million. Therefore, if the nation hopes to increase food security, it must control population growth.

As mentioned earlier, food availability ensures that adequate food is obtainable. Unfortunately, many Nigerians lack sufficient food storage facilities and competing household needs. Consequently, they sell their produce during harvest (Obamiro et al., 2003). Generally, adequate availability of food in Nigeria on a per capita basis does not certainly transform into adequate food for every citizen.

Furthermore, access to food by all families suggests that a majority of the population must meet minimum nutritional standards and have consistent access to

food at all times in homes (Idachaba, 2004). Regrettably, accessibility to food in Nigeria is a big issue because of the present level of insecurity in the country's key farming regions. This is worsened by the rising threats posed by climate change due to global warming. Also, other notable issues influencing food insecurity in Nigeria involve external threats such as income loss (unemployment or underemployment), poverty, and political violence.

Remarkably, food insecurity has remained on the rise in Nigeria regardless of various strategies articulated by global food agencies, including the International Institute for Tropical Agriculture (IITA), the International Fund for Agriculture Development (IFAD), the International Food Policy Research Institute (IFPRI), and the International Institute for Sustainable Development (IISD). Of course, various agricultural initiatives and interventions in Nigeria have remained less effective. Therefore, food insecurity is increasing, as shown by the adverse effects on access and usage (Babatunde et al., 2007).

IV

CONCEPT OF URBAN AGRICULTURE

Agricultural development is generally significant for enhancing both the earnings of people who survive on agriculture and the growth of the non-agricultural sector (Dev, 2019). The last ten years have seen an increase in academic research on urban farming initiatives and public interest in urban agriculture (Santo et al., 2014; Golden, 2016; Reynolds and Cohen, 2016; McClintock et al., 2017). UA covers cultivating fruit trees, food crops, and raising livestock. It encompasses any economic activity carried out by urban dwellers inside cities, outside of cities, and on rural land adjacent to cities that involves food production, farming, marketing, and animal husbandry. The literature provides evidence of the numerous social, economic, and environmental benefits of UA. First, UA adds to household food availability and dietary diversity as a source of food security. Also, Binns and Nel (2019) suggest that UA offers substantial employment opportunities for urban farmers and other service providers along the supply chain, serving as a livelihood strategy. Furthermore, UA has a positive environmental impact by reducing energy use and greenhouse gas emissions, given the shorter distances food travels before reaching consumers. Five main types of UA have been identified based on their locations inside and outside of urban areas (Table 1).

The importance of agricultural development in Nigeria cannot be over-emphasised. Specifically, urban agriculture has demonstrated a substantial positive impact in Nigeria. This is because it creates diverse opportunities for urban and peri-urban dwellers. Its positive ecological impact is apparent as it reduces energy usage and greenhouse gas emissions.

TABLE 1. MAJOR TYPES OF URBAN AGRICULTURE

TYPES OF UA (1)	DESCRIPTION (2)
Market Gardening	This method is used in the production of perishables and staple foods. They can be found on the outskirts of the town, close to residences, riverbanks, dumping sites, and other places.
Compound and Yard Farming	This is frequently observed in fenced-in houses, particularly in the downtown regions, newly constructed areas, and residential quarters. It is the source of annual crops grown for local use.
Subsistence Farming on Open Lands	Farmers who grow crops for both personal consumption and commercial gain are primarily affected by this.
Expanded Commercial Farming	These are located in nearby villages and are primarily owned by landowners in urban areas. Huge hectares of land are managed for grain crops, cattle rearing, piggery, and fish farming, with the addition of machinery in certain situations.
Constricted Surrounding Land Farming	These are farmlands in nearby villages that have been overtaken by the expanding city. The land was owned by the villagers, who also farmed it for profit. Here, raising livestock is also a common practice.

V

PROSPECTS OF URBAN AGRICULTURE IN NIGERIA

The population of cities is expanding quickly on a global scale (Arbolino et al., 2018). According to projections, there will be a 68 per cent increase in the worldwide population living in urban areas by 2050 (UN-DESA, 2019). But around the world, urbanisation is occurring at varying rates. According to World Health Organization (WHO) projections, cities in the global south have a mean annual population growth rate four times higher than those in the global north (WHO, 2015). Notably, the cities in sub-Saharan Africa, which are expected to experience the majority of the world's population growth, are predicted to expand at a rate of 4.1 per cent per year, outpacing the global average of 1.84 per cent (WHO, 2015). Similarly, the number of people living in Nigeria's cities is expected to double by 2037, with an annual growth rate of approximately 4.3 per cent (UN-DESA, 2019).

Nigeria's urban population has increased swiftly in the last 50 years and will probably continue to increase in the foreseeable future. The degree to which the urban population grows in the country is persistently increasing, which is against the situation in the 1960s and 1970s. This burgeoning population has greatly influenced urbanisation in Nigeria. The pattern, trend and features of urbanisation have been apparent in Nigeria (Aliyu & Amadu, 2017). Of course, Nigeria's cities have grown remarkably, with the rate of urban growth consistently above 2 per cent per annum (UN-DESA, 2019). Consequently, there has been a swift expansion of Nigerian towns, frequently in an unplanned and uncontrolled manner. Thus, there is a need for more resources, particularly food, which is commensurate to this growth.

Several studies have called for comprehensive research towards the development of urban agriculture as a strategy for sustaining the food supplies in urban areas due to the unprecedented rate of urbanisation and its negative implications for

urban food security, particularly in the global South countries (Gwan and Kimengsi, 2020). Also, urban residents can find employment opportunities from UA in various forms and degrees (Adeyemo et al., 2017). A few land areas where urban agriculture is typically practised in the global north are allotments, private home gardens, community gardens, and commercial market gardens (Foster et al., 2017). On the other hand, urban food production occurs in the global south on privately owned or rented land, in greenhouses, in empty or open spaces, and in rivers, ponds, and lakes (Ibitoye et al., 2016). UA is becoming increasingly well-liked globally, becoming a more important topic for research and policy on the agenda for international development (Horst et al., 2017).

Urban agricultural activities take place in many of Nigeria's towns (Asadu et al., 2021) because it has been recognised as one of the primary means of ensuring food security. It usually takes place on roadsides, near waste dumpsites, and open spaces within the townships (Olumba et al., 2021). Apart from agronomy, it also involves rearing animals, including poultry, sheep/goats, pigs and others. Despite its significance to the socio-economic development of many towns in Nigeria, Urban Agriculture has attracted little or no effort from the government and its policy (Okorukwu et al., 2016). Also, there is a dearth of sufficient data and information regarding the extent, importance, development and output of UA products and their connection to SME developments in Nigeria.

VI

CONSTRAINTS TO URBAN AGRICULTURE IN NIGERIA

One of the most effective ways to address the issue of food security brought on by rural-urban migration is through urban agriculture. But, many studies suggested that the biggest obstacle to UA is the lack of government support (Frayne et al., 2014; Smart et al., 2015; Masvaure, 2016; Cadzow and Binns, 2016; Nchanji, 2017). Also, farmers' ability to develop their gardens profitably is usually hampered by their limited access to production factors like fertiliser, clean water, capital and knowledge (Dyer et al., 2015; Omondi et al., 2017), the lack of agricultural inputs and equipment and poor soil quality (Ouédraogo et al., 2019), labour shortages, marketing, economic and environmental issues (Rohit et al., 2017).

Generally, Nigeria faces several challenges, such as limited access to productive factors, inadequate government policy, the absence of land, and tenure insecurity. Of course, several studies (e.g. Assefa, 2016; Bonatti et al., 2017; Chagomoka et al., 2018; de Medeiros et al., 2019) uphold that the two main obstacles are a lack of access to land and tenure instability. The tenure system surrounding UA's available land spaces is a barrier to UA (Asadu et al., 2016). In their quest for access to urban farmland, farmers encounter a plethora of socio-economic and institutional obstacles that prevent them from carrying out their production activities to the best of their abilities (Olumba et al., 2019). Therefore, when land is available, policy support is essential to securing tenure for the development of urban agriculture. For example, if there is strong political will,

a large amount of land may be used permanently or temporarily, even in highly urbanised areas.

The social, economic, and institutional framework in which urban farmers function affects how accessible their land is, which puts the practice and sustainability of UA in jeopardy (Famakinwa et al., 2017). In Nigerian urban areas, owners or users of land are more likely to be well-off individuals. The rationale is that they have the financial means to obtain an adequate amount of land and can afford to pay for additional legal requirements related to the land acquisition procedure. Also, only men have assets to put as security for loans and pay for land purchases in Nigeria (Omali, 2023). This disparity in gender leads to men being granted land leases while women are compelled to live in smaller plots and earn less than men (Frayne et al., 2014).

The loss of prime agricultural land in urban areas due to urbanisation is a frequently mentioned barrier to UA (Amponsah et al., 2016). Rapid and unchecked urban population growth and development have resulted in significant land use changes, which hurt UA's sustainability (Ayambire et al., 2019). More competitive land uses are encroaching on prime agricultural lands due to rising land values and land competition brought on by rapid urbanisation in and around cities (Bonye et al., 2021).

Irrespective of its importance, UA in Nigeria suffers many limitations. The main issue is related to the lack of access to land and the insecurity of land tenure. In the context of UA in Nigeria, tenure insecurity is a consequence of urban agriculture not usually giving the required attention to city planning. This hurts the approval process for the establishment of urban farms.

VII

IMPROVING URBAN AGRICULTURE IN NIGERIA

The government's willingness to support UA will depend on their perception of how much it will enhance people's livelihoods and the economy. For this reason, thorough research is necessary to guide agricultural policy. Additionally, there are plans for urban development that set aside land for different uses, such as urban gardening. Still, there are no strong regulations to guarantee that these plans are followed. Therefore, strict enforcement, control policies, and development plans are essential to improve land allocation to UA and prevent uncontrolled urban sprawl.

Furthermore, urban farmers are still driven to establish large farms through better production systems that require less input (water, fertiliser) (Dyer et al., 2015). Also, the inclusion of many farmers and increased production in cities are made possible by specialisation in dry season farming and vertical farming using sack gardens. Policy support can accelerate UA development (Bonatti et al., 2017). For instance, policy support for land distribution for urban agriculture can contribute to the growth of UA. Policy support for UA is driven by perceived benefits in terms of income generation, food security, and well-functioning institutional arrangements. Similarly, UA development is positively impacted by strong internal organisation and

farmer cooperation (Cadzow and Binns, 2016; Olivier and Heinecken, 2017). Cooperation and forming working groups among farmers enhance farming abilities and yields. It facilitates funding access and allows them to form joint ventures to access markets. Lastly, Assefa (2016) noted that proximity to a market is critical to widespread UA implementation. Producers benefit from closer proximity in cost and income because of lower travel expenses, improved market pricing awareness, and less risk in transporting highly perishable goods.

In sum, a comprehensive study is essential to guide agricultural policy as the government's disposition to support UA is a function of its level of confidence in UA. Also, stringent enforcement, control policies, and development plans are essential to improve land allocation to UA and prevent uncontrolled urban sprawl. Of course, anthropogenic and natural systems influence land use/land cover alterations in urban areas. Monitoring LULC change in such complex situations requires applying advanced techniques such as geospatial technology.

VIII

APPLICATION OF GEOSPATIAL TECHNOLOGY FOR URBAN AGRICULTURE

The process of changing land use/land cover (LULC) in urban areas is multifarious, and both anthropogenic and natural factors typically cause it. Therefore, employing innovative tools and methods for change detection in urban LULC planning and monitoring is imperative. The use of geospatial technology, which combines Global Navigation Satellite Systems [GNSS], Remote Sensing (RS), and Geographic Information Systems (GIS), has made it easier to assess how LULC has changed over time (Okeke and Omali, 2016). Numerous benefits are associated with these tools, such as reducing the time and expense of LULC extraction (Dibs, 2018; Dibs and AL-Hedny, 2019). A detailed explanation of the potency of these technologies is made in the following paragraphs.

First, GIS adaptability and dynamism give planners the required information for effective planning and plan execution. GIS provides a platform for expanding understanding of the real world by integrating analytical skills with modelling and spatial analysis (Omali and Umoru, 2019). It is an effective tool that helps farmers manage, evaluate, and visualise spatial data associated with agricultural operations, which is essential to precision farming. Spatial analysis is crucial to investigate the relationship and impact between entities in geographic space (Hao, 2019). Spatial GIS analysis is possible, including land suitability analysis, which establishes the suitability of a particular land use or portion thereof. Using the evaluation results of various criteria, sound decisions can be made regarding appropriate areas for particular uses, like agriculture, or more specialised uses, like choosing the right crop type for a given soil. It is also crucial to study crop productivity and related stresses. To provide useful insights for decision-making, GIS technology combines geographic data—such as maps, satellite imagery, and field observations—with attributes—such as crop types,

yield data, and soil characteristics. The following are how precision farming makes use of GIS:

    i.   Field Mapping and Management
    ii.   Soil Mapping and Analysis
    iii.   Yield Monitoring and Analysis
    iv.   Precision Application of Inputs
    v.   Remote Sensing Integration
    vi.   Decision Support Systems

Second, Chawla et al. (2020) suggest that satellite remote sensing is appropriate for evaluating water security regarding water quantity, quality, and extreme events. Furthermore, the data from remote sensing are used to update knowledge about every feature on the earth's surface. Collecting data using a ground-based survey method to identify and quantify change takes a lot of money and effort. As a result, it is difficult to know how much land is used for agriculture in most emerging countries. One effective method for tracking LULC change is remote sensing. It makes it possible to quickly and affordably measure the spatiotemporal characteristics of urban farmlands. The increasing availability of high- and medium-resolution satellite imagery (MacLachlan et al., 2017; Young et al., 2017) and the rise of cloud computing services are driving rapid advancements in land change monitoring. Precision farming can depend on remote sensing, which uses satellite and aerial photography to gather vital data for soil analysis, disease detection, yield estimation, crop monitoring, and yield monitoring.

Third, accurate location determination on Earth is important in the current scheme of things. Ziggah et al. (2019) strongly believe that the Global Navigation Satellite Systems (GNSS), mainly the GPS (Global Positioning System), are widely accepted in this respect. The GNSS is commonly used in precision agriculture because of its great accuracy in determining position, time, and direction. Precision farming avoids adverse effects on the ecosystem while increasing agricultural productivity at a low cost (Omali et al., 2022). Currently, the most popular precision agriculture application is site-specific fertiliser application and mapping/ measuring soil, water, and crop resources. According to earlier studies, Multi-GNSS can give Precision Agriculture a more accurate and stable positioning (Kabir et al. 2016). GNSS use in precision farming is crucial for the following reasons:

    i.   *Field Mapping and Boundary Definition*: Farmers can precisely map field boundaries and define management zones inside fields using GNSS technology.
    ii.   Auto-Steering and Guidance Systems: Tractors and sprayers are examples of agricultural equipment with auto-steering systems that automatically steer along pre-established routes or guidance lines using GNSS signals.
    iii.   Variable Rate Application (VRA): With GNSS technology, inputs like pesticides, fertilisers, and irrigation water can be applied at different rates according to the spatial variability of a field.

iv.   Yield Monitoring and Mapping: Crop yields are monitored in real-time as they are harvested by harvesters fitted with GNSS-enabled yield monitors. GNSS positioning data is combined with yield data to generate comprehensive yield maps that inform future management choices and offer insights into the spatial variability in crop performance.

v.   Soil Sampling and Precision Soil Management: GNSS technology precisely records sample locations in the field, making precise soil sampling easier. Using GNSS-guided soil sampling, farmers can gather soil samples at designated sites, guaranteeing representative sampling and facilitating the development of site-specific soil nutrient management plans.

vi.   Irrigation Management: GNSS technology facilitates precision irrigation by locating irrigation sensors and equipment. GNSS-guided irrigation systems can modify the rate at which water is applied based on spatial variability in soil moisture levels and crop water requirements to maximise water use efficiency and reduce water waste.

vii.   Remote Sensing Integration: GNSS data can be combined with remote sensing technologies like drones and satellite imagery to track crop health and growth trends. Farmers can pinpoint management interventions for crop stress, disease, or nutrient deficiency by integrating GNSS positioning with remote sensing data.

GNSS receivers can access absolute positions and real-time information anywhere on the Earth's surface where there is unobstructed coverage to the required number of satellites. This characteristic makes it a daily necessity in business, military, environmental systems, tracking and surveillance, agriculture, etc.

Generally, applying geospatial technology will enhance the delivery process of land tenure security in Nigeria. The GIS-based approach has proven effective, robust, consistent and versatile in managing land records (Akeh and Mshelia, 2016), such as registering land properties, land owners, land-related and property transactions, and taxes (Adeoye, 2006). Of course, such an effective and efficient system of land-related registration guarantees that the information delivered is consistent and readily accessible to the public to meet their needs, such as authentication of legal interest in land (Ekemode et al., 2017**).** The geospatial system is a potent tool for data storage, information management, quick and easy data access, and retrieval of statistical data and updated reports from the office and the field. Its adoption in Nigeria will support land administration in creating and updating cadastral maps and records.

Furthermore, Nigeria's urbanisation level is notably high (Essien, 2023). Nigeria is one of the fastest-growing urbanised nations in the world, with half its inhabitants presently living in urban areas. Thus, developing a consistent urban land use map or land use and land cover that shows different urban development stages is essential. The traditional methods used in Nigeria for monitoring spatiotemporal changes in land use and land cover involve aerial photography and field surveys (Okeke et al., 2008), which are costly and labour-intensive. However, geospatial technology provides a valuable

tool (Lui and Coomes, 2015) that is cost-effective and requires less labour for monitoring and evaluating the effects of long-term LULC changes due to the urbanisation process. Remote Sensing and GIS have been widely used to provide systematically reliable data on the spatiotemporal extent of urban land and other LULC (Rimal et al., 2018; Chen et al., 2020). Hence, applying geospatial technology offers significant advantages for implementing urban agriculture in Nigeria.

IX

CONCLUSION

The practice of urban agriculture to improve food security in Nigeria is the focus of this study. It is pertinent because it examines the opportunities and limitations concerning UA in Nigeria. Urbanisation has significantly impacted food systems and changed dietary patterns in tandem with it. Specifically, there are more low-income urban consumers now than ever before. Of course, the variety and quality of food available to them, along with the level and stability of the cost of food access, all affect their level of food security. Providing food in urban areas is not as commonly accepted or encouraged in Nigeria. Despite this, it is evident that raising livestock or cultivating food within or outside of urban areas serves as a major source of food supply and frequently provides a sizeable income for urban households in many cities within Nigeria.

There are many issues with urban agriculture in Nigeria, and they differ depending on the kind of farming or the area in which it is practised. Land tenure insecurity is one of the main obstacles limiting UA's potential in Nigeria. The rate at which cities are growing is driving up demand for land for residential and commercial development. Even before harvesting seasons, more landowners are making demands for their properties. Of course, farmers frequently forfeit their crops, either with or without payment from landowners. Therefore, when land is available, policy support is essential to securing tenure for the development of urban agriculture.

The loss of prime agricultural land in urban areas (LULC change) due to urbanisation is a frequently mentioned barrier to UA in Nigeria. More competitive land uses are encroaching on major agricultural lands due to rising land values and land competition brought on by rapid urbanisation in and around cities in Nigeria. Monitoring LULC change is of great importance for agriculture practice in Nigeria. In this regard, applying geospatial technology encompassing GIS, remote sensing, and GNSS has proven potent. The tools have also been successfully used in precision farming, soil suitability analysis, etc. Therefore, applying geospatial technology to improve UA and food security in Nigeria is significant.

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