

Vertical Farming for Sustainable Food Security in Nigeria: A Review

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Abstract

Nigeria is facing major issues with food production due to a rapidly increasing population and a lack of available land for farming. Vertical farming is becoming an important solution to help tackle food security problems in Nigerian's quickly urbanizing areas. This method of farming involves growing crops in stacked layers within controlled environments, which makes the best use of space and serves as a sustainable alternative to traditional farming. The fast population growth in Nigerian cities creates serious food security challenges because there is not enough arable land. Vertical farming allows for the year round cultivation of fresh produce in urban settings. This method decreases reliance on rural Agriculture and cuts down on distribution costs. It guarantees a steady supply of food while offering higher quality nutrition at lower prices. This article examines vertical agriculture by looking into the issues present in the current food system and how vertical farming can help solve Nigerian's food security problems. We explore the benefits of this innovative approach, such as increased crop yield, less water usage, better access to fresh produce and reduced harm to the environment. We also discuss where vertical farming stands today in Nigeria by showcasing successful projects and pinpointing areas that need improvement. Our findings indicate that vertical farming could be vital for sustainable food security in Nigeria.

Keywords: Vertical Farming (VF); Sustainable Food Production; Food Security; Food System; Nigeria

INTRODUCTION

Global food system is starting to decline as the world population is expected to reach 9.7 billion by 2050 and food demand is expected to increase anywhere between 59% to 98% (Deepika and Anureet ., 2021). By that period, the planet's arable land is estimated to be half of what it was in the 1970s. To come up with the solution "Vertical Farming" is one of the techniques to replace arable land. Vertical farming involves growing food in a staked layers, often within structured like tall buildings, repurposed warehouse, or shipping containers, instead of traditional fields or

greenhouses (Deepika and Anureet, 2021). This modern indoor farming method uses controlled Environment Agriculture (CEA) technology, as illustrated in plate 1. In vertical farming, people artificially manage temperature, light, humidity, and gases. This setup is similar to greenhouses that utilize metal reflectors to enhance natural sunlight along with artificial lighting, as shown in plate 1. The main goal of vertical farming is to reduce resources usage and decrease agricultural carbon footprint. Vertical farming is considered a modern way to feed a large global population by 2050. The idea of vertical farming is not entirely new. Examples dating back to ancient times can be found in the Hanging Gardens of Babylon, one of Philo's seven wonders of the Ancient World, built around 600 BC. In 1915, Gilbert Ellis Bailey coined the term "Vertical Farming" and wrote a book called vertical farming. He argued that hydroponic farming in a controlled vertical would have economic and environmental benefits. In the early 1930s, William Frederick Gericke started hydroponics at the University of California, Berkeley. In the 1980s, Ake Olsson, a Swedish organic farmer, also proposed vertical farming as a way to produce vegetables in the city. It is known for inventing a spiral-shaped trace system for plant growth (Corvalan, *et al.*, 2005; Healy *et al.*, 2013; Thomaier, *et al.*, 2015; Despommier *et al.*, 2010, Despommier, 2010). At the end of the century, Despommier an American ecologist and public health professor passionately revived the concept of vertical agriculture. He describe vertical farming as the mass cultivation of plants and animals for commercial purposes in skyscrapers. Using advanced greenhouse technologies such as hydroponics and aeroponics, the vertical could theoretically produce fish, poultry, fruits and vegetables (Despomier, 2010). Vertical agriculture is considered to promote more sustainable agricultural practices than conventional agriculture, which refers to large-scale outdoor agriculture that includes systems that include intensive irrigation, intensive tillage, and the excessive use of fertilizers, pesticides, and herbicides (Healy, *et al.*, 2013).

The body of literature on the subject distinguishes between three types of vertical farming (Despommier, 2014; Muller, *et al.*, 2017). The first type refers to the construction of tall structures with several levels of growing beds, often lined with artificial lights. This often modestly sized urban farm has been springing up around the world. Many cities have implemented this model in new and old buildings, including warehouses that owners repurposed for agricultural activities (Despommier ., 2013). The second type of vertical farming takes place on the rooftops of old and new buildings, atop commercial and residential structures as well as on restaurants and grocery stores (Despommier, 2014; Touliatos, *et al.*, 2016). The third type of vertical farm is that of the visionary, multi-story 5 building. In the past decade, we have seen an increasing number of serious visionary proposals of this type. However, none has been built. It is important; however, to note the connection between these three types, the success of modestly sized vertical farm projects and the maturation of their technologies will likely pave the way for the skyscraper farm (Despommier, 2014).



Plate 1: Indoor vertical farming

Source: (Deepika and Anureet, 2021)

METHODOLOGY

Research on this topic takes many forms, such as professional reports, academic papers, and articles as shown in the references of this paper. This study combines different sources to try to answer the questions mentioned earlier. It also looks at a variety of literature reviews related to vertical farming. Additionally, it includes reviews of technologies and current farming methods while considering the future of farming technology. This review uses an informative qualitative approach. It examines existing studies, articles, and reports on vertical farming to grasp what we currently know about the field. The paper collects complex technical details and makes them easier for non-specialist to understand. By reviewing, organizing, and gathering information from different sources, the paper aims to provide a clearer understanding of both the theory and practice of vertical farming.

Why Vertical Farming

The world's population will continue to grow over the next decade. The estimated population of 7.3 billion is expected to reach 8.5 billion by 2030, an annual increase of 85 million or 1.16% (United Nations *et al.*, 2020). According to a recent study commissioned by the Club of Rome and conducted by Earth4All Collective in collaboration with the Potsdam Institute for Climate Impact Research, Stockholm Resilience, and BI Norwegian Business School, the world's population is expected to fluctuate, and instability could occur (Watts, 2023). The United Nations estimated that the world's population would reach 9.7 billion by mid-century. However, the new study's results show that the world's population will rise to 9 billion by 2046 and then decline to 7.3 billion by 2100. Like the UN estimate, the study by Earth4All Collective predicts that throughout the first half of the century, the population will record a steady increase (Watts, 2023). The growing world population indicates that youth is the segment that is rapidly increasing. By 2050, 1.3 billion (16%) of the global population will fall within the age category of 15–24 years. In Sub-Saharan Africa, youth aged 15–24 constitute 20% of the total population and are expected to increase by 2050 (Niang, 2015). Between 2020 and 2050, about 1.4 billion children are expected to be born in Africa (European Commission, 2023). Thus, the African region will account for the highest share of population growth in the future, but this will have an impact on youth violence and conflicts due to policy backlash, negligence of the ruling class, and a massive gap in infrastructure supply and

economic development (Ikelegbe, 2020; Sanderson, 2020). Nigeria is an essential player in population studies because of the demographic strength it poses. With an estimated population of 220 million, it is the seventh most populous country in the world, constituting 15% of the African population (Worldometer, 2023). Nigeria is an exciting area of study in population discourse because it is the country that is projected to have the highest population bulge in the next 50 years. By 2050, Nigeria is projected to reach 450 million people, with youth between the ages of 15 and 24 constituting around 25%, and this will qualify the country to be the third most populous country on earth after China and India. There is a desperate need for transformative solutions to combat this immense global challenge (Despommier, 2013). Vertical farming could enable food production in an efficient and sustainable manner, save water and energy, enhance the economy, reduce pollution, provide new employment opportunities, restore ecosystems, and provide access to healthy food. In a controlled environment, crops will be less subject to the vagaries of climate, infestation, the nutrient cycle, crop rotation, polluted water runoff, pesticides, and dust (United Nations, 2017). As such, indoor farming could possibly offer a healthier environment to grow food (Mukherj and Morales, 2010). Since indoor farming operates year-round and is independent of weather conditions, it could also provide greater yields and perpetual income (Katz and Bradley, 2013). Furthermore, indoor farming provides a low-impact system that can significantly reduce travel costs, as well as reduce Green House Gas (GHG) emission. Also, vertical farming could ignite local economies by providing much needed “green collar” jobs to urban areas (Corvalan *et al.*, 2005), by cutting down on travel distances between distant farms and local market (Mukherji *et al.*, 2010; Astee and Kishanni, 2010).

Climate change has contributed to the decrease of arable land. Through flooding, hurricane, storms, and drought, valuable agricultural land has been decreased drastically, thereby damaging the world economy (Despommier, 2010; UN, 2017; Kalantian, *et al.*, 2017). Scientists predict that climate change and the adverse weather conditions will continue to happen at an increasing rate. These events will lead to the despoliation of large tracts of arable land, rendering them useless for farming. Furthermore, traditional farming requires substantial quantities of fossil fuels to carry out agricultural activities (e.g., plowing, applying fertilizers, seeding, weeding, and harvesting), which amounts to over 20% of all gasoline and diesel fuel consumption in the United States. Conventional farming practices often stress profit and commercial gain while paying inadequate attention to inflicted harm on the health of both human and the natural environment (Despommier, 2010). These practices repeatedly cause erosion, contaminate soil, and generate excessive water waste. Regarding human well-being, the World Health Organization has determined that over half of the world’s farms still use raw animal waste as fertilizer, which may attract flies, and may contain weed seeds or disease that can be transmitted to plants (Al-Kodmany, 2018). Consequently, people’s health is adversely affected when they consume such produce. Further, growing crops in a controlled indoor environment would provide the benefit of reducing the excessive use of pesticide and herbicide, which create polluting agricultural runoff (Cho, 2011).

Table 1: Key sustainable benefits of the vertical farm

Sustainability Pillar	Benefits
Economic	Reduce costs, Create jobs in the city, Reduce energy, packaging, and fuel to transport food, and Turn waste into an asset.

Social	Create a local community of labourers and social networks with farmers, Improve food quality and, subsequently, consumers' health. Improve food security
Environmental	Needs less space, Produces regardless season, Reduces fossil fuel, reduces embodied energy, Increases bio-diversity, and Reduces cities' carbon emissions.

Source: (Mohad and Sahar, 2023).

1. Food Security: the global population is expected to rise by 40%, surpassing 9 billion by 2050, leading to a need for 70% more food to satisfy this demand. Advocates of vertical farming assert that it creates a compact and self-sustaining ecosystem that handles multiple functions, such as food production and waste management. It allows for the organized and sustainable production of food, ensuring access to healthier options. As current agricultural supply struggles to keep pace with demand, embracing this innovative farming approach becomes essential.

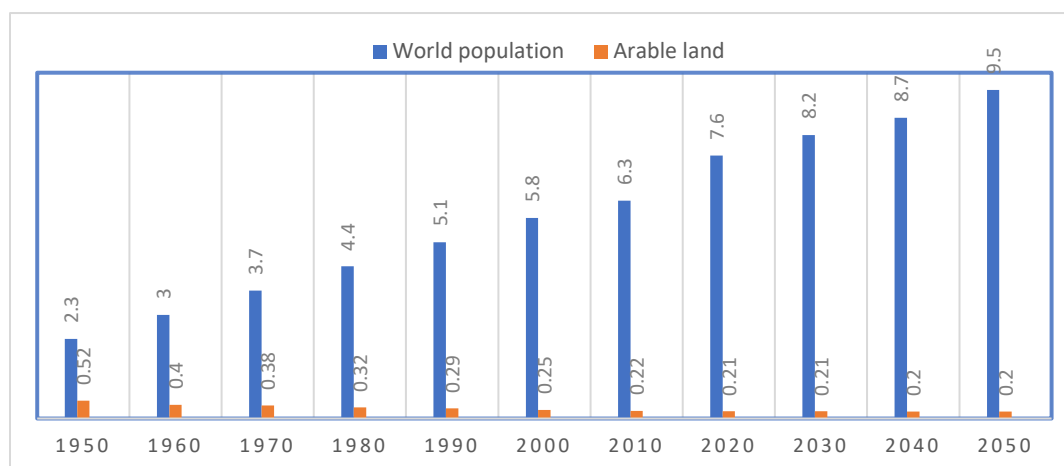


Figure 1: World population (billions) versus arable land (ha per person) 1950 – 2050 **Source:** (Gupta, et al., 2021).

Beginning with just 0.52 hectares of arable land per person, the global area of cultivable land is steadily decreasing, raising concerns (Thokchom *et al.*, 2021). Additionally, the degradation of water resources and climate change are exacerbating food shortages for the increasing population. The negative effects of these two major factors on sustainable agriculture are crucial for ensuring future food supply. While the overall impact of climate change is anticipated to boost crop production – likely due to the combined benefits of CO₂, improved radiation use efficiency, fertilization and longer growing season (Jin *et al.*, 2017), agriculture remains the largest consumer of water worldwide. Consequently, water quality is a key factor influencing crop yield (Hoestra and Chapagain, 2007). Historically, the decline in water quality and availability has adversely influenced agriculture, posing risks to human health (Lu *et al.*, 2015). These issues, along with rural to urban migration, have contributed to the reduction of arable land as illustrated in Figure 1.

2. Climate Change: climate change threatens to render vast areas of arable land unusable for agriculture. Traditional farming practices rely on fossil fuels to operate machinery, resulting in

greenhouse gas emissions that contribute to climate change, a significant global concern. The term “food miles” describes the distance that food travels to reach urban centers, on average, food journeys about 1,500 kilometers from farm to table, resulting in carbon dioxide emissions from transportation in contrast, vertical farming minimizes the reliance on machinery and addresses the issue of food miles since it takes place within urban areas (Despommier, 2014).

3. Space Efficient: vertical farming offers advantages over traditional horizontal farming. With the global population on the rise and agricultural land increasingly being converted into residential development, the availability of arable land is diminishing. A vertical farm situated in a 30-story building, approximately 100 meters tall with a footprint of nearly 2 hectares, can generate crop yields comparable to about 970 hectares of conventional horizontal farming. This indicates that one high – rise farm can produce a 480 equivalent outputs.

4. Ecosystem: Despommier (2013), states that farming has disrupted more ecological processes than anything else has; it is the most destructive process on earth. However, indoor vertical farming can help mitigate this impact by restoring biodiversity, thereby lessening the negative effects of climate change on ecosystems. If cities adopt vertical farms that occupy only 10% of ground space it could lead to reductions in CO₂ emissions and pave the way for technological advancements that improve the biosphere in the end. Additionally, eliminating fertilizer runoff could aid in the restoration of coastal and river waters, benefiting marine life.

5. Economic Development: vertical farming presents an opportunity to bolster local economies. These farms can help bridge the food cost gap seen in traditional agriculture since they are situated in urban areas, allowing producers to sell directly to consumers and cut down on transportation expenses, which can amount for up to 60% of cost (Despommier, 2014). Vertical farming also offers distinct advantages over conventional farming methods by enabling layered cultivation, which optimizes yield per square meter- a significant benefit in urban settings (Despommier, 2013).

6. Social and Political: the vertical farming sector is expected to generate new employment opportunities for individuals in various roles such as farmers, technologists, project managers, maintenance personnel, as well as marketing and retail staff, thereby supporting local industries (Al-Kodmany, 2018, Kozai and Niu, 2022; Son, 2016). However, feedback from surveyed vertical farmers indicates a demand for more specialized workers with expertise in plant science, cultivation and maintenance, as the industry currently tends to attract technically trained individuals lacking significant agricultural knowledge (Allegaert, 2020).

Advantages of Vertical Farming

The advantages of vertical farming can be grouped and summarized across economic, environmental, social and political aspect (Murase and Ushada, 2006; Fitz-Rodriguez *et al.*, 2010; Despommier, 2010; The Economists, 2010; Kozai, 2013).

Economic advantages

The economic advantages of vertical farming are many and include the prestige of marketing premium CGG food with export-sales potential and a lower cost base due to protection from floods, droughts, and sun damage (Kozai, 2013). There are essentially no requirements for fertilizers,

herbicides, or pesticides. No soil is required if hydroponics is employed; only nutrients and a water supply. There is no need for long-distance transportation due to localized production and no need for farm machinery such as tractors, trucks, or harvesters (Despommier, 2010). There are no seasonality issues due to continuous crop production that occurs all-year round and can be programmed to match demand (The Economist, 2010; Kozai, 2013).

Environmental advantages

The environmental rewards are impressive, such as providing healthy organic food free from chemicals. There is a significant decrease in fossil fuel use because transportation from rural areas to city consumers is avoided by using solar panels, rooftop wind turbines, and storage batteries, we can reduce the burning of fossil fuels. This will help lower carbon levels in ecosystems (Despommier, 2010). We also increase fresh water by evaporating black and grey water to save water resources. Furthermore, there is a chance to restore the national ecosystem by reclaiming rural land for plants. Most importantly, vertical farming promotes environmental sustainability (Despommier, 2010).

Social advantages

Vertical farming will create new job opportunities in fields like engineering, biochemistry, biotechnology, construction, maintenance and research and development for technology improvements (Fitz-Rodriguez *et al.*, 2010; Despommier, 2010). Increased productivity can lead to lower food and energy prices and boost disposable income. We can also address the oversupply of high-rise apartments and empty warehouses in cities by converting these vacant spaces into multi-story farms near consumers, which can revitalize neglected neighborhoods. This approach may help combat isolation in remote rural areas by training workers in technology for vertical farms located in local towns and cities.

Political advantages

One important political advantage of vertical farms is that they make it easier to meet climate change commitments while also supporting adaptation and mitigation efforts. The closed-system approach supports biosecurity because of greater protection from invasive pest species. A distributed network of vertical farms has lower blackout risks and there is reduced dependence on a few large power stations that are vulnerable to earthquakes or terrorist attacks (Murase and Ushada, 2006).

Challenges and Limitations of Vertical Farming

Some people have criticized the initial idea of vertical farming as outlined by Despommier (2010). For example, Cox (2016) pointed out several issues, such as the limited variety of crops that can thrive in this system - mostly just vegetables like lettuce, strawberries, and tomatoes. He also mentioned that only a small part of the population could benefit from it and that energy costs are quite high. Additionally, he argued that only the plants on the top level would receive sunlight in a greenhouse setting, while energy from solar panels is restricted because plants can not be staked vertically. However, many of Cox's points have become less important due to ongoing technological improvements. For instance, solar panels have become more efficient at generating power and new low-cost LED lights offer better light exposure for plants. Moreover, using

rotatable stacked plant arrays inside tall buildings allows for more sunlight access (Morrow, 2008, Massa *et al.*, 2008). The price of storage batteries is dropping quickly, similar to trends seen in electronics (Moore's law). The latest LED technology can significantly boost crop yields in greenhouse by matching the light spectrum to different plants types and their needs (Massa *et al.*, 2008; Trouwborst *et al.*, 2010). The main challenges facing vertical farming can be summed up as follows (Alter, 2010, The Economist, 2010; Cox, 2016); starting cost can be very high if land is bought in central business areas. The number of crops grown is not as great as for rural farming. Production volumes are also not as large as broad-acre farming and scaling-up may add cost and complexity. Challenges that are more specific are the need to manage disruption to the rural sector, to raise investment capital, and to train a skilled workforce (Alter, 2010).

Techniques of Farming Methods

Vertical farming is a special method that needs careful attention, especially in crowded cities where land for traditional farming is limited or in large urban areas that lack sufficient space for local food systems (Menezes *et al.*, 2017; Specht *et al.*, 2016b). Ultimately, the idea of having a vertical farm in a busy city center could address many real problems tied to food production and environmental issues (Benke and Tomkins, 2017; Suparwoko and Taufani, 2017). Vertical farming has also become an important part of urban or local agriculture by offering different ways to produce food (Pinstrup-Andersen, 2018).

1. Hydroponics

Hydroponics refers to growing plants in liquid nutrient solution, with or without using artificial materials. Commonly used materials include expanded coir, clay, perlite, wood fiber, brick pieces, packing peanuts made of polystyrene and vermiculite (Shrestha and Dunn, 2010; George and George, 2016). Plants like tomatoes, lettuce, cucumbers, pepper, as well as decorative flowers such as roses and freesia can all thrive using hydroponics (Shrestha and Dunn, 2010) as shown in plate 2. This method is the most widely used technique in vertical farms since it allows for growing plants in nutrients solutions without soil (AlShrouf, 2017).

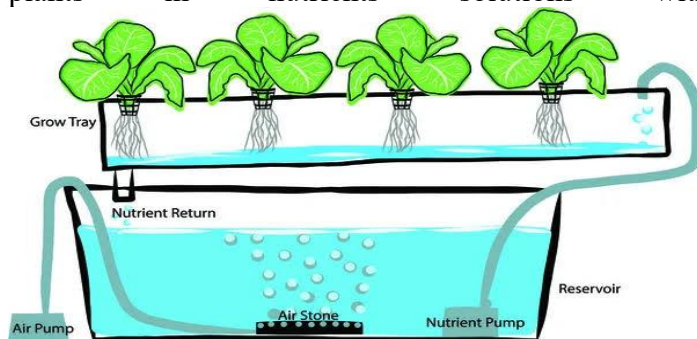


Plate 2: Hydroponic graphic Illustration

Source: (Birkby, 2016)

2. Aeroponics

Aeroponics is a modern upgrade from traditional hydroponics. In an aeroponic system, plants grow in a closed environment that combines water, nutrients, and air, allowing them to thrive with plenty of sunlight and very little water, without any soil (Hewitt and Graham, 2015) as shown in plate 3. The main difference between hydroponic and aeroponics is that hydroponics uses water as the growing medium, while does not use any medium at all. Instead of water, aeroponics utilizes nutrient solutions of mist, eliminating that need for trays or containers to hold water. This method is highly efficient for growing plants because it uses up to 95% less water compared to traditional farming methods and takes up very little space.

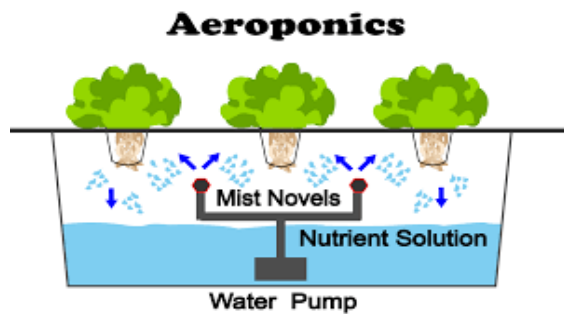


Plate 3: Aeroponic Graphic Illustration. **Source:** (Birkby, 2016)

3. Aquaponics

Aquaponics combines hydroponics and fish farming to create a beneficial relationship between plants and fish as illustrated in plate 4. This system merges hydroponics with aquaculture to grow food. Unlike traditional soil gardening, which uses about 10% of the water that aquaponics requires (Blidariu and Grozea, 2011), aquaponics offers significant advantages, especially in places where nutrient levels are low. In most aquaponics setups, plants and fish provide around 70% of the needed nutrients. The leftover solid waste can be utilized to cultivate regular garden crops or fruit trees (Al-Kodmany, 2018).

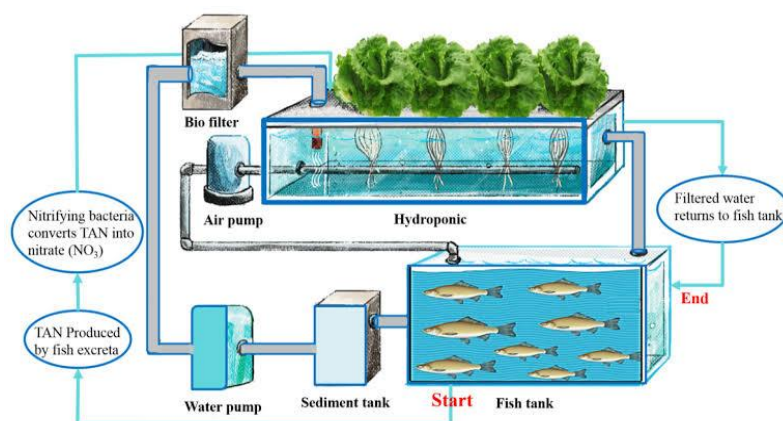


Plate 4: An aquaponics system. **Source:** (Martin, *et al.*, 2016).

Crops produced using vertical farming

Crops grown through vertical farming require a good growing medium that is loose, rich in nutrients, well drained, and allow for plenty of air circulation (Calcino *et al.*, 2018). Using pure top soil for seedlings and transplants is not recommended due to problems with diseases, weed seeds, drainage, aeration and inconsistent physical conditions. It is essential to fertilize the transplant, and there are various ways to water them, including both mechanical and manual methods (Despommier, 2013). The types of crops that can be grown depend on the size of the systems (Despommier, 2014), as shown in Table 2.

Table 2: Crops produced using Vertical Farming (VF)

Fruit	Strawberries, Blackberries, Tomatoes, Watermelon, Cantaloupe, Raspberries, Blueberries, Grapes, Dwarf Citrus Trees, Dwarf Pomegranate Tree, Bananas, Papaya.
Vegetables	Broccoli, Beans, Squash, Corn, Cauliflower, Beets, Carrots, Onions, Radishes, Cabbage, Leafy Greens, Parsnips, Celery, Cucumbers, Potatoes, Yams, Peppers, Wheatgrass, Onions, Leeks, Carrots, Radishes, Squash, Zucchini, Peas, Bok Choy, Kale, Swiss Chard, Arugula, Watercress, Chives, Microgreens.
Herbs	Ginger, Chives, Oregano, Mint, Basil, Sage, Rosemary
Grains	Rice, Barley

Source: (Mohad and Sahar, 2023).

The common goal of agriculture is increase the yield in a sustainable way. In Table 4 shows the estimated yield of a vertical farm compared to greenhouse farming for the different crops.

Table 3: Estimated yield of a vertical farm compared to greenhouse.

Crops	Yield in Vertical Farming (tons/ha)	Yield in Green House (tons/ha)
Carrot	58	30
Potatoes	150	28
Tomatoes	155	45
Lettuce	37	25
Pepper	133	30
Total (Average)	106.6	31.6

Source: (Ronald, 2020).

Vertical farms in Nigeria

Here are some notable vertical farms in Nigeria (farmandfoodies.wordpress.com)

1. **Urban Green Farms:** located in Lagos, this startup uses hydroponics systems to grow vegetables in urban spaces, supplying fresh produce to local markets.
2. **Green and Berries Farms:** Collaborating with the Association for Vertical Farming (AVF) and Grow Pipes, this farm aims to establish regional Training and Demonstration Centres and promote sustainable agricultural practices.
3. **Isimi Lagos Eco-City Vertical Farm:** Part of a 300-hectare eco-city project in Lagos, this vertical farm contributes to the city's goal of achieving net-zero emission by 2040.
4. **Youth-Led Initiatives:** various Nigerian entrepreneurs are exploring vertical farming as a modern agricultural model, leveraging technology to increase crop yields and reduce inputs costs, primarily in urban areas like Lagos. These farms are primarily located in urban areas, utilizing abandoned buildings, rooftops, and other underutilized spaces to optimize land use and promote sustainable agriculture. The association of verticals farming (AVF) is also working to establish regional Training and Demonstration Centres throughout Africa, including Nigeria, to promote vertical farming practices (www.verticalfarmdaily.com).

Potentials of Vertical Farming

The vertical farming concept was introduced to boost the amount of agricultural land by building upward. This means that we can increase the area available for crops by constructing a tall building with multiple levels on the same piece of land (Despommier, 2010; The Economist, 2010).. One method involves using a single tall glasshouse design where many racks of crops are stacked vertically. This is an extension of the greenhouse hydroponic farming system and helps solve soil related issues, like the need for herbicides, pesticides, and fertilizers (Despommier, 2010; The Economist, 2010). By being close to consumers, it can cut transportation costs, allow for year round production based on demand and optimized plant growing conditions by adjusting temperature, humidity and lighting for better yields (Despommier, 2010; The Economist, 2010).. Indoor farming in a controlled setting also uses much less water than outdoor farming because it recycles gray water and has lower evaporation rates. Due to these advantages, vertical farming is likely to be adopted first in desert and drought prone areas such as parts of the Middle East and Africa, as well as in small densely populated countries like Israel, Japan, and the Netherlands. Given the economic and environmental benefits of vertical farming. Agricultural experts believe that Nigeria could enhance its agricultural output through this method, create job opportunities in urban areas via the value chain and untimely promote economic growth. Angel Adelaja, the CEO and founder of fresh Direct Produce and Agro-Allied Services, a company that uses vertical farming technology to grow high quality organic producer, shard that this eco-friendly farming method can yield 15 times more crops. She explained that a 120-foot hydroponics container could produce as much food as one – and- a- half football fields in just four weeks or less. Based in Abuja, she uses shipping containers for her vertical farming, which allows her to cultivate a variety of crops that typically struggle in Nigeria's traditional farming conditions. She noted that this farming technique enables year round crop production regardless of the season and help and save

resources. Samson Ogbole, the team leader at soilless farm Lab, an innovative agro-food tech startup for some of its crops, expressed his belief that vertical farming is crucial for Nigeria to achieve food security in the future due to its incredible potential.

CONCLUSION

Vertical farming represents the future of agriculture. The Nigerian population is expected to reach 400 million by 2050, making Nigeria the third most populous country globally (UNFPA, 2025). Meanwhile available farmland is shrinking due to urban development, industrial growth, and other factors that take away land use for farming. It is time to adopt modern vertical farming methods for a more sustainable agricultural approach. Although vertical farming is not yet widely accepted or fully developed and has some limitations compared to traditional methods, it is expected to become as commonplace as conventional farming in the near future. "We live vertically, so why can't we farm vertically?" Vertical farming has become an essential solution for tackling food sustainability issues in cities, especially as more people move to urban areas. This innovative method addresses the urgent challenge of food security by utilizing advanced technologies, making the best use of resources, and encouraging local food production, vertical farming provides a sustainable way to feed the growing global population. It has the power to change how we produce food, improve food security by raising crop yields, making food more accessible and lowering environmental impact.

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