

"Urban Agriculture and Sustainable Communities": An Analytical Study of Urban Agriculture as a Tool for Achieving Food Security and Sustainability in Modern Cities

Dalia Shalaby Eldamaty

Assistant Professor, Elgazeera Higher Institute of Engineering and Technology in Mokattam, dr.dalia@gi.edu.eg

Ahmed Mahmoud Nagi,

Associate Professor, Vice Dean for Education and Student Affairs, Faculty of Engineering City University of Cairo, nagitos@hotmail.com

Abstract

This research discusses the concept of urban agriculture as an effective tool to enhance food security and achieve sustainable development in cities. With increasing urbanization and rising demand for food, urban agriculture becomes an urgent necessity to utilize available spaces in urban environments such as rooftops and public parks. The paper reviews the multiple benefits of this practice, including improving environmental quality, enhancing the local economy, and increasing social interaction between residents.

The research analyzes successful local and global experiences in urban agriculture, highlighting its potential to address challenges facing urban communities, such as lack of space, legal restrictions, and Lack of cultural awareness, lack of resources and cultural awareness

The research provides recommendations to promote urban agriculture, including developing supportive policies, providing training and resources, and strengthening community partnerships. Through these recommendations, the paper aims to provide a framework for mainstreaming urban agriculture as a sustainable practice that contributes to improving the quality of life in cities.

The results show that urban agriculture not only enhances food security but also contributes to improving the psychological and social health of communities, making it an important tool to meet future challenges in urban environments.

Keywords

Urban Agriculture, Food Security, Sustainable Development, Urban Communities Sustainability, Agricultural Innovation

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Introduction:

By 2050, three-quarters of the global population is expected to live in cities. These unprecedented levels of urbanization currently occurring in many local areas are causing numerous social, economic, and environmental problems on a global scale this unplanned urbanization is considered one of the major challenges facing local governments and international institutions. Urban overcrowding entails a series of negative consequences, such as growing food insecurity, urban poverty, and increased unemployment.

Ensuring food supplies for the growing urban population has become an increasing challenge, especially in the context of rising food prices, which have become increasingly volatile and unpredictable. Therefore, the concept of urban agriculture has been gradually updated, and its functions have expanded in many cities. Urban agriculture is now recognized and implemented by governments and organizations worldwide as a

significant economic development issue. It is closely linked to the economic, social, and cultural development of cities, providing an innovative agricultural model that is city-based and serves urban needs.

For this reason, many cities are developing urban agriculture policies. However, these policies are more widely implemented in developed countries than in developing ones. Understanding the political landscape and benefits of urban agriculture is crucial for improving urban agriculture practices and policies, particularly in developing nations.

The research analyzes successful local and global experiences in urban agriculture, highlighting its potential to address challenges facing urban communities, such as lack of space and legal restrictions. The paper also discusses the challenges and barriers that may hinder the expansion of urban agriculture, including limited resources and cultural trends.

Finally, the research provides recommendations to

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promote urban agriculture, including developing supportive policies, providing training and resources, and strengthening community partnerships. Through these recommendations, the paper aims to provide a framework for mainstreaming urban agriculture as a sustainable practice that contributes to improving the quality of life in cities. The results show that urban agriculture not only enhances food security but also contributes to improving the psychological and social well-being of communities, making it an essential tool to meet future challenges in urban environments.

Research Problem:

Despite the many benefits of urban agriculture, this practice faces significant challenges that limit its spread and success. Among these challenges are the lack of available space, regulatory restrictions, and cultural trends that may hinder the adoption of agriculture in urban environments. This problem requires a comprehensive study to understand the influencing factors and how to overcome them, with the aim of promoting sustainable agricultural practices in urban environments.

This research paper can be the beginning of a deeper understanding of urban agriculture and its role in developing urban communities in a sustainable manner. The research problem can be summarized in a number of points,

Rapid Urban Growth and Environmental Challenges:

- Lack of environmental planning in the design of buildings.
- The extent to which current building designs can adopt urban agriculture techniques.
- The economic costs of establishing and maintaining green spaces.
- The increase of environmental problems.

Research Goals:

- 1- Assess environmental benefits: Study how urban agriculture impacts air and water quality and species diversity.
- 2- Analyze the impact of urban agriculture on urban planning and its role in improving urban land use.
- 3- Study its impact on architectural design and how it can be integrated into buildings and urban facades.
- 4- Analyze social dimensions: Understand how urban agriculture can enhance social cohesion and increase community engagement.
- 5- Identify challenges facing urban agriculture, including legal and economic constraints.
- 6- Propose policies and strategies to promote urban agriculture in cities to enhance the role of urban agriculture in sustainable urban and

architectural planning.

Research Methodology:

The research is based:

1. Descriptive approach: where technological developments in architecture are reviewed. The research is based on sources including:
 - Academic books and Scientific articles published in specialized architectural journals and Official reports from international organizations
2. Comparative approach: by comparing case studies to evaluate the efficiency of interactive technologies in achieving sustainability and improving the functional performance of buildings.
3. Analytical approach: by analyzing data from case studies to identify future challenges and come up with results and recommendations for future researches.

1- Urban Agriculture Definitions

1-1 Food and Agriculture Organization of the United Nations (FAO) [1]

Urban agriculture is a means of enhancing food security and achieving sustainable development. FAO promotes urban agriculture practices that contribute to improving nutrition and reducing poverty by increasing local production.

1-2 World Health Organization (WHO) [2]

WHO focuses on the health benefits of urban agriculture, such as increasing access to fresh and nutritious foods, which contributes to improving public health and reducing diet-related diseases.

1-3 United Nations Human Settlements Program (UN-Habitat) [3]

UN-Habitat promotes urban agriculture as part of sustainable city planning. It emphasizes the importance of integrating agriculture into urban design to enhance green spaces and improve the quality of life in urban areas.

1-4 Food and Agriculture Organization (IFAD) [4]

IFAD focuses on the role of urban agriculture in supporting the most vulnerable groups in society, by creating jobs and increasing income, which contributes to reducing poverty.

The concept of urban agriculture represents a multidimensional approach adopted by different organizations to achieve food security, improve health, and promote sustainable development in urban environments. Each organization considers urban agriculture an important tool that fits its own goals and vision, reflecting the diversity of potential benefits of this practice.

2- Urban Agriculture Methods that Suit the Nature of the Urban environment and Available Space. [5]

2-1 Vertical Farming

Relies on the use of walls and partitions to grow

plants in multiple layers.

- It saves space and increases productivity in cramped urban areas.
- It can be implemented using soil or hydroponic systems.

2-2 Rooftop Farming

- Utilizing the roofs of buildings to grow vegetables and fruits.
- It contributes to reducing indoor temperatures and improving thermal insulation.
- It can take the form of traditional gardens or soil-less growing systems.

2-3 Vertical Gardens (Green Walls & Living Walls)

Growing plants on walls using advanced irrigation systems.

- Improves air quality and adds an aesthetic touch to buildings.
- Used in residential, commercial, and school buildings.

2-4 Community Gardens

Creating shared gardens in neighborhoods or public spaces.

- Strengthening social bonds among residents and achieving food security.
- Can be located on unused land or within public parks.

2-5 Container Gardening

Using tubs, boxes, and containers to grow plants on balconies and walkways.

- Flexible and easily relocated according to lighting conditions and climate changes.
- Suitable for tight spaces in apartments and apartment buildings.

2-6 Urban Greenhouses

Small greenhouses within cities for growing crops year-round.

- Providing a protected environment that allows the cultivation of weather-sensitive plants.



Figure1. Technologies used in urban farming

- Smart farming techniques are used to increase production efficiency.

2-7 Street & Public Space Farming

Utilizing sidewalks, walkways, and empty spaces for agriculture.

- It contributes to improving the urban landscape and increasing green spaces.
- It promotes a culture of sustainability and community interaction.

2.8 Hydroponics & Aeroponics

- Hydroponics: Plants grow in nutrient solutions instead of soil.
- Aeroponics: Roots are suspended in the air and sprayed with nutrients.
- It uses less water and increases plant growth.

3- International Experiences

3.1 Eco polis Vertical Farm – Taiwan

Location: Taipei, Taiwan

Description:

- One of the world's first vertical farming demonstration projects.
- It features a sustainable design that promotes food self-sufficiency within urban areas.
- It relies on soil-less cultivation using hydroponic and aeroponic systems, enabling the cultivation of fruits and vegetables indoors. [6]

Technologies Used:

- Hydroponics and aeroponics.
- Artificial lighting to promote plant growth.
- Water recycling and energy-saving technologies.

Benefits:

- Reduces water consumption by 90% compared to traditional farming.
- Produces fresh produce year-round.
- Improves air quality and reduces urban temperatures.



Figure2. Ecopolis Vertical Farm – Taiwan

3.2 Pasona Urban Farm – Japan

Location: Tokyo, Japan

Description:

- One of the most prominent examples of integrating agriculture into the workplace.
- Located within Pasona's headquarters, office spaces have been transformed into urban farms that grow rice, tomatoes, leafy greens, and even fruits.
- The project aims to create a sustainable and healthy environment for employees, increasing productivity and improving quality of life. [7]



Figure3. spaces have been transformed into urban

3.3 Melbourne Sky farm

Location: Australia:

- Melbourne Sky farm is located in the heart of Melbourne, Australia, on the rooftop of a multi-storey car park near the Melbourne Convention and Exhibition Centre.

Project Overview:

- Melbourne Sky farm is an innovative urban agriculture project that aims to transform car park rooftops into sustainable green spaces, growing fruits and vegetables using modern urban agriculture techniques. [8]

Project Objectives:

- Transforming underutilized urban spaces into productive agricultural areas.
- Providing fresh and sustainable produce to city residents.
- Supporting urban biodiversity and enhancing green spaces.
- Raising awareness about the importance of urban agriculture and sustainability through educational programs and workshops.

Technologies Used:

- Indoor farming using LED lighting.
- Smart irrigation systems.
- Water recycling and the use of organic fertilizers.

Benefits:

- Reducing the distance between production and consumption, reducing carbon emissions.
- Improved indoor air quality.
- Providing fresh food within work environments, reducing the need for transportation and logistics.



Figure4. spaces have been transformed into urban

Project Features and Benefits:

- **Local Food Production:** Growing fresh crops such as leafy greens, herbs, and fruits for the benefit of local communities.
- **Reducing carbon emissions:** Reducing the need to transport agricultural produce from rural areas to cities.
- **Improving urban climate:** Reducing the urban heat island effect through green spaces.
- **Reusing water:** Sustainable irrigation systems significantly reduce water consumption.
- **Educational space:** The project hosts workshops and educational programs for schools and local communities on sustainable agriculture.

Agricultural techniques used:

- **Hydroponics:** Growing crops without soil using nutrient-rich water.
- **Water recycling systems:** Reduce water consumption.
- **Sustainable design:** Using recycled materials in the construction of farm infrastructure.



Figure 5. Melbourne Sky farm

3.4 Urban Sky farm in South Korea

Location: Seoul, South Korea

Project Overview:

- Urban Sky farm aims to redefine urban agriculture by creating a vertical agricultural tower specifically designed for food production within densely populated cities. The tower's design is based on the idea of a giant tree, with its different layers providing dedicated spaces for agriculture, in addition to other functions that support urban sustainability. [9]

Project Goals:

- Increase food production within cities and reduce reliance on rural agricultural land.
- Improve air quality and reduce the urban heat island effect.
- Promote the concept of sustainability and food self-sufficiency within urban communities.
- Provide social and educational spaces for city residents about sustainable agriculture.

Project Features and Benefits:

- Sustainable Food Production: Providing dedicated spaces for growing leafy greens, fruits, and herbs using smart agricultural systems.
- Improving the Urban Environment: Reducing air and noise pollution through vertical green spaces.
- Water Recycling: Adopting smart irrigation systems that collect rainwater and recycle it to reduce water consumption.



Figure 6. Transforming urban spaces into productive

- Carbon Emission Reduction: Reducing the need to transport agricultural produce from outside the city, which reduces fuel consumption and harmful emissions.
- Sustainable Design: The building is solar-powered, provides natural ventilation, and uses energy-saving technologies.

Agricultural Techniques Used:

- Vertical Farming: Growing crops on multiple layers within the tower.
- Hydroponics: Growing plants without soil using nutrient solutions.
- Solar Energy Use: Solar panels on the tower's roof provide the energy needed for irrigation and lighting.
- Organic Waste Recycling: Converting plant residues into natural fertilizer for use in agriculture.

Design Details:

- The tower consists of a tree-like structure, with its base representing roots that contain water bodies and agricultural environments, while the upper levels contain spaces dedicated to vertical farming.
- The tower includes areas dedicated to recreation, education, and research, making it a multifunctional project serving the community.
- It features the use of sustainable building materials and green construction techniques to enhance environmental efficiency.



Figure 7. Melbourne Sky farm

3.5 Pacific Place – Hong Kong

Location: Hong Kong

- Project Overview: Pacific Place is a luxury commercial complex located in Hong Kong, one of the city's most popular commercial and residential destinations. The complex includes luxury hotels, offices, retail outlets, and public spaces, along with a sustainable design that integrates urban agriculture into its green spaces, particularly in the rooftop gardens and courtyards. [10]

Features of the project's urban agriculture:

- The complex includes a rooftop garden used to grow a variety of vegetables and fruits, promoting the concept of sustainable agriculture within urban areas.
- The grown produce is used to supply restaurants within the complex with fresh produce, reducing the need to import agricultural products.
- Green spaces contribute to improved air quality and reduced urban heat islands.
- Sustainable irrigation and rainwater harvesting techniques are used to reduce freshwater

consumption.

Design and Sustainability:

- The project's design is based on the principles of green architecture, integrating green spaces into the design to promote environmental sustainability.
- Green roofs provide a natural environment within the city, improving ecological balance and enhancing the comfort of users and visitors.
- Plants on rooftops and outdoor spaces contribute to reducing energy consumption by cooling buildings and reducing the need for excessive air conditioning.

Environmental and Economic Benefits:

- Reducing carbon emissions by reducing the need to import agricultural products.
- Improving food sustainability by providing fresh, local sources for restaurants and hotels.
- Increasing green spaces, which enhances the quality of life in urban areas.
- Raising awareness of the importance of urban agriculture among city residents and complex visitors.

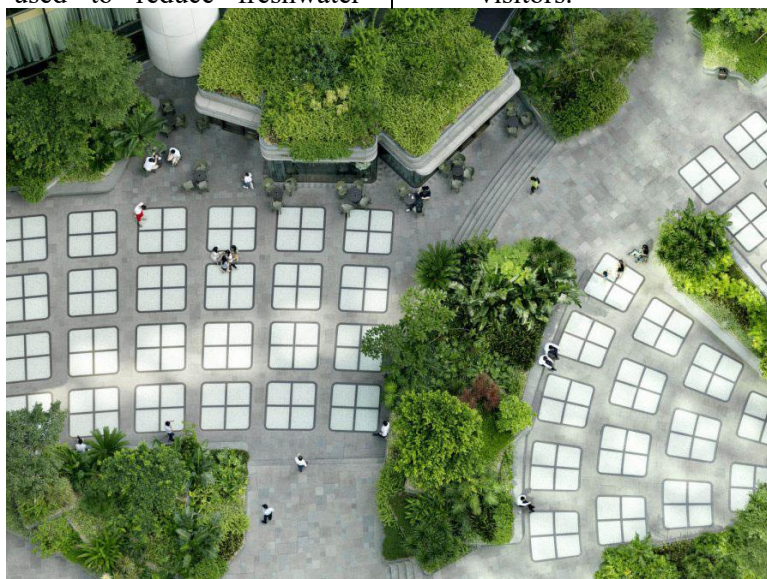


Figure 8. Pacific Place – Hong Kong

3.6 Brooklyn Grange - New York

Location: Brooklyn and Queens, New York

Project Description:

- Brooklyn Grange is one of the largest urban rooftop farms in the world, growing over 50,000 kg of organic crops annually on the roofs of buildings in New York City. [11]

Benefits and Features:

- Growing vegetables and fruits in underutilized

rooftop spaces.

- Providing agricultural produce to local markets and restaurants in New York City.
- Contributing to stormwater drainage and improving air quality in the city.
- Providing workshops and educational programs to raise awareness about sustainable agriculture.



Figure 9. Brooklyn Grange - Brooklyn Grange

4- Global Initiatives Encouraging Urban Agriculture

4-1. The "1,000 Urban Farms" initiative – Canada [12]

- Aims to establish 1,000 small farms on rooftops and other unused spaces in Canadian cities.
- Focuses on the use of hydroponics and aeroponics to maximize production in limited space.

4-2. The "Detroit Green" project - United States [13]

- aims to transform abandoned land in Detroit into urban farms to produce food for city residents.
- The project includes educational and training programs to support local communities in establishing their own farms.

4-3. The "Farm B" initiative – Singapore [14]

- A smart agricultural platform that helps residents transform their balconies and rooftops into small farms.
- It relies on smart agriculture technologies such as remote sensing and automatic irrigation systems.

4-4 Rooftop Gardening Initiative - Cairo, Egypt [15]

- Aims to utilize the rooftops of buildings in Egyptian cities for organic crop cultivation.
- The initiative includes training families on sustainable home gardening methods, such as hydroponics.

4-5 Edible Cities Network Initiative - European Union [16]

- A European Union-funded project that aims to transform cities into sustainable places through urban agriculture.
- It includes cities such as Berlin, Oslo, and

Shanghai, where public agricultural spaces are being designed in urban areas.

4-6 Grow Up Urban Farms Project - United Kingdom [17]

- A British company that relies on hydroponics in urban environments to produce fresh crops.
- It operates vertical farms within cities, reducing the need for traditional agricultural land.

4-7 Pasona Urban Farm Initiative – Japan [18]

- An urban farm within an office building in Tokyo, where farms are integrated into the workplace.
- Employees participate in growing crops within their offices, promoting sustainability and public health.

4-8 Lufa Farms Project – Canada [19]

- The first rooftop farm in Montreal, providing fresh produce to city residents through a vertical farming system.
- It relies on sustainable irrigation systems and reduces the use of chemical pesticides.

4-9 AgroUrbana Initiative – Chile [20]

- The first vertical urban farm in Latin America, providing fresh leafy vegetables using hydroponics.
- It aims to reduce dependence on imports and increase local food security.

4-10 Veggie Bus Initiative – India [21]

- A mobile project using recycled buses used as mobile greenhouses for agriculture.
- It aims to provide fresh agricultural produce to poor urban areas and improve food security.

5- The Role of Urban Agriculture in Developing Sustainable Urban Communities

These local and global experiences demonstrate how urban agriculture can play a key role in improving food security and promoting

sustainability in communities. Through innovation and community collaboration, positive outcomes can be achieved that impact the quality of life in cities.

5-1 Achieving food security:

Urban agriculture contributes to increasing local food production, which reduces dependence on external food supplies, and increases the availability of fresh food in local markets.

5-2 Promoting environmental sustainability:

Urban agriculture contributes to reducing carbon emissions by reducing the distances over which food is transported. It also helps improve air and water quality by increasing green spaces.

5-3 Improving quality of life:

Urban agriculture provides spaces for relaxation and social interaction, which enhances the psychological and social well-being of communities. It also encourages a healthy lifestyle by increasing access to fresh fruits and vegetables.

5-4 Boosting the local economy:

Urban agriculture can contribute to creating new job opportunities in areas such as agriculture, agricultural trade, and the development of small food projects.

5-5 Promoting environmental awareness:

Through education and awareness, urban agriculture encourages residents to understand the importance of sustainability and interact positively with their environment.

5-6 Supporting biodiversity:

Urban agricultural spaces contribute to supporting biodiversity by providing habitats for native species and beneficial plants.

6- Obstacles Faces urban agriculture Implementation:

6-1 Urban and Architectural Barriers:

- **Lack of Available Space:** In densely populated cities, it can be difficult to find suitable spaces for agriculture.
- **Buildings Not Adapting to Urban Agriculture:** Many buildings are not equipped to support the weight of soil, plants, and irrigation systems.
- **Design Integration Difficulties:** Integrating green elements into existing architectural designs can be complex and costly.

6-2 Environmental Barriers:

- **Pollution:** Air, water, and soil pollution in cities can affect crop quality.
- **Climate Change:** Rising temperatures or climate fluctuations.
- **-Lack of Suitable Soil:** Some urban areas lack fertile soil.

6-3 Economic Barriers:

- **High Cost:** Installing urban agriculture systems

(such as green walls or rooftop gardening) requires significant investment.

- **Maintenance Costs:** Urban agricultural systems require regular maintenance, which increases financial burdens.
- **-Difficulty Achieving Economic Return:** Some urban agriculture projects can take a long time to turn a profit.

6-4 Administrative and Legislative Barriers:

- **Lack of Supporting Legislation:** In some cities, there are no laws or incentives to support urban agriculture.
- **Ownership Issues:** Some projects may face legal obstacles due to land ownership or building permits.
- **Health and Safety Restrictions:** There are restrictions related to the quality of agricultural products produced within cities.

6-5 Sociocultural Barriers:

- **Lack of Community Awareness:** Some residents are unaware of the importance of urban agriculture or its environmental and economic benefits.
- **Resident Rejection of Some Applications:** Some individuals may oppose converting public spaces or rooftops into agricultural areas.
- **Lack of Trained Labor:** Lack of experience in urban agriculture techniques can hinder its spread.

Research Results:

From what was presented in the research, we find that urban agriculture of all types is an urgent necessity for all urban communities to address the challenges they face, due to its role in:

- **Urban:** Contributes to the revitalization of urban areas and improves the quality of life.
- **Architectural:** Integrates nature into design, enhancing the internal and external environment of buildings.
- **Sustainability:** Reduces resource consumption and contributes to greener, smarter cities.

Recommendations:

-Developing supportive policies:

- The need to develop policies and legislation that encourage urban agriculture, including facilitating the obtaining of licenses for agriculture in public and private spaces.
- Organizing educational awareness campaigns targeting local communities to inform them of the benefits and methods of urban agriculture, and enhancing community participation.

-Providing training and resources:

- Establishing training programs for urban

farmers to enhance their skills and knowledge of sustainable agriculture methods, and providing resources such as seeds, organic fertilizers, and tools.

- Encouraging cooperation between local governments, NGOs, and the private sector to develop and support urban agriculture projects.

-Improving infrastructure:

- Investing in the necessary infrastructure to support urban agriculture, such as providing clean water, and establishing local markets to market agricultural products.
- Supporting academic and applied research focused on urban agriculture, including exploring new technologies such as vertical farming and hydroponics.

-Providing economic incentives:

- Providing financial incentives, such as tax breaks or financial support for urban farmers, to encourage more individuals and groups to enter the field of urban agriculture.

-Impact assessment:

- Establishing mechanisms to assess the environmental, social and economic impact of urban agriculture projects, which helps improve future strategies and decisions.

-Promoting innovation:

- Supporting technological innovations that enhance the effectiveness of urban agriculture, such as smart applications for agricultural planning and resource management.

-Promoting community participation:

- Encouraging the community to participate in the design and implementation of urban agriculture projects, which enhances belonging and environmental awareness.

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