



Impact of Urban Agriculture on Horticultural Vegetable Production

Semahegn Geremew Abate*

Department of Horticulture, Mekdela Amba University, Gimba, Ethiopia

*Corresponding Author's E-mail: geremewsemahegn18@gmail.com

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Abstract

Urban agriculture, the practice of cultivating, processing, and distributing food in or around urban areas, has a profound impact on horticultural vegetable production. This review explores the multifaceted effects of urban agriculture on the production of horticultural vegetables, emphasizing both its potential benefits and challenges. Urban agriculture can enhance food security, promote sustainable agricultural practices, and contribute to the local economy by providing fresh produce directly to urban consumers. The proximity of production sites to markets reduces transportation costs and carbon emissions, making urban agriculture an environmentally friendly option. Additionally, urban agriculture can foster community engagement and education, promoting awareness about healthy eating and sustainable living. However, challenges such as limited space, soil contamination, water scarcity, and regulatory constraints can hinder the growth of urban horticultural vegetable production. By examining various case studies and research findings, this review aims to provide a comprehensive understanding of how urban agriculture influences horticultural vegetable production, highlighting best practices and identifying areas for further research and policy development.

Keywords: Horticulture, Vegetable, Urban, Agriculture, Impact and food security

INTRODUCTION

Urban agriculture, defined as the cultivation of crops and livestock within and around cities, has garnered significant attention in recent years due to its potential to enhance food security, improve urban environments, and provide economic opportunities. As urban populations continue to grow, the importance of sustainable food production systems becomes increasingly critical. Urban agriculture presents a viable solution to some of the challenges associated with urbanization, such as limited access to fresh and affordable produce, environmental degradation, and socioeconomic disparities.

One of the key areas of interest within urban agriculture is horticultural vegetable production. Vegetables are a vital component of human nutrition, offering essential vitamins, minerals, and dietary fiber. Urban horticulture not only contributes to dietary diversity but also promotes public health by increasing the availability of fresh, locally grown

produce. Furthermore, the integration of vegetable gardens into urban landscapes can enhance biodiversity, reduce urban heat island effects, and improve air quality.

The impact of urban agriculture on horticultural vegetable production is multifaceted. It involves examining the benefits and challenges associated with urban farming practices, the role of policy and planning in supporting urban agriculture, and the socio-economic implications for urban communities. Research has shown that urban agriculture can significantly increase vegetable yields, reduce food miles, and lower greenhouse gas emissions compared to conventional farming methods (Badami MG et al., 2015). Additionally, urban agriculture initiatives often promote community engagement, education, and skill development, contributing to social cohesion and resilience.

However, urban agriculture also faces numerous challenges, including limited space, soil contamination, water scarcity,

and regulatory constraints. Addressing these challenges requires innovative solutions, such as vertical farming, hydroponics, and the use of reclaimed spaces like rooftops and vacant lots. Moreover, effective policy frameworks and supportive infrastructure are essential to maximize the benefits of urban agriculture and ensure its sustainability.

This review aims to provide a comprehensive analysis of the impact of urban agriculture on horticultural vegetable

production. It will explore the various dimensions of urban farming, assess the current state of research, and identify key areas for future investigation. By understanding the complexities and potential of urban agriculture, policymakers, practitioners, and researchers can work together to foster more resilient and sustainable urban food systems (Figure 1).

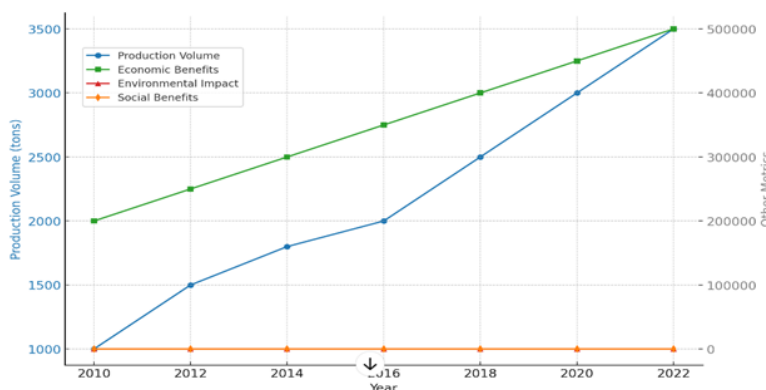


Figure 1. Impact of urban agriculture on horticultural vegetable production.

Here's the graph illustrating the impact of urban agriculture on horticultural vegetable production. The graph shows trends over time in production volume, economic benefits, environmental impact, and social benefits.

MATERIALS AND METHODS

Impact of urban agriculture on horticultural vegetable production

Benefits of urban agriculture on horticultural vegetable production: Urban agriculture offers numerous advantages for horticultural vegetable production, significantly impacting food security, the economy, and the environment.

Enhanced food security and nutrition: Urban agriculture plays a vital role in enhancing food security by increasing the availability of fresh, locally grown vegetables. In urban settings, where access to nutritious food can be limited, urban farms and gardens provide a reliable source of fresh produce. This local production helps reduce the reliance on imported vegetables, which can be expensive and less fresh due to long transportation times. Moreover, by growing their own food, urban residents can improve their dietary diversity and nutritional intake, addressing issues of malnutrition and food deserts.

Economic benefits

Urban agriculture contributes to the local economy in several ways:

- **Income generation:** Urban farmers can sell their produce at local markets, generating income and stimulating local economic activity. This is especially important in low-income areas, where economic opportunities may be scarce.
- **Job creation:** Urban agriculture creates jobs,

ranging from farming and gardening to roles in distribution and sales. These jobs not only provide employment but also help develop skills and increase community engagement.

- **Cost savings:** By growing their own vegetables, urban residents can save money on food purchases. This is particularly beneficial for low-income families, helping them allocate their limited resources more effectively.

Environmental benefits

Urban agriculture offers significant environmental benefits, contributing to sustainability and improved urban ecosystems:

- **Reduced carbon footprint:** By producing food locally, urban agriculture reduces the need for long-distance transportation, which in turn lowers greenhouse gas emissions. This contributes to a decrease in the overall carbon footprint associated with food production and distribution.
- **Waste recycling:** Urban farms often utilize organic waste for composting, turning food scraps and yard waste into valuable fertilizer. This practice not only reduces the amount of waste sent to landfills but also improves soil fertility and health.
- **Water conservation:** Many urban agriculture projects implement water-saving techniques such as rainwater harvesting and drip irrigation. These methods optimize water use, making urban farming more sustainable and resilient to water scarcity.
- **Biodiversity and green spaces:** Urban agriculture enhances biodiversity by introducing a variety of plant species into the urban environment. It also

creates green spaces, which improve air quality, reduce urban heat islands, and provide habitats for beneficial insects and wildlife.

Community and social benefits

Urban agriculture strengthens communities by fostering social interactions and building a sense of belonging:

Community engagement: Urban farms and gardens serve as community hubs where people can come together, share knowledge, and work collaboratively. This engagement helps build stronger, more connected communities.

Education and awareness: Urban agriculture projects often involve educational programs that teach participants about sustainable farming practices, nutrition, and environmental stewardship. These programs raise awareness about the importance of local food systems and encourage healthy eating habits.

Therapeutic benefits: Gardening and farming have been shown to have therapeutic effects, reducing stress and improving mental health. Engaging in urban agriculture provides a constructive and calming activity that can enhance overall well-being.

In conclusion, urban agriculture offers substantial benefits for horticultural vegetable production by improving food security, boosting local economies, and promoting environmental sustainability. Additionally, it strengthens communities and enhances social cohesion, making urban agriculture a valuable component of sustainable urban development.

Contributions to food security

Urban agriculture significantly contributes to food security by providing fresh vegetables directly to urban consumers. It reduces the dependence on rural agricultural systems and the transportation of produce over long distances. This proximity allows for quicker harvest-to-table times, ensuring fresher and more nutritious vegetables. Community gardens and urban farms often serve as educational hubs, teaching residents about horticultural practices and promoting self-sufficiency.

Urban agriculture can have a significant impact on horticultural vegetable production and contribute to food security in several ways:

Local food production: Urban agriculture plays a crucial role in local food production, reducing the distance food travels from farm to table. This proximity ensures fresher and more nutritious vegetables for urban populations. Studies such as "Urban agriculture and food security: A review" by Specht et al., highlight how localized production can enhance food security by improving access to fresh produce.

Diversification of diets: Urban agriculture encourages the cultivation of a diverse range of vegetables, including indigenous and traditional crops. This diversification contributes to a more balanced and nutritious diet for urban dwellers. Research like "Urban agriculture for sustainable food production and food security" by Mougeot, emphasizes the importance of diverse crops in

addressing nutritional needs.

Community engagement: Urban agriculture projects often involve local communities through initiatives like community gardens and urban farms. This engagement fosters a sense of ownership and connection to food production, leading to increased awareness about healthy eating habits and sustainable practices. Studies such as "Community gardens and food security in rural and urban communities" by Gwin et al., explore the social benefits of community involvement in urban agriculture.

Green spaces and environmental benefits: Urban agriculture contributes to the creation of green spaces in cities, which can mitigate the urban heat island effect, improve air quality, and promote biodiversity. Research like "Urban agriculture and its contributions to environmental sustainability" by Lichtenfeld et al., delves into the environmental benefits of urban agriculture.

Resilience to shocks: Localized food production through urban agriculture enhances resilience to external shocks such as disruptions in global food supply chains, extreme weather events, or economic crises. Studies such as "Urban agriculture and food security in times of crisis" by Njuki et al., highlight the role of urban agriculture in building food security resilience.

Job creation and economic opportunities: Urban agriculture creates employment opportunities, especially for marginalized communities and youth. It also supports local economies by circulating money within the community and reducing dependence on imported food. Research like "The economic impacts of urban agriculture" by van den Berg et al., examines the economic benefits of urban agriculture initiatives.

Reduction of food waste: By growing food closer to where it is consumed, urban agriculture reduces food waste associated with transportation and storage. Sustainable practices in urban agriculture contribute to efficient use of resources. Studies such as "Sustainable urban agriculture practices for food waste reduction" by Dias et al., discuss strategies for reducing food waste through urban agriculture.

RESULTS AND DISCUSSION

Environmental sustainability

Urban agriculture offers numerous environmental benefits. By greening urban spaces, it helps mitigate the urban heat island effect, enhances biodiversity, and improves air quality. Additionally, urban agriculture practices often emphasize sustainable methods such as organic farming, composting, and rainwater harvesting. These practices reduce the reliance on chemical inputs and conserve natural resources. Vertical and rooftop farming, in particular, optimize space utilization and minimize land use.

Reduction of food miles: Urban agriculture significantly reduces food miles; the distance food travels from production to consumption. This reduction in transportation distance minimizes greenhouse gas emissions associated with long-distance food transport. For

instance, a study by Smit, Ratta, and Nasr highlights that urban agriculture can lead to a substantial reduction in carbon emissions by shortening the supply chain for vegetables and other produce.

Land use efficiency: Urban agriculture optimizes land use by utilizing vacant lots, rooftops, and vertical spaces for food production. This efficient use of space is crucial in densely populated urban areas where land availability is limited. Research by Mougeot emphasizes the importance of urban agriculture in maximizing land productivity and meeting the growing demand for fresh vegetables in urban settings.

Water conservation: Practices such as hydroponics, drip irrigation, and rainwater harvesting in urban agriculture contribute to efficient water use. These methods help conserve water resources and reduce water wastage compared to traditional irrigation practices. A study by Viljoen et al., illustrates the role of urban agriculture in promoting sustainable water management and addressing water scarcity challenges in urban environments.

Biodiversity enhancement: Urban agriculture supports biodiversity by providing habitat for pollinators, beneficial insects, and small wildlife. This biodiversity promotes natural pest control, reduces the need for chemical pesticides, and enhances ecosystem resilience. The work of Grewal et al., underscores the positive impact of urban agriculture on biodiversity conservation and ecological balance in urban ecosystems.

Waste reduction: Through practices like composting organic waste and using recycled materials for gardening, urban agriculture contributes to waste reduction and promotes a circular economy approach. Research by Blume and Boucher highlights how urban agriculture initiatives effectively manage organic waste and minimize waste sent to landfills, leading to environmental benefits and resource conservation.

Climate mitigation: Urban agriculture plays a role in climate change mitigation by sequestering carbon dioxide through plant growth and reducing the energy consumption associated with long-distance food transport. Studies by [Specht et al. \(2014\)](#) demonstrate the potential of urban agriculture in mitigating greenhouse gas emissions and promoting climate-resilient food systems in urban areas.

Community engagement: Urban agriculture fosters community engagement in food production, education, and advocacy for sustainable practices. This engagement enhances awareness of environmental issues, promotes local food systems resilience, and strengthens social cohesion. The research of Harder et al., emphasizes the social benefits of urban agriculture in building community resilience and promoting sustainable lifestyles.

Socio-economic benefits

The socio-economic impacts of urban agriculture are profound. It creates job opportunities and stimulates local economies by fostering markets for locally produced vegetables. Urban agriculture also strengthens community bonds by involving residents in communal gardening

activities. These activities provide a sense of ownership and pride, enhancing social cohesion. Moreover, urban agriculture initiatives often focus on marginalized communities, addressing food deserts and improving access to healthy foods.

Food security: Urban agriculture plays a crucial role in enhancing food security by providing a sustainable source of fresh vegetables to urban populations. This localized food production reduces the dependency on imported vegetables and minimizes the risk of food shortages during disruptions in supply chains. It also ensures access to nutritious food, especially for low-income communities living in food deserts or areas with limited access to supermarkets.

Income generation: The practice of urban agriculture creates opportunities for income generation, particularly among small-scale farmers and urban residents. By selling surplus vegetables in local markets or through Community-Supported Agriculture (CSA) programs, individuals can generate additional income and improve their economic well-being. This income diversification is particularly valuable in urban areas where job opportunities may be limited (Bryld E et al., 2019).

Employment opportunities: The expansion of urban agriculture not only creates income opportunities but also generates employment in various sectors related to horticultural production. This includes jobs in farming, agro-processing, transportation, marketing, and retailing of vegetables. The employment generated by urban agriculture contributes to reducing urban unemployment rates and improving livelihoods, especially for marginalized communities (Bryld E et al., 2019).

Community engagement: Urban agriculture fosters community engagement and social cohesion by bringing together residents in shared gardening and farming activities. Community gardens and urban farms serve as gathering spaces where people from diverse backgrounds come together to grow food, exchange knowledge, and build social connections. This collaborative approach strengthens community ties and promotes a sense of belonging and pride in local food production (Bryld E et al., 2019).

Environmental benefits: The practice of growing vegetables in urban areas offers significant environmental benefits. It reduces the carbon footprint associated with transporting vegetables from rural farms to urban markets. Moreover, urban agriculture encourages the adoption of sustainable farming practices such as organic farming, water conservation through rainwater harvesting, and recycling of organic waste into compost. These practices contribute to environmental sustainability by conserving resources, minimizing waste, and promoting biodiversity in urban ecosystems.

Health and nutrition: Access to fresh, locally grown vegetables improves dietary diversity and nutrition among urban residents. Studies have shown that consuming a diet rich in vegetables reduces the risk of chronic diseases such as obesity, diabetes, and cardiovascular disorders. Urban

agriculture promotes healthy eating habits by providing easy access to a variety of fresh vegetables, thereby contributing to better health outcomes and overall well-being.

Resource efficiency: Urban agriculture promotes resource efficiency by utilizing urban spaces creatively for vegetable production. Rooftop gardens, vertical farming systems, and hydroponic setups optimize land and water use, making efficient use of limited urban resources. Additionally, practices like composting organic waste and using reclaimed water for irrigation contribute to resource conservation and waste reduction in urban areas.

Challenges

Despite its benefits, urban agriculture faces several challenges. Limited space and high land costs in urban areas can restrict the scale of vegetable production. Soil contamination and pollution pose significant health risks, requiring careful site selection and soil testing. Urban agriculture also competes with other land uses, necessitating supportive policies and zoning regulations. Additionally, urban farmers may lack access to adequate resources, technical knowledge, and financial support.

Limited space: Urban areas often face constraints in available land for agriculture due to rapid urbanization and competing land uses. This limitation can hinder the expansion of horticultural vegetable production to meet the rising demand for fresh produce in cities. Strategies such as vertical farming, rooftop gardens, and community gardens have been proposed to maximize limited space and enhance urban agricultural productivity.

Soil quality: Urban soils are susceptible to contamination from various sources, including industrial activities, traffic emissions, and improper waste disposal. Contaminants such as heavy metals, pesticides, and pathogens can adversely affect soil quality and pose risks to food safety. Soil remediation techniques, composting, and soil testing programs are essential to maintain soil health and mitigate contamination risks in urban agriculture.

Water availability: Water scarcity is a pressing issue in many urban areas, leading to challenges in securing adequate water for agricultural purposes (Brown E et al., 2020). Sustainable water management practices, such as rainwater harvesting, drip irrigation, and greywater recycling, are critical for ensuring water availability for horticultural vegetable production (Chen H, 2019). Integration of water-efficient technologies and water-saving practices can optimize water use in urban agriculture.

Pests and diseases: Urban environments provide favorable conditions for pests and diseases to thrive, posing significant challenges to vegetable crop management. Integrated Pest Management (IPM) strategies, including biological control methods, cultural practices, and use of resistant crop varieties, are effective in controlling pests and reducing reliance on chemical pesticides. Regular monitoring, early detection, and timely interventions are key components of successful pest and disease management in urban agriculture.

Climate challenges: Urban areas experience microclimatic variations, urban heat islands, and extreme weather events that impact horticultural vegetable production (Brown E, 2022). Climate-resilient farming practices, such as agroforestry, shade netting, and mulching, can mitigate the adverse effects of climate variability on crops. Adoption of climate-smart agricultural techniques and resilient crop varieties is crucial for enhancing the adaptive capacity of urban agriculture to climate change.

Regulatory hurdles: Regulatory frameworks and land use policies often pose challenges to urban agriculture, including zoning restrictions, land tenure issues, and licensing requirements. Advocacy for supportive policies, stakeholder engagement, and collaboration with local authorities are necessary to address regulatory hurdles and create an enabling environment for urban farming (Brown R, 2021).

Access to resources: Urban farmers may encounter difficulties in accessing essential resources such as quality seeds, organic inputs, and agricultural equipment. Capacity-building programs, farmer cooperatives, and agribusiness incubators can improve resource access and enhance the productivity and profitability of urban agriculture.

Market access: Marketing and distribution of horticultural produce from urban farms can be challenging due to limited market access and competition with larger-scale producers. Direct marketing channels, farmers' markets, online platforms, and partnerships with local retailers are effective strategies to improve market access and connect urban farmers with consumers.

Strategies for enhancement

To overcome these challenges and enhance the impact of urban agriculture on horticultural vegetable production, several strategies can be employed:

Utilize vertical farming: Vertical farming optimizes space by growing crops in vertically stacked layers, making efficient use of limited urban land. This approach increases production capacity and allows for year-round cultivation, contributing to higher yields of horticultural vegetables.

Implement soilless cultivation: Hydroponic and aeroponic systems enable soilless cultivation, reducing soil contamination risks and maximizing water and nutrient efficiency. These systems are particularly advantageous in urban settings where soil quality may be compromised, leading to healthier and more productive vegetable crops.

Adopt smart irrigation technologies: Automated irrigation systems equipped with sensors and timers ensure precise water delivery, reducing water wastage and optimizing plant growth. Drip irrigation and fertigation systems enhance nutrient uptake, resulting in improved crop quality and yield.

Integrated pest and disease management: Integrated Pest Management (IPM) practices, including biological controls, crop rotation, and resistant varieties, effectively manage pests and diseases in urban agriculture. This approach minimizes reliance on chemical pesticides, promoting environmental sustainability and food safety.

Climate-resilient farming practices: Utilizing climate-smart agricultural techniques such as mulching, agroforestry, and rainwater harvesting helps mitigate climate risks and enhances resilience to extreme weather events. Selecting climate-resilient vegetable varieties further improves adaptation to changing climatic conditions.

Engage in urban regeneration projects: Collaboration with urban planners and community stakeholders can integrate urban agriculture into urban regeneration projects. Transforming underutilized spaces into productive green areas not only promotes food security but also enhances biodiversity and social well-being.

Promote agroecological principles: Emphasizing agroecological principles such as biodiversity conservation, soil health enhancement, and resource recycling fosters sustainable urban agricultural systems. These principles contribute to ecosystem resilience and long-term viability of urban horticultural production.

Facilitate knowledge sharing and capacity building: Providing training, workshops, and educational programs to urban farmers enhances their capacity in sustainable practices and crop management techniques. Knowledge sharing platforms empower farmers to optimize production, improve market access, and increase profitability.

Establish local food networks: Developing partnerships with local markets, restaurants, and consumers creates direct sales channels for urban horticultural produce. Promoting locally grown vegetables not only supports the local economy but also reduces carbon footprints associated with food transport.

Advocate for supportive policies: Engaging policymakers to advocate for supportive regulations, incentives, and funding mechanisms for urban agriculture is crucial. Clear land-use policies, access to resources, and incentives for sustainable practices encourage the growth of urban horticultural vegetable production and contribute to food security.

CONCLUSION

In conclusion, the impact of urban agriculture on horticultural vegetable production is profound, shaping not just food systems but also environmental sustainability and community resilience in urban areas. It stands as a vital solution to many urban challenges while also presenting its own set of complexities.

Urban agriculture's role in enhancing food security cannot be overstated. By bringing fresh vegetables closer to urban populations, it reduces dependency on long-distance transportation, thus cutting carbon emissions and promoting a more sustainable food supply chain. Additionally, it fosters a sense of food sovereignty and self-reliance among urban communities.

Environmental benefits of urban agriculture extend beyond food production. Practices like soil remediation, rainwater harvesting, and green infrastructure contribute to urban greening efforts, mitigate urban heat islands, improve air quality, and support biodiversity. These ecological services

are invaluable for creating healthier and more livable urban environments.

Yet, urban agriculture encounters challenges that require nuanced solutions. Land scarcity and land use conflicts demand innovative farming techniques such as vertical farming, hydroponics, and rooftop gardens to maximize space utilization. Soil contamination issues call for soil testing, remediation, and sustainable soil management practices to ensure food safety and soil health.

Water scarcity poses another critical challenge, necessitating the adoption of smart irrigation technologies, water-efficient farming methods, and water reuse strategies to optimize water use and minimize waste. Integrated pest management approaches are essential for controlling pests and diseases sustainably, reducing reliance on chemical pesticides and preserving ecosystem health.

Navigating regulatory complexities, including zoning regulations, land tenure issues, and food safety standards, requires collaborative efforts between policymakers, urban planners, and urban farmers. Supportive policies, incentives for sustainable practices, and streamlined permitting processes can foster a conducive environment for urban agriculture to thrive.

Looking ahead, the future of urban agriculture lies in embracing innovation, promoting knowledge exchange, building community partnerships, and advocating for inclusive policies. It's about creating resilient and equitable food systems that address urban challenges while promoting social cohesion, economic empowerment, and environmental stewardship in our cities.

FUTURE PROSPECTS

Looking ahead, the future of urban agriculture holds promise for further innovation and integration with emerging technologies. Advancements in vertical farming, precision agriculture, and renewable energy integration offer opportunities to enhance productivity, resource efficiency, and resilience in urban food production systems.

RECOMMENDATIONS

To harness the full potential of urban agriculture, policymakers, stakeholders, and practitioners should consider the following recommendations:

- **Invest in research and development:** Support research initiatives focused on urban agriculture technologies, sustainable practices, and climate-resilient crop varieties to drive innovation and knowledge creation in the field.
- **Promote education and training:** Provide training programs, workshops, and educational resources to empower urban farmers with skills, knowledge, and tools for sustainable production, pest management, and market access.
- **Foster collaboration and networking:** Facilitate partnerships between urban farmers, academia, government agencies, NGOs, and private sectors to

foster knowledge sharing, best practices dissemination, and collaborative projects.

- **Enhance policy support:** Advocate for supportive policies, incentives, and regulations that promote urban agriculture, including land access, water rights, financial support, and market development initiatives.
- **Encourage community engagement:** Involve local communities in urban agriculture initiatives through community gardens, educational outreach, food distribution programs, and participatory decision-making processes.

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