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**EDITORIAL**

# Urban horticulture: Building the evidence base to support integration into cities and towns

Urban horticulture, a form of urban agriculture focussed specifically on the growing of fruits and vegetables in cities, provides a healthy food source to millions of people globally. In recent years, recognition of the potential importance of urban horticulture to local food security has become increasingly relevant to urban societies in response to high fruit and vegetable prices, the Covid-19 pandemic and empty supermarket shelves in response to extreme weather events. In response, there has been a top-down, policy-driven push and a bottom-up, community-led pull to increase the amount of land available for urban horticultural production. For example, the local authority in Hull, a deprived UK city, has recently passed a motion to give local communities a 'right to grow' on suitable council-owned land, and this motion is now under consideration (Barkham, 2023). However, the rationale for increasing land available for urban horticulture extends beyond food security, with urban horticulture providing many other key benefits to urban dwellers, including improved health and well-being, social cohesion, flood mitigation, carbon storage and a habitat for wildlife.

Whilst there is growing evidence that urban horticulture currently does and could further support more sustainable and resilient cities, there remain important scientific, engineering and socio-cultural challenges that must be overcome to successfully integrate food growing into cities more widely. This special collection for *Plants, People, Planet* brings together articles spanning mechanisms to engage urban communities with food cultivation (Sia et al., 2023); the benefit of urban horticulture to healthy diet and sustainability (Gulyas & Edmondson, 2023); the role of pollinators in supporting horticultural production (Nicholls et al., 2023); the importance of soil microbial communities for healthy and productive plants in urban green spaces (Stewart et al., 2024); experimental approaches to improve sustainability of aquaponically produced horticultural crops (Jones et al., 2023); the challenges to horticultural production of a specific crop, strawberry, in urban systems and the importance of knowledge exchange with rural producers (Zacharaki et al., 2024); and the role of institutions, such as the Royal Horticultural Society, in leading research into environmental horticulture at small scales in domestic gardens and community gardens (Gush et al., 2023). This collection of articles reflects the interdisciplinary nature of understanding the benefits of and the challenges to expansion of urban horticulture.

One of the key factors that could limit the potential of urban horticulture is the acceptance of land being used for food growing

and participation by urban communities (Edmondson et al., 2020). In their opinion piece, Sia et al. (2023) use Singapore as a case study to discuss the role of four different urban horticultural programmes, informed by research, to deliver benefits to urban inhabitants. They argue that it is necessary to redirect focus on urban horticulture 'to address the numerous socio-ecological challenges of living in an increasingly urbanised world'. The four programmes discussed provide opportunities for urban dwellers to engage with urban horticulture in different forms, from community gardening, small-scale ( $2.5 \times 1 \text{ m}^2$ ) allotment gardening for individuals, provision of seeds to grow leafy and fruited vegetables at home and more structured horticulture in specialist therapeutic horticulture gardens in public parks. Each of these schemes has been successful in engaging the target communities, for example, there has been an average annual growth of 300 plots on the allotment scheme, but they have also provided more to inhabitants by supporting positive changes to well-being. The case of Singapore presented provides a pathway to increase community engagement and expand urban horticulture successfully in other cities globally. This links to a wider body of research demonstrating the desire of urban residents to integrate food production into urban landscapes, for example, in a study in Portland, Oregon, USA, visitors expressed a preference for more food-bearing plants (amongst other vegetation resources, such as more flowering plants) into urban parks (Talal et al., 2021), and in the United Kingdom, there are growing waiting lists for allotment plots to grow food (Gulyas & Edmondson, 2023).

In addition to the well-being benefits of participation in urban horticulture, the consumption of fresh fruits and vegetables is crucial to a healthy and food secure population. Recent research in the United Kingdom has demonstrated that urban growers currently produce enough fruit and vegetables to feed approximately 3% of a city's population on their recommended 'five-a-day' diet (Edmondson et al., 2020), but in many countries typical consumption does not meet the required targets. In the United Kingdom, less than a third of adults eat their required five-a-day (PHE, 2019), and in the United States and the European Union (EU), less than 20% and 12% of adults meet current fruit and vegetable consumption guidelines (Eurostat, 2022; USDA, 2020). In their article, Gulyas and Edmondson (2023) use a citizen science diary approach with urban growers in UK allotments to demonstrate that this community are able to grow >50% of the vegetables, 20% of the fruits and 50% of the potatoes for their

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households. Importantly, they found that contrary to the general population, urban growers ate >25% more than their recommended five-a-day and 70% more than the UK average; they also wasted 95% less fruit and vegetables than the UK population. This research demonstrates the role that urban horticulture could have in food system resilience, improving urban diets and consequently public health and urban sustainability.

Key to the successful production of fruit and vegetables for consumption in urban areas is the pollination of crop plants. In their article, Nicholls et al. (2023) address a gap in our understanding of the size and diversity of urban pollinator communities from an urban horticultural perspective. Their UK-based study asks which insects visit urban crop plants and are there sufficient insects in urban areas to support adequate pollination. They found a diverse range of taxonomic groups of insect pollinators visiting a broad range of fruit and vegetable crops. However, using pollinator deficit experiments in allotments, they found limitations in the quality of strawberry crops suggesting that there is potential to improve the delivery of pollination to some urban crops. This research further supports the role of urban horticultural spaces in providing habitat for pollinator communities (Baldock et al., 2019), provides key insight into the importance of pollinators for urban horticultural crop production and highlights the need for further understanding of the relative roles of different insect groups in pollination.

Whilst pollinators are a vital component of crop production aboveground, soil microbes play an equally important role belowground. In their review, Stewart et al. (2024) focus on the role of the soil microbial community and plant-microbe symbiosis in helping to mitigate the effects of urban stresses, for example, urban heat or pollution, on plants. They argue for a focus on harnessing the power of plant-microbe interactions to enhance the health of plants and ultimately urban greenspaces. By focussing on specific problems including, reliance on synthetic chemical fertiliser, drought and drought, they provide examples of how integrating management of plant-microbe interactions into greenspace management, including areas of urban horticultural production, could improve the sustainability of cities and towns and ultimately the benefits that urban inhabitants derive from urban greenspaces.

Urban horticulture has traditionally taken place in urban green spaces, but cities and towns offer a unique opportunity to use hydroponic and aquaponics systems to grow fruit and vegetable crops in and on buildings. A clear challenge here relates to the sustainability of such approaches relating to the production techniques. Jones et al. (2023) focus on the effect of insect protein source as fish feed in circular multi-trophic food production systems (insect, fish and crop) on nutritional value of fish waste for hydroponic crop production. Their findings suggest that black fly soldier meal and poultry meal enhance the nutritional content of fish wastewater, in turn enhancing the nutrient profiles of two crops—lettuce and basil. This article provides an important step in understanding how to optimise resource use in hydroponic systems for more sustainable crop production in urban horticultural systems that utilise unused grey spaces in cities and towns.

For urban horticulture to reach its potential, production should include both greenspace and indoor farming methods, such as the

aquaponics systems discussed in Jones et al. (2023). Zacharaki et al. (2024) focus on strawberries as a highly suitable crop that can provide a food source year-round and can be grown effectively both in traditional soil-based horticultural systems and in protected environments in, or on, buildings. They review the challenges to successful integration of production in an urban horticultural setting and highlight the important role that knowledge exchange plays between urban growers and commercial strawberry producers operating in the urban environment, focussing on their understanding of plant physiology, pathogen management, pollination and environmental requirements, fertigation and propagation. This not only provides key context for the expansion of strawberry production specifically but also highlights the role of knowledge exchange between rural and urban producers and also between different urban producers in successful urban horticultural expansion.

For urban horticulture to reach its potential to provide a food source to local communities, it must be done in a sustainable way, enhancing the environmental benefits it supports and minimising the harmful impacts of growing practices (Gush et al., 2023). In their article, Gush et al. (2023) focus on the work of the [Royal Horticultural Society](#) in leading research focussed on understanding the role of domestic and community gardens in the context of the global environmental challenges we face. They argue that a key research priority is to understand the complex interlinkages between soils, plants, water, weather and people and provide an example of how institutions can shape the research that informs the delivery of environmental horticulture.

This special collection showcases the interdisciplinary nature of the challenges and opportunities presented by the expansion of urban horticulture and provides insight, research direction and focus on the rationale for and remaining knowledge gaps to successful integration. Community involvement in urban horticultural projects, whatever the size, is essential to ensure success of projects and research further refining how to motivate people who have never participated in growing to engage could provide important pathways to increase sustainable food production. Different organisations can play a role in this, for example, institutions like the [Royal Horticultural Society](#) (Gush et al., 2023), or using the global network of botanical gardens to showcase food growing in projects like the [Sustainable Communities Field School](#) in the University of British Columbia Botanical Garden (Krishnan et al., 2019). However, integration of food growing into cities must be sustainable, and there remain questions about how to minimise the impact and enhance the environmental benefit of urban horticulture in both soil-based systems and growing hydroponically in grey spaces in cities. The application of lifecycle assessment to different urban horticultural production practices could provide pathways to optimise the sustainability of food growing in cities (Edmondson et al., 2019).

The growing body of research demonstrating the multifaceted benefits of urban horticulture must now translate into action, the [UK House of Lords Horticulture Sector Committee](#) recently published a report on the future of the English horticultural sector, highlighting the need for research and support for amateur and professional growers to help with the transition to environmentally friendly growing and important role of research and development in horticultural

science to support innovation (House of Lords Horticulture Select Committee, 2023). This report also recognises the need for the UK government to produce a Horticulture Strategy for England. Based on this special collection and the wider evidence base in the scientific literature, it is clear that urban horticulture should be a part of all government horticultural strategies globally for a shift towards more sustainable cities and communities.

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Jill L. Edmondson wrote this article.

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## CONFLICT OF INTEREST STATEMENT

No conflict of interest is declared.

## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## KEYWORDS

cities, food security, health, society, sustainability, urban agriculture, urban ecosystem services, well-being

Jill L. Edmondson 

*Plants, Photosynthesis and Soil, School of Biosciences, University of Sheffield, Sheffield, UK*

## Correspondence

Jill L. Edmondson, Plants, Photosynthesis and Soil, School of Biosciences, University of Sheffield, Sheffield, UK.

Email: [j.edmondson@sheffield.ac.uk](mailto:j.edmondson@sheffield.ac.uk)

## ORCID

Jill L. Edmondson  <https://orcid.org/0000-0002-3623-4816>

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