



Urban agriculture: Declining opportunity and increasing demand—How observations from London, U.K., can inform effective response, strategy and policy on a wide scale

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ABSTRACT

Allotment gardening systems are widely used to provide urban residents with small-scale community agricultural plots. Originating in local food production needs, allotments provide multiple additional benefits and contribute to urban resilience. Despite overwhelming evidence of the diversity of benefits that they offer, allotments are under threat, though the extent of the decline in provision remains largely unknown. London, U.K. serves as a model in which to quantify contemporary provision of, and demand for, allotments in a growing city. This study provides concrete evidence to inform future policy and planning.

The data come from multiple sources: previous publications provide baselines, while local authorities and management groups provided current details of allotment sites and their waiting lists; allotments were additionally mapped using GIS to determine area of provision.

Allotment sites are being lost in London at an increasing rate, approximately triple that of a decade ago, and the compensatory measure of decreasing individual plot sizes within a site is widely employed to buffer demand. This decline can be largely attributed to increasing land value and pressures coupled with restrictive local authority finances.

This decline in provision has coincided with an increase in popularity. We found that the demand for allotments has increased four-fold since 2006. When considering the 55 % of sites for which we obtained sufficient data, provision would need to increase by 77 % in order to address the current length of waiting lists.

This study is the first step in aiding evidence-based decision-making in preservation of this vital resource. Ultimately, the results of this study and the tools it employs can inform the future direction of allotment provision strategies and land use-planning in a wide range of urban contexts.

1. Introduction

Globally, more than half of the world's population lives in urban areas (55 per cent), rising to 68 per cent by 2050 (DESA, 2018). With this continuing shift to urban living, cities encounter increasing pressures such as pollution, environmental degradation, resource scarcity and decreasing public health (The United Nations, 2015). Careful planning of cities is therefore required to ensure they become sustainable and resilient to future challenges. One contributor to achieving resilience is urban agriculture (UA). Urban agriculture has recently been popularised in discussions on sustainable cities due to its extensive co-benefits, such as; decreasing the urban heat island intensity, offering habitat networks

through cities, preserving agricultural knowledge in urban populations and offering increased human health and well-being (Ackerman et al., 2014; Speak et al., 2015). Though UA can take many forms, it is a powerful tool in forming cities capable of mitigating future challenges and directly address a nexus between the sustainable development goals (SDGs) 2: zero hunger, 3: good health and wellbeing, and 11: sustainable cities and communities (Drescher et al., 2006; United Nations, 2015).

1.1. Allotments

Allotment gardens, also known as community gardens in N. America, are a widespread form of UA which offer an agricultural opportunity to

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those with limited, or no, access to land. Within an allotment site, which may host many small gardens, a plot is a piece of land which can be rented by an individual for a small fee, with the primary purpose of growing fruit and vegetables. With the exception of intensive and green belt agriculture, allotments represent the largest land area devoted to UA in many medium-high density cities around the world including London (Breuste, 2010; Garnett, 2000).

In 2006, allotments in London involved more than 20,000 individual participants (Environment Committee and London Assembly, 2006). In the U.K., the responsibility for allotment provision and management falls on boroughs and local authorities, however, it is becoming increasingly common for these to assign the management of allotment sites to an independent association under 'designated management'.

In Britain, allotments are recognised under Section 23 of the Small Holdings and Allotments Act of 1908. This places a duty on local authorities to provide allotments when there is sufficient local demand (Small Holdings and Allotments Act, 1908). This duty, however, does not extend to Inner London authorities.

The use of allotment gardens is not a novel concept and they first appear in images and documentation of the mid-1700s surrounding newly urbanising industrial areas (Imbert, 2015; Savill, 2009). In the UK, they continue to be measured in 'rods' an Anglo-Saxon squared measure, with an original allotment plot size set at 20 rods (approximately 100 m²). The system of allotments as we know them today emerged out of the 19th Century 'allotment' of land to the labouring poor in order to grow their own produce and historically, these were publicly supported in order to improve food security. In Europe, this was most evident during the two World Wars. Allotments played a key part in the British government's 'Dig for Victory' campaign and, alongside home gardening, allotments were estimated to have produced 10 % of all UK grown food in 1944 (Barclay, 2012; Sandover, 2013). In the latter part of the 20th century, allotments declined in popularity and many faced abandonment. In recent years, accompanying a resurgence in environmental and health awareness, allotments have entered a new phase of interest, which has been coined as "the revival of urban gardens" (Speak et al., 2015). In contrast to the pioneer allotment movement, the new allotment revival has not been focussed around food production. Instead, allotments are now valued for the many wider benefits they provide to cities and their inhabitants (Audate et al., 2019; Speak et al., 2015).

1.2. Urban food systems

To date, the drive for sustainable agriculture has primarily been focussed on rural areas and improving conventional agricultural methods. Now, urban agriculture is growing in importance to resilient and sustainable cities by contributing to food security, shortening food supply chains and reducing food miles (Gerrard, 2010; Holmer and Drescher, 2005). Shorter supply chains, coupled with an increase of trust in food systems, have led the Food Ethics Council to view a growth in sustainable and local production from allotment systems as plausible and as contributors to an attractive future (Steedman and Schultz, 2009). Here we do not consider indoor urban food production systems and address one of the diverse outdoor forms of UA which occur at many scales, including, but not limited to; private gardens, green roofs, window boxes, community gardens and allotments (Van Veenhuizen, 2006). Urban agriculture will not replace its rural counterpart, however, urban food production has the potential to alleviate pressure on rural systems while offering a multitude of co-benefits.

1.3. Wider benefits

There is extensive evidence for the multiple benefits that allotments provide, particularly in cities (Bell et al., 2016; Gómez-Baggethun and Barton, 2013; Speak et al., 2015). Despite origins in food production, plot-holders are increasingly less concerned with the output of their

allotment and are instead more interested in the process of gardening and the health and social benefits this is perceived to bring. These shifting motivations towards cultural benefits including growing for aesthetic enjoyment and recreation were evident in a Warsaw study (Bell et al., 2016).

The open greenspace allotments provide plays a part in regulating ecosystem processes in cities. These include, but are not limited to; pollination, nutrient cycling, water purification, flood water management, local climate and air quality and soil fertility (Speak et al., 2015). These benefits spread beyond boundaries of allotments and reach those not directly involved. Wider environmental awareness grows; 45 % of allotment gardeners surveyed in Stockholm intentionally planted flowers with the specific intention of attracting pollinators (Andersson et al., 2007). Spill-over effects of such diverse plantings (including other Ecosystem Services such as seed dispersal and pest regulation) are noticed in the wider landscape; increasing the pollination of crops at urban-rural boundaries and contributing to maintaining functional ecological networks at the landscape scale. Allotments have been shown to promote soil health and their top soils were found to be higher in soil organic carbon as well as total nitrogen and less compacted (lower in bulk density) than conventional agricultural fields (Edmondson et al., 2014).

Allotments create a mosaic of habitats and can act as a refugia for biodiversity within an urban setting. Despite covering a relatively small proportion of urban land, allotments provide high-quality and varied habitats for many species groups (Matteson et al., 2008). Importantly, these spaces can make large contributions to the creation of a habitat network. Allotments, even small sites, can serve as stepping stones or corridors between larger habitat areas (Bell et al., 2016).

Allotment gardens have important societal and health benefits (Audate et al., 2019). Environmental and nutritional education are improved, for instance, urban garden participation led to improved nutrition through purchase decisions in France and in Italy the pedagogic role and contribution to multicultural community integration of allotments are highly prized (Della Valle and Corsani, 2009; Martin et al., 2017). Health benefits cover both physical and mental health, with the latter being increasingly recognised at a policy level (Houlden et al., 2018). A Dutch survey demonstrated that allotment gardening had a significant positive effect on a composite health index and that allotment gardeners visited their doctors less frequently than non-gardening neighbours (Van den et al., 2010). Supporting studies have shown that allotment gardeners have better body mass indices (BMIs), lung function, self-reported health scores and higher levels of physical activity than comparison groups (Genter et al., 2015). There is now recognition of the part that environment plays in determining an individuals' mental health – to the extent that nature-based interventions (green care, green prescription and ecotherapy) are being increasingly used as an aid for health care. Both subjectively and empirically (through a reduction in cortisol levels), gardening has been shown to be a greater reliever of stress than reading or other forms of physical exercise (Hawkins et al., 2011; Van Den et al., 2011). Allotments also have societal benefits and can contribute to improved social interaction, community cohesion, skill and knowledge acquisition, and place making and identity (Bragg and Atkins, 2016; Piore et al., 2018). Plot-holders strongly agree that "urban gardening strengthens the integration of people in the community" and "growers create better interpersonal relationships", the value of allotments to social capital is growing in parallel with urbanisation (Audate et al., 2019; Istenič et al., 2015).

1.4. Allotment policy

Wherever they exist, allotments are influenced by multiple tiers of policy. In London the city-wide direction on greenspace including allotments is outlined in the 'London Plan' (Greater London Authority, 2017a, 2017b). This plan acknowledges the importance of urban agriculture (Policy G8: Food Growing) and insists that in their local

Development Plans, boroughs should “protect existing allotments and encourage provision of space for community gardening including for food growing, within new developments or as a meanwhile use on vacant or under-utilised sites” (Greater London Authority, 2017a, 2017b). Local authorities (LA) are responsible for allotment provision within their management area, therefore, policy surrounding allotment provision varies widely. Notably, only four London boroughs have current allotment strategies; Brent, Harrow, Islington and Kingston (Brent London Borough Council, 2018; London Borough of Harrow Council, 2010; London Borough of Islington Council, 2012; London Borough of Merton Council, 2007; The Royal Borough of Kingston upon Thames Council, 2015). Looking at evidence in broader strategies, few boroughs propose increasing allotment provision as a viable and/or necessary solution. Conversely, boroughs such as Haringey describe increasing provision as being wholly unrealistic (London Borough of Haringey, 2005). Instead, strategies surrounding allotment provision tend to aim for maintenance of current provision.

A recurring theme in local policy is acknowledgement of the shortness of allotment supply frequently underpinned by councils’ reporting a lack of resources (both financial and spatial) to address this issue. For example, one local administration identified that the cost of providing new allotments in line with demand would lead to a £650,000 budget shortfall (London Borough of Barking and Dagenham, 2011). The Merton Open Space Strategy found similarly, concluding that it was “unlikely” that the council could financially allocate and maintain more land for allotments (London Borough of Merton Council, 2010). Consequently, most boroughs have prioritised other solutions to the problems surrounding allotment provision. These solutions include;

- increasing the quality of existing sites (London Borough of Bexley, 2008; London Borough of Enfield Council, 2010; London Borough of Harrow Council, 2010),
- favouring other urban gardening schemes such as community gardens (where plots are shared) (London Borough of Croydon, 2018; London Borough of Islington Council, 2012; London Borough of Southwark Council, 2019),
- closing allotment waiting lists (London Borough of Islington Council, 2012), and,
- increasing the efficiency of the management of allotment sites (London Borough of Haringey, 2005; London Borough of Merton Council, 2010).

1.5. London allotment records and management

In London, the responsibility for the management of allotments lies with local authorities for each borough. Sites are increasingly under ‘delegated management’ where a volunteer group directly manages them. The rise in delegated management means councils often now lack a unified system to track allotment provision or demand in their borough. Hence, records surrounding allotment provision and demand have become fragmented, and obtaining a complete picture is challenging.

Two studies have previously made strides in cumulating this fragmented evidence; one in 2006 by the Greater London Authority (GLA) and the second, a follow up, in 2012 by the Campaign to Protect Rural England (CPRE) (Environment Committee and London Assembly, 2006; Southgate, 2012). Both reports identified a falling number of allotment sites in London. This decrease was attributed to increasing land pressure and the need to build at high densities, particularly in Inner London. The 2006 study identified 737 allotment sites across Greater London, indicating a loss of 3.2 sites per year over their 10-year window. The same study recorded 20,786 plots on these sites. In comparison, the follow up study in 2012 identified just 723 allotment sites – a loss of 2.3 sites per year between the two reports. Additionally, the 2012 report did not differentiate between private and council owned allotment sites as the 2006 study did, hence, the loss of allotments may be larger than indicated there.

Paradoxically, evidence suggest that while there is a decrease in the number of allotment sites across London, demand has never been higher – resulting in long waiting lists for those interested in leasing a plot. The 2012 study did not gather evidence relating to city-wide waiting lists, however, the GLA identified over 4,300 individuals waiting for allotment plots in 2006 (Environment Committee and London Assembly, 2006).

1.6. Aims

Despite extensive evidence of their benefits, the current provision of and demand for allotments in London, and elsewhere, remains a large knowledge gap. The last comprehensive study of allotment provision in London was carried out in 2012 while the demand for allotments hasn’t been directly measured since 2006 (Environment Committee and London Assembly, 2006; Southgate, 2012).

This study aims to assess and quantify the current provision of – and demand for – allotment gardening spaces in London. Using comparisons with past studies, we will draw conclusions on how these have changed over time. In doing so, this research can feed into both London and wider policy making and may influence future allotment provision.

2. Methods

Broadly, the study was conducted in three stages:

- 1 A database of active allotment sites in London (excluding private sites) was created by extensive manually searching through local authority websites and associated allotment pages.
- 2 Allotment sites were located and spatially mapped to confirm distribution and size.
- 3 Where possible, individual sites were contacted to gather information.

The data were then analysed and compared to past publications – allowing conclusions to be drawn about trends in allotment provision/demand over time.

2.1. Creating an allotment database

A database of active allotment sites across London was created using a manual search on all local council websites. These sites were then filtered for inclusion. For example, any Community Gardens that did not offer individual plots were excluded from the study. The management of each site was identified, and grouped into 3 categories:

- I sites managed by the council (or a company on behalf of the council),
- II self-managed sites (otherwise known as delegated management) whereby a site is run completely by an independent association, and,
- III privately-owned and managed sites.

This study will focus on council and self-managed sites. The removal of privately owned and managed sites from the study is in part due to the fact that only a small number of councils provided details of these external sites and so it is difficult to ensure that all have been identified.

2.2. Spatial mapping

Quantum GIS (QGIS) v3.4.4 was used to spatially map the allotments identified in the manual search (QGIS Development Team, 2013). The study relied initially on two datasets; OS Open Greenspace and GLA allotment locations (Greater London Authority, 2006; Ordnance Survey, 2019).

First published by Ordnance Survey (OS) in 2017, OS Open Greenspace is geospatial data focussing on different green spaces in Britain

that is biannually updated (Ordnance Survey, 2019). The dataset, accessible as a shapefile, contains polygons of greenspace that are grouped into categories. One of these categories, is “Allotments Or Community Growing Spaces”; however, these spatial polygons do not have attributed names, and so are not identifiable. Conversely, in 2006, the GLA released a spatial dataset whereby named allotments were mapped using points – these points gave no indication to the shape or size of the site (Greater London Authority, 2006).

Combining these two datasets, while updating the data to mirror sites identified in the manual search stage creates an updated and verified map of allotments in London. This map is capable of informing the user about each site, including; name, location, size, shape and boundaries. Firstly, all polygons found in Greater London with the grouping “Allotments Or Community Growing Spaces” were extracted. Then, a function was used whereby if the GLA point files were located within the OS map polygon, the polygon adopted the name of the allotment as an attribute. Two difficulties were encountered during this process. The dataset acquired from the GLA contained errors whereby all allotment sites in certain boroughs were mapped incorrectly. This required manual correction using the allotment addresses provided by the council website (and which were gathered while creating the allotment database). There were additionally instances where the point location was slightly incorrect and did not overlap with the polygon preventing automated ‘adoption’ of the name attribute. This was solved by manual verification.

A challenge to the spatial mapping methods is the now-outdated GLA dataset. The ‘named point file’ was created in 2006, and since, some sites have closed while others have opened. To account for this, the dataset created from the manual search was compared to the GLA 2006 sites and any discrepancies were addressed. As the OS data is more recent, often site polygons were present and simply lacked a GLA name label, hence as the address of allotment sites are known, they can be identified manually instead. Finally, for allotments where neither a polygon nor point were present, the site was identified using the address. Then, a google satellite layer was used to draw a new polygon around the visible edge of the allotment site – this polygon was then attributed a name (Imagery ©, 2019 Google). The field calculator function was used to calculate the area of each site.

2.3. Allotment site information requests

Each site with an available email address was contacted with a request for information about the site. Requested information included; the number of plots at each allotment site, waiting list length (number and time) and waiting list status (open/closed). In the case that the authority was unable to provide this information then a Freedom of Information Request response on the topic dated July 2018 was used (Sutton Borough Council, 2018).

2.4. Determining the drivers of allotment demand

Current plot-holders on London allotments were invited to complete an online survey which addressed the self-perceived value of allotments by allotment gardeners. Contactable allotment sites were sent a link to the survey which was circulated to plot-holders using whatever means possible. The survey was live from 05/06/2019 to 18/07/2019 with 317 responses recorded. Respondents were asked to rank the importance of 9 benefits of allotments, from a scale of 1–9.

2.5. Data analysis and interpretation

Analysis of spatial data was conducted in QGIS (QGIS Development Team, 2013). All other data analysis used RStudio (RStudio Team, 2015).

2.6. Ethics approval

Contacting allotment site managers using email was evaluated as low-risk and carried-out in accordance with the recommendations of the institution’s approvals process for non-medical studies. The study was approved by the Head of Department and Joint Research Compliance Office at Imperial College London.

3. Results

3.1. The provision of allotments

The manual search identified 682 active, council owned or leased allotment sites in London. 52.8 % of these sites are council-managed whereas the other 47.2 % are self-managed. The preferred management of site varies between local administrations. Information regarding allotment plot provision was able to be gathered for 399 sites, representing 58.5 % of those available. On these sites alone, 24,883 individual growing spaces were reported.

This is the first study to identify the distribution and associated land area devoted to allotments in London, setting a precedent and providing an accurate current estimate for future comparisons. Verification by GIS plotting revealed that the 682 identified allotment sites cover 895 ha in London. The active growing area is smaller than this, due to the area required for infrastructure such as access paths, trading huts and toilets. Brent council estimates that infrastructure areas comprise 21 % of the allotment total area (Brent London Borough Council, 2018). Applying this scaling factor would mean that in London approximately 188 ha are required for infrastructure, leaving 707 ha as active growing space.

3.2. Allotment distribution

Allotment sites are not evenly distributed across London; Inner London boroughs hold noticeably fewer sites than their Outer London counterparts (Fig. 1). Just 16 % of allotment sites (113) are located in Inner London. When the area of allotment sites is considered, the proportion attributed to Inner London falls to just 7.9 % of the total.

The boroughs richest in allotment sites are Bromley (51), Barnet (44) and Ealing (44) – all located in Outer London. These Outer London boroughs, however, are often larger and have lower population densities than their Inner counterparts. Considering number of allotments per head calibrates these differences between boroughs (Fig. 2). Per capita, the areas richest in allotments are Sutton, Bromley and Bexley. Unsurprisingly, the boroughs that fare the worst in this are located in Inner London. Twelve of the 13 boroughs with the least allotment space per head of population are located in Inner London, with only Croydon (17 sites) from Outer London ranking poorly (12th).

3.3. Using area as a metric of provision

This study evaluates and argues for the use of land area as a measure of the provision of allotments in London. The area covered by allotments in London varies between sites (Fig. 3). Allotment areas range from just 110 m² (0.011 ha) to over 10 ha. The majority of sites cover less than 1 ha. Using site and plot numbers alone falls short in measuring ‘real’ provision as allotment numbers give no indication of the size of each site. Hackney, for example, ranks remarkably well for Inner London when numbers of allotment sites were considered (9 sites). All of these sites, however, are very small, only containing a handful of plots each. When land area and area per person are considered, the lack of allotment availability in Hackney is exposed (Fig. 4). Conversely, Croydon ranks poorly when site numbers are used as the metric (17 sites) but contains the 4th largest area of allotments out of any borough. Plot numbers, whilst sometimes a useful metric of provision, fail to indicate area. It is unknown if plot numbers are changing due to changes in the total area of the site or changes in the area of individual plots.



Fig. 1. The location of council owned or leased allotment sites in Greater London (red). The location and boundaries of each site have been mapped. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

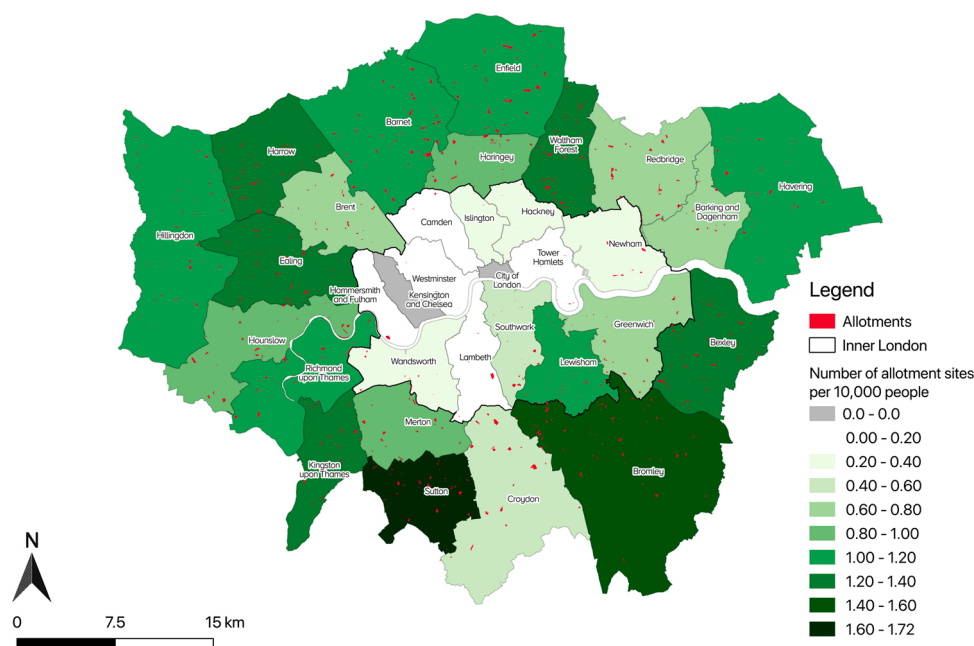


Fig. 2. The number of allotment sites per 10,000 people shown per borough for Greater London. A darker colour indicates a greater number of allotment sites per 10,000 people. This metric was calculated using the population per borough, the area of the borough and the number of allotment sites.

Using the measure of area of allotments per head, the highest scoring boroughs are Barnet, Enfield and Bromley (Fig. 4). The lowest scoring boroughs (other than the two boroughs where no sites are present – the City of London and the Royal Borough of Kensington and Chelsea) are Westminster, Lambeth and Hackney.

3.4. How allotment provision has changed

There are currently 682 council owned or leased allotments in use, a net loss of 41 sites in a 7-year period (5.7 %), or a rate of loss of 5.9

allotment sites per year. This decrease is markedly above the rates of loss observed in 2006 and 2012 (3.2 and 2.3 sites per year respectively) suggesting the rate of loss of allotments is increasing in London.

The number of individual allotment plots provided has increased since 2006. In 2006, 20,786 plots were identified, whereas currently 24,883 plots are provided by only 58.5 % of sites. This is a measured increase of 20 % across the 13-year period – with the increase likely to be much larger if the full current provision was known. Given the loss in overall area, this indicates that the size of plots may have substantially decreased in the past thirteen years.

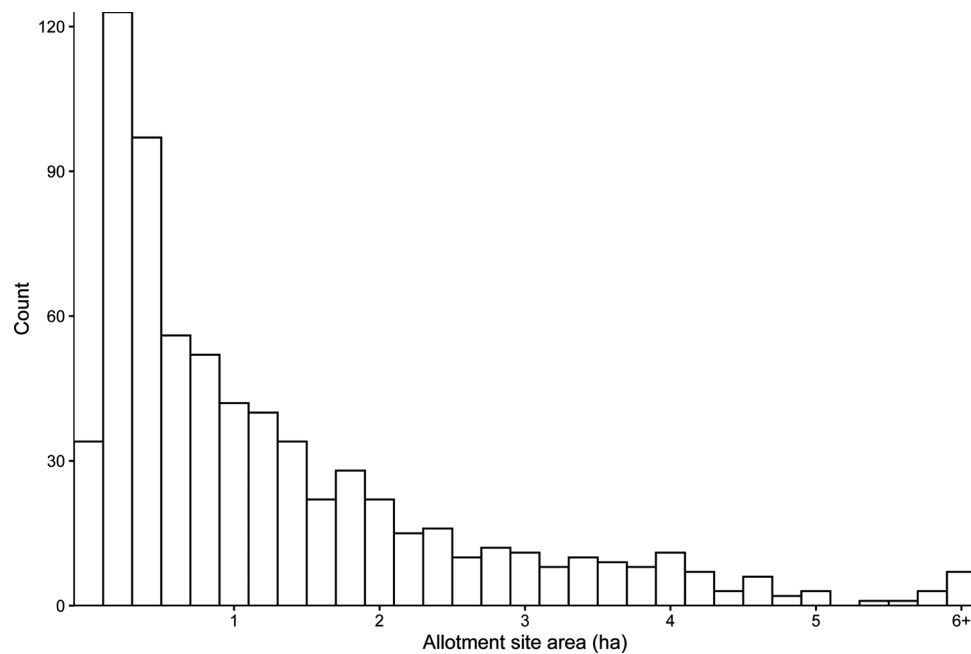


Fig. 3. The variation in land area covered by individual allotment sites (ha) across Greater London. Frequencies are calculated using 0.2 ha bandwidths.

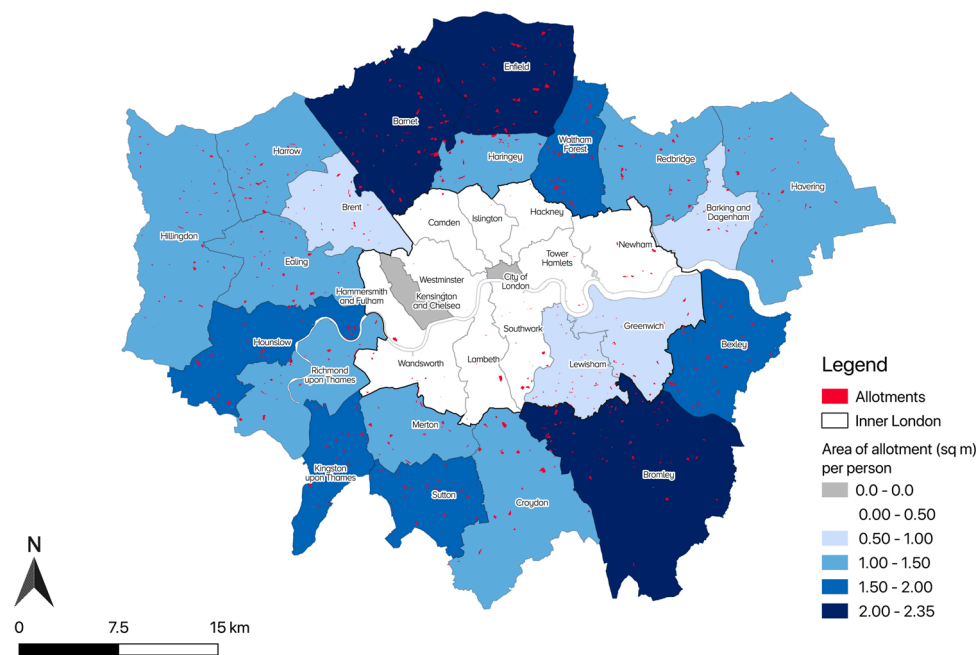


Fig. 4. The area of allotments (m^2) per person for each borough in Greater London. The darker the colour, the larger area of allotment land available to an individual in that borough.

The decline in allotment provision varies spatially, with some boroughs losing allotments more rapidly than others. Comparing current distribution maps with those of 2006 allows estimation of the change of allotment distribution over time (Fig. 5). Seventeen Boroughs have experienced a net loss of allotment sites, with the largest losses coming from Barnet and Lambeth where each lost 7 sites over this 13-year period. The number of sites remained constant in 11 boroughs, whereas only 5 boroughs increased in allotment provision over this time period (Haringey, Islington, Lewisham, Hounslow and Westminster).

3.5. The demand for allotments

This study received information on occupancy and demand from 377 allotment sites – 55 % of allotment sites in London. Only 42 allotment sites are known to not hold a waiting list. This indicates that at least 20,323 plots are occupied – termed, manifest demand. There are, additionally, those individuals on a waiting list to receive a plot – the latent demand. Information from the 377 sites revealed that 17,424 people are currently waiting for an allotment plot in London. Two outliers were identified for waiting list times – one of 72 years and one of 152 years, both were removed from parameter estimations as these were influential and arose due to unique circumstances. Individuals are otherwise expected to wait,

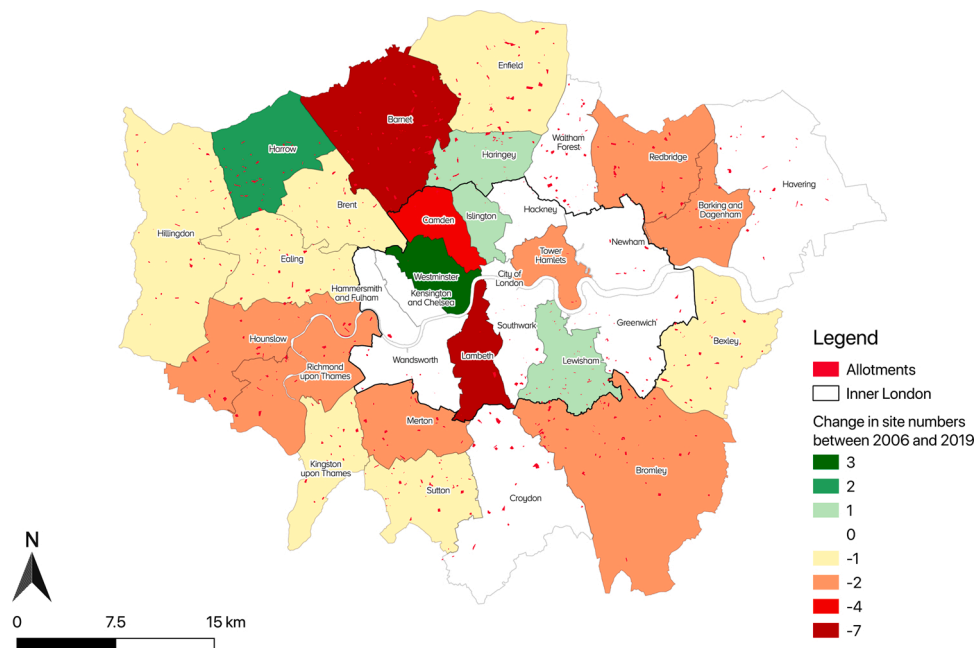


Fig. 5. The change in the number of allotment sites in each borough between 2006 and 2019. Green represents a net gain in allotment sites over the time period, red represents a net loss of allotment sites in that borough. White indicates that there has been no net loss or gain in the borough. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

on average, 4–5 years before receiving a plot (range of 1–15, Fig. 6). There is, however, large variation in waiting list times. While 26 % of allotment sites with a waiting list estimate the wait for a plot is only a year (Fig. 6), elsewhere, the strength of demand for allotment plots in London has meant some allotment sites have closed their waiting lists altogether – there are currently at least 61 closed waiting lists in London (16.3 %).

3.6. How the demand for allotments has changed

The latent demand for allotments has increased rapidly since 2006. The GLA study identified over 4,300 people were waiting for plots in

2006, 13 years later this number has increased over four-fold despite only 55 % of allotment sites providing data. It is therefore beyond doubt that latent demand and interest in allotments has grown remarkably in recent history.

3.7. Drivers of demand: the self-perceived value of allotments by allotment gardeners

The surge in demand for growing spaces goes beyond simply a demand for food production. Plot-holders identified relaxation and mental health benefits as being the most important aspect of allotment

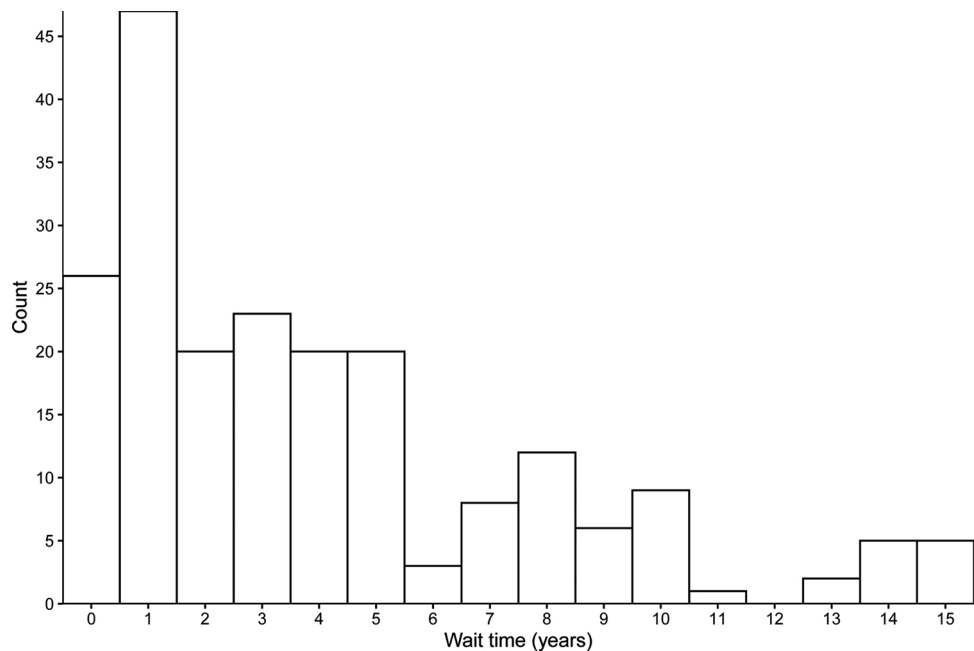


Fig. 6. The estimated length of time (in years) an individual currently has to wait to receive a vacant plot at allotment sites in Greater London. Waiting times are available for 207 allotment sites (30.4 % of allotments in Greater London).

gardening for them (Fig. 7). Followed by recreation and physical health which were valued just as importantly as food production. Saving money was ranked least important by current plot-holders. Socialising – which is often quote as being a co-benefit of allotment gardening – ranked low in importance.

3.8. Interactions between supply and demand

Allotment supply in London simply does not meet demand. Where both provision (plot numbers) and demand (waiting list numbers) are known for allotment sites, 22,669 allotment plots have a combined waiting list of length 17,424. The latent demand for allotment is 76.9 % that of allotment provision – in other words, provision would have to increase by approximately 77 % in order to address the growing waiting lists at allotments.

Clearly, this relationship between supply and demand is not equally distributed. In seven boroughs, the number of people on the waiting list exceeds that of the number of plots and provision would have to at least double in order to meet demand. In other boroughs, provision is meeting demand successfully. For example Enfield's waiting list is only 3.9 % the size of the number of plots in their borough (2,293). Bexley too fares impressively, offering 2,034 allotment plots, having only 92 people on their waiting list and an approximate wait time of 1 year.

4. Discussion

4.1. The decline of allotment sites due to increased competition for land

Local authorities in all growing urban centres are faced with managing increased competition for land in tandem with frequently diminishing local budgets. This can drive decline of low direct revenue greenspace such as allotments and the sale of allotment sites to give way for new development has been previously observed. In London, both the 2006 and 2012 reports accredited allotment decline to this and competition for land has only increased since these studies (Environment Committee and London Assembly, 2006; Southgate, 2012). In common with cities in many parts of the world, London's population has risen by 10 % (from 8.31 million to an estimated 9.11 million) since 2012 and this creates a rising demand for housing and infrastructure (GLA Intelligence, 2013; Greater London Authority, 2017a,2017b). Allotment land is particularly desirable for development due to its readily available nature: the land is largely accessible, non-toxic with good soil health and requires minimal or no ground clearance of existing structures (Crouch, 1998). Alongside increased demands for land, the restrictions in local budgets encourage 'cashing-in' on land while addressing issues such as housing shortages. In the UK, A House of Commons report identified that the financial constraints of local authorities makes the sale of such high-value land very appealing (House of Commons, 1998). This is mirrored in local level policy; with allotment

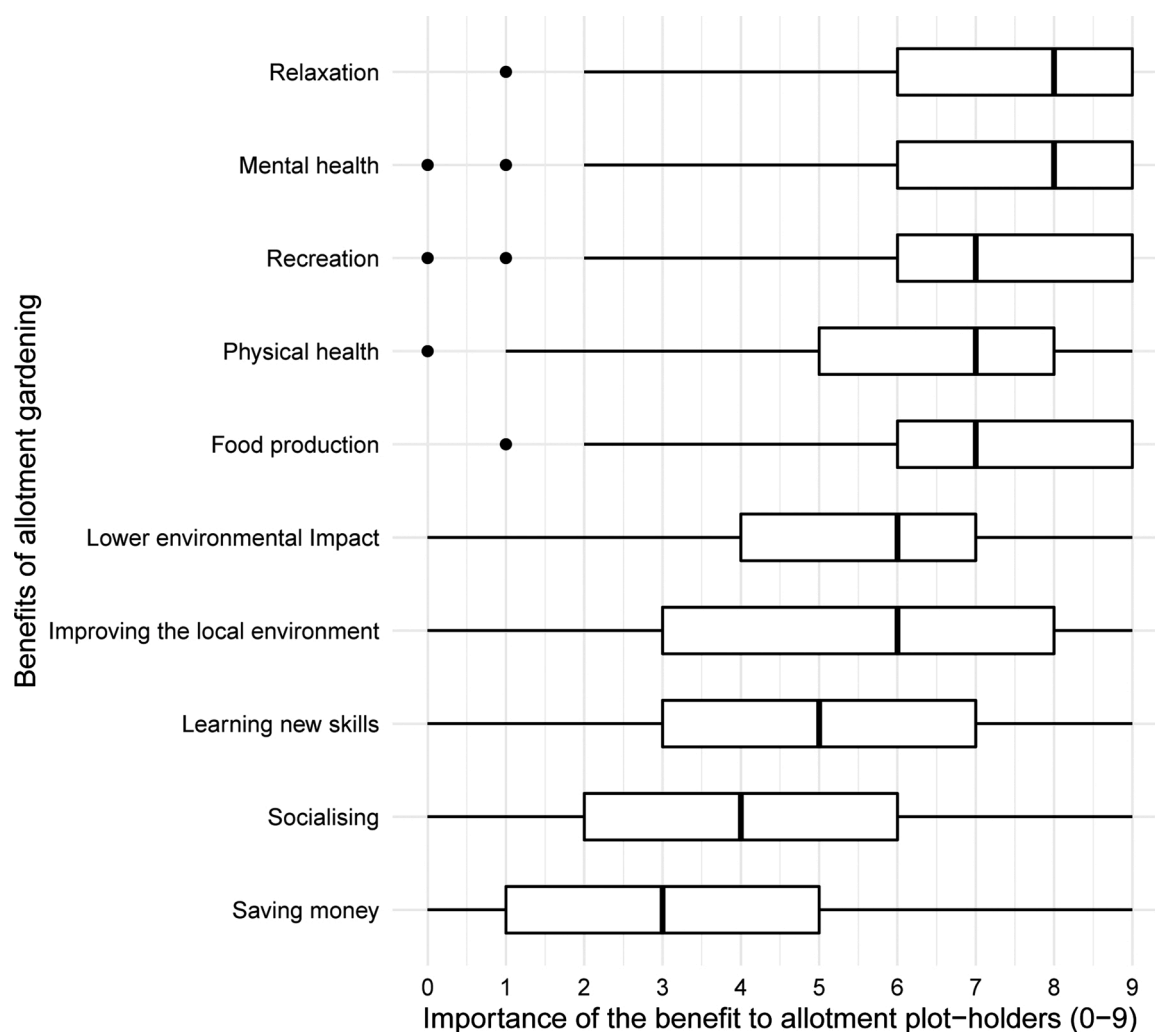


Fig. 7. How allotment gardeners value the benefits associated with allotment (n = 317). Plot holders ranked benefits between 0 and 9. Allotment gardeners most value the relaxation and mental benefits of allotments.

strategies or open green space strategies blaming financial constraints for not being able to increase allotment provision. It is clear that the pressure on land, coupled with restrictive local urban budgets, is putting allotments at an increasing risk of closure.

The decline in land devoted to allotments is not unique to London, nor to cities in the U.K. This study adds to cumulating evidence that shows rapid decline of urban allotment gardens across the Global North. In Prague, a study monitoring land use change across the city concluded that allotments sites were being increasingly lost to private uses – primarily as permanent residences, or used for the construction of residential projects, transportation infrastructure or commercial facilities (Spilková and Vágner, 2016). Increasing pressures cause the economic value of urban land to rapidly rise – beyond the perceived economic returns offered by allotments (Spilková and Vágner, 2016). Increased usurpation of urban allotments for development purposes has also been observed in the Netherlands, Germany, Poland and Spain (Bellows, 2004; Domene and Sauri, 2007; Groening, 1996, 2005; Melsner, 2009). The broad drivers of allotment decline appear to be relatively universal, observations and suggestions from this study – focussing on the management of allotments in London, are likely to be applicable to other medium-high density cities in the Global North.

4.2. Spatial variation in the provision of allotments

Even with strong guidance in the form of national or regional policy, and recommendations based on an understanding and valuation of the wider benefits associated with such spaces, local-level policy and constraint are the key influences on the provision of allotment facilities to city-dwellers. The responsibility for providing, and ability to provide allotments falls squarely on the local authority books and the few clearly monetised benefits can rarely counterbalance this. In London, the effect of the difference in requirement between Inner and Outer boroughs is emphatic. Outer London boroughs have a statutory requirement to provide allotments where there is demand, Inner London does not and though the outer London provision does vary, it is substantially greater than in Inner London. Other factors also contribute to differing prioritisation of allotment funding and support and may have multiple drivers such as, the perceived value of allotments, funding allocations, or different management styles – delegated management versus council management. We observed that spatial variation is not reflective of immediate local policy: three boroughs which lack specific allotment strategies fare best in allotment provision (measured by area per person). Another three boroughs that do possess a positive allotment strategy have still decreased in provision since 2006 (Brent, Kingston & Merton). Thus, even with positive intent, it is likely that financial constraint and a lack of resources to address provision trumps all. It will only be when wider benefits are accounted for that the true value of allotments will emerge. If this recognition of value in the multiple benefits of allotments intended by planning frameworks was recognised by local authorities it would provide significant justification for their protection (Mougeot, 2005).

Cities vary in their power structures, but what emerges from this study is further evidence that hierarchical levels must work together to deliver national policies. Without this cooperation and resource flow, local levels will be unable to mirror commitments such as the protection and enhancement of allotments. A closer working relationship is therefore required between policy makers and those at the delivery end so that delivery can be optimised.

4.3. Decreasing individual plot sizes

While the number of allotment sites has decreased, the availability of individual plots has instead increased, suggestive that the size of individual plots has substantially decreased in the past 13 years. Both the 2006 and 2012 studies commented on the potential of decreasing plot sizes to address rapidly increasing demand: halving allotment plot sizes

doubles the number of units within the same land area. Studies which compare allotments in urban, peri-urban and rural areas found that allotment plots were smaller in urban than any comparison location (Mougeot, 2005). Again, this was attributed to land scarcity and a pattern of reduction in individual plot areas to accommodate a greater number of people (Mougeot, 2005).

4.4. Land area as a measure of allotment provision

Using land area, in combination with plot numbers, to indicate allotment provisioning creates a metric which incorporates the observed changing plot sizes. Monitoring land area would allow more subtle trends in provisioning to be observed. Using site numbers alone, allotments of different sizes are deemed interchangeable – a larger site cannot be differentiated from a smaller site. Advantageously, land area does differentiate between different sizes, painting a more informative picture of allotment provisioning.

The mapping of allotment sites, as was done to calculate land area, allows the consequences of a proposed change in allotment provision to be assessed at the landscape level. We propose that allotment provision should no longer be considered on a case-by-case basis, instead, the effects on the distribution of allotments as a whole – using mapping techniques – must be considered. A landscape level approach is advantageous to the current planning system as it allows the wider repercussions of closures to be fully understood. Successfully employing such an approach would require effective communication between boroughs, this should be reflected in city-level policy.

4.5. Rising demand

We provide evidence that the popularity of allotments in London is increasing. This can, in part, be explained by the decrease in provisioning. If a popular site is forced to close, individuals join waiting-lists elsewhere. Undoubtedly, the loss of 55 allotment sites since 2006 has lengthened waiting lists or filled plot vacancies elsewhere. With a four-fold increase in waiting lists since 2006, it is, however, clear that demand is increasing at a rate beyond that explained by allotment closures alone.

This increase in demand for allotments coincides with observations of increase in incidence of mental ill-health in many cities (Gruebner et al., 2017). Our survey of allotment gardeners supports findings in existing literature that allotments are no longer primarily valued for food production (Istemić et al., 2015). Instead, mental and physical health benefits are the most valued aspects of allotment gardening. This high perceived value of relaxation could, in part, be due to the rise of mental ill-health and hence a greater demand for pastimes that counteract it. Current health systems cannot cope with the mounting demand of such urban ill-health and 75 % of cases of depression and anxiety in London remain untreated (Healthy London Partnership, 2018). As a result, people may increasingly be turning to activities – such as allotment gardening – that help address these issues, increasing further their popularity. Future studies should identify an explicit link between these self-perceived health benefits and their alleviation of burden on the National Health Service. This economic link could be the key to placing allotments higher on the policy agenda.

Urbanisation and a shortage of private green space may also contribute to allotment demand. In London, 21 % of households do not have access to a private or shared garden (Office for National Statistics, 2020). Additionally, vegetation makes up just 57 % of land area in London gardens, with the remaining 43 % being hard surfaces, side passages and buildings (Smith et al., 2011). Allotments are unique in being social green spaces, but with individual control, they are valued as such. The growing popularity of allotments may therefore be driven by the shortfall of garden green spaces in dense urban areas.

4.6. Lack of communication between allotment sites exacerbates waiting lists

The difficulties encountered by this study when gathering data surrounding allotments demonstrates the lack of communication between allotment sites, at the borough and city scale. Approximately half of the allotments identified are currently under delegated management, in these areas the local council does not hold records surrounding allotment vacancies. The absence of a centralised monitoring system means no advice can be given to individuals on long waiting lists about alternative sites that have vacancies. Such delegated management can thus exacerbate local-scale spatial variation in waiting list times. The lack of communication between boroughs/districts regarding site availability leads to similar trends. An allotment site's closest neighbour may be situated in a different administrative area and are therefore managed completely independently, consequently, despite being in close geographic proximity the two sites are extremely isolated. Increased communication between sites – both within and between administrative areas – is required to address allotment demand and spatial variation. The need to consider allotment opportunities at a landscape scale is not a lesson unique to London and should be applied to any city that relies on the devolution of power to smaller scale management groups.

4.7. Study limitations

There are limitations of waiting list data to accurately convey demand. Firstly, an individual may apply to multiple sites and accept the first offered plot to them (Campbell and Campbell, 2013). Secondly, people on the waiting list may no longer want a site or may have received one elsewhere. A study conducted in Brent asked all 570 waiting list applicants to confirm if they wished to remain on the waiting list, of which, only 268 did – representing a reduction of over 50 %. Thirdly, people who want an allotment plot may be deterred by long wait times and may not put their name on a waiting list; particularly those who are more mobile such as renters. Finally, waiting list numbers may also be a biased indicator of demand as they do not indicate if the waiting list has been closed in the past, or if it is capped. Islington council, for example, follows a strategy whereby a waiting list is closed when it reaches 200 names and opens again once it drops below 100 (London Borough of Islington Council, 2012). Despite these limitations, which may act in both directions, waiting lists are still the most widespread and accessible proxy for demand.

4.8. Key recommendations

- We have identified the benefits of closer cooperation between hierarchical levels when delivering national policies. Here, we identified the specific gap between city-wide policy directives and those at the local administration level. This imbalance, particularly concerning financial restrictions, has exacerbated the decline of allotments.
- Allotments should be considered at the landscape scale, particularly when managed in isolation. In part, this is achieved through increased communication between allotments sites. Current management trends exacerbate data fragmentation for both plot availability and waiting list lengths. Increased communication between sites would allow vacant plots to be filled more quickly and waiting list times to be more even. Crucially, such communication must occur both within and between local administrations. The use of novel spatial mapping tools aid this recommendation as they allow sites to identify their closest neighbours and form networks, while also allowing individuals seeking a plot to identify other potential sites.
- The demand and provision of allotment sites should be more closely monitored with thorough scrutiny of any proposed closures. We suggest that proposed closures of allotment sites should no longer be considered on a case-by-case basis and instead that the wider effects

on the distribution of allotments as a whole must be considered. Again, this will be most effective with efficient communication channels that cross hierarchical ranks as well as by using novel aids such as spatial mapping tools.

5. Conclusion

Allotments are an invaluable part of an urban environment, promising many ecological, social and health benefits beyond their primary function as food growing spaces. Despite this, there is now robust evidence of the rapid decline in provision. This decline must be halted and attempts made to increase provision if both current demand and sustainable city policy commitments are to be met. The proximate fate of allotments is currently held in the hands of local authorities which are faced with financial restrictions and conflicting demands for land use; allotments often lose out. If nothing is done to address these drivers, we are likely to lose these green components so valuable to our cities.

This study is the first step in aiding evidence-based decision-making in preservation of this vital resource. By identifying the current challenges, opportunities and demand for allotments, we provide policy makers and local planners with evidence to make decisions with regards to the future of this diversely useful form of urban agriculture.

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CRedit authorship contribution statement

Ellen Iona Fletcher: Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft, Project administration. **C. Matilda Collins:** Conceptualization, Methodology, Writing - review & editing, Supervision, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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