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**Exploring the Role of Nature-Based Typologies and Stewardship Schemes in Enhancing Urban Green Spaces: Citizen Perceptions of Landscape Design Scenarios and Ecosystem Services**

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# **Exploring the Role of Nature-Based Typologies and Stewardship Schemes in Enhancing Urban Green Spaces: Citizen Perceptions of Landscape Design Scenarios and Ecosystem Services**

## **Abstract**

This research investigates the UK citizens' perceptions of the ecosystem services (ES) created using a range of Nature-Based Solutions (NBS) in urban green spaces (UGS). The longevity of the ES derived from UGS is dependent on the effective on-going maintenance of urban landscapes, therefore this paper also gathers data on direct UGS participation specifically through the lens of civic stewardship to assess the impact of such schemes upon ES. NBS typologies were created and used, in the mixed methods study, to gauge perceptions of and preferences for alternative urban landscape design. The UGS survey collected data from 345 respondents on ES and the NBS typologies. Twelve semi-structured interviews provide qualitative data on NBS typology preferences, perceptions, and understanding of ES as well as motivations behind civic engagement in UGS in the UK. Stewardship programmes were found to increase community resilience by providing additional ES. The results showed a preference for integrating complex, multifunctional UGS into the fabric of urban centres to ensure accessibility and to maximise engagement. More complex NBS typologies were perceived to provide additional ES when compared with traditional monoculture mown grass and shrub amenity planting. Mixed native planting and Tiny Forest NBS typologies were perceived as providing more provisioning, cultural, regulating, and supporting ES. Considering both UK citizens' perceptions of the ES gained from alternative NBS and stewardship schemes in UGS represents a holistic approach that can improve the design and management of NBS in cities. This study is the first to explore both concepts in the UK and suggests a holistic UGS approach to address urban challenges, including those related to Climate Change.

**Keywords:** Public Perceptions, Social-Ecological Systems, Cultural Ecosystem Services, Provisioning Ecosystem Services, Tiny Forest

## **1. Introduction**

The ongoing process of urbanisation, with over half of the world's population currently residing in urban areas, represents a persistent global phenomenon (Esch et al. 2014). Projections indicate that this trend will continue over the next three decades, with estimates suggesting a rise from 56 percent in 2021 to 68 percent by 2050 (United Nations Human Settlements Programme (UN-Habitat) 2022). Cities are confronted with formidable societal challenges due to this rapid urbanisation, encompassing the safeguarding of the well-being of their citizens while simultaneously addressing a range of pressing environmental and health issues (Kuddus, Tynan, and McBryde 2020). Addressing such complex issues is critical for legislators, urban planners, and landscape architects alike.

In this context, urban green spaces (UGS) have emerged as crucial components, offering numerous ecosystem services (ES) to both society and the environment (Chang et al. 2017; Russo and Cirella 2020). UGS encompass diverse nature-based solutions (NBS) typologies, such as groups of trees, water retention basins, bioswales, rain gardens, and more (Eisenberg et al. 2022). In the last decade, the concept of NBS has received a lot of attention in the literature as it has the potential to address global societal challenges by offering solutions that are both cost-effective and simultaneously offer environmental, social, and economic benefits that aid in building urban resilience (Cohen-Shacham et al. 2016; Escobedo et al. 2019).

As a result, the use of NBS typologies in UGS are increasingly recognised as an essential means of enhancing ES within urban areas (Bona et al. 2022; Longato et al. 2023; Oral et al. 2020). However, the type and complexity of the NBS used in UGS can impact the level of ES attained. Previously published research highlighted the over-reliance on and the low ES value of

monocultural grass communities (Ignatieva and Ahrné 2013; Ignatieva et al. 2020; Zhang and Muñoz Ramírez 2019). This highlights the need for a shift in landscape design and management practices to prioritise the implementation of multifunctional NBS which enhance biodiversity and create ES.

In response to the increasing demand for ES in urban areas, UGS with diverse NBS typologies must be thoughtfully designed and developed (Larondelle and Lauf 2016). Therefore, to design a more sustainable and resilient UGS, the literature emphasises the interdependence of nature and people (Heymans et al. 2019). The development of concepts and theories for urban planning and design has emphasised the need for a more holistic Social-Ecological Systems (SES) approach since the early 2000s (Heymans et al. 2019). The SES approach acknowledges the dynamic interactions between ecosystems and human societies and advocates for collaborative and integrated approaches to achieve sustainable urban systems (Bennett et al. 2018; Conrad and Daoust 2008). For UGS to function effectively, continual coordination, collaboration, and co-management among various stakeholders, including municipal organisations and civic groups, are crucial (Campbell et al. 2022). Thus, the stewardship of UGS, involving the active participation of individuals and communities in environmental practices such as green infrastructure restoration and maintenance, plays a vital role in enhancing ES (Caggiano et al. 2022; Davies and Santo-Tomás Muro 2023; Sanecka, Barthel, and Colding 2020).

Incorporating an SES approach in urban ecosystems is recognised as an effective model for addressing climate change mitigation and social issues (J. Fischer et al. 2015; Preiser et al. 2018; Folke et al. 2011). The dynamic interactions between social and ecological systems are central to the SES approach, which necessitates an active effort to enhance our understanding of these interactions (Preiser et al. 2018). Moreover, the resilience of SES is significantly influenced by human perceptions of ES (Alessa and Kliskey 2021). Perceptions of ES are

influenced by the SES, emphasising the importance of comprehending public perceptions to optimise urban green spaces' design and management (Quintas-Soriano et al. 2018; Nahlik et al. 2012; Kandel et al. 2018).

Another challenge in maximising ES in UGS is the lack of agreement on typologies or subcategories of NBS (Castellar et al. 2021). This ambiguity makes it difficult to design UGS that fully capitalise on the potential of NBS to enhance ES. For instance, the perception of whether a green area with a lawn provides comparable ecosystem services to the same area with woodland may vary among stakeholders (Chen, Wang, and Jia 2018). Therefore, understanding complex personal motivations towards UGS is essential to optimise the design and management of NBS typologies. (Frantzeskaki 2019); Buchel and Frantzeskaki 2015), which are more effective, sustainable, and resilient (Leach et al. 2018; Armitage et al. 2012). There is an increasing body of work on perceptions, particularly since the Covid-19 pandemic, however, the review of literature review has revealed a need for further research on people's acceptance and support for alternative NBS typologies and different management regimes (Teixeira et al. 2022; L. K. Fischer et al. 2020). In addition, despite the increasing recognition of the importance of NBS in UGS, there is still a paucity of UK-based studies concerning people's perceptions of ES and NBS in urban centres (Haq 2011; Roberts, Glenk, and McVittie 2022).

This paper aims to address the gaps in the existing literature by providing new data on a holistic SES approach to the design and management of UGS. By examining perceptions of ES related to alternative NBS typologies and analysing the impact of UGS stewardship on underutilised urban land, this study seeks to develop a blueprint for maximising ES in urban environments.

Specifically, this paper aims to achieve the following objectives:

- Evaluate people's knowledge and understanding of ES

- To gather data on the perceived ES value of different NBS typologies.
- Investigate the desire for and impact of stewardship schemes in creating and managing UGS.

By investigating people's perceptions and stewardship schemes in creating and managing different NBS typologies, we hoped to fill a significant gap in existing research. While past research has mostly focused on these two components separately, we recognised the necessity to explore them concurrently to acquire a more thorough knowledge of the interaction between the community and NBS.

The active involvement of key stakeholders and the broader community in planning, implementing, and maintaining NBS has been proven to enhance the sustainability, effectiveness, and acceptance of such solutions (European Commission Directorate-General for Research and Innovation et al. 2023). Embracing 'co-governance' approaches fosters collaboration, breaking down institutional barriers, and generating societal benefits that extend beyond the mere physical impact of NBS interventions (European Commission Directorate-General for Research and Innovation et al. 2023). This inclusive approach strengthens citizen engagement in civic decision-making, encouraging active participation and a sense of ownership in shaping their surroundings (European Commission Directorate-General for Research and Innovation et al. 2023).

## **2. Methodology**

A mixed methods approach involving quantitative and qualitative research methods was implemented to increase the depth of research. By synthesising both data sets, the overall results can be refined and provide clearer answers to the research aims (Creswell, J., and Piano Clark 2008).

### **2.1 Survey**

The survey was conducted in the UK during the Covid-19 pandemic, so an online survey was deemed to be the most appropriate. The survey was widely circulated using the snowballing technique on social media platforms, as well as being distributed through personal and professional networks (Lavrakas 2008). As the focus of this study was on urban landscape typologies in the UK, the sample size is based on the UK urban population in 2020, which was estimated to be approximately 55.91 million (WorldOMeter 2021). To ensure a high level of accuracy, the study aimed for a 95% accuracy rate with a margin of error of 5-10%. The first section of the survey focused on knowledge and understanding of the ES provided by UGS. This study applied the approach taken by Agbenyega et al. (2009) where the survey questions were formulated around key components of each ES category. A 5-point Likert scale was adopted to facilitate a range of responses and to increase response rates.

### **2.1.1 Research Through Design (RTD)**

The study applied the Research Through Design (RTD) methods (Lenzholzer, Duchhart, and Koh 2013). to develop landscape scenarios representing different NBS typologies within a compact UGS, in Oxford, UK. RTD was chosen as a pragmatic approach to provide empirical evidence and test theoretical conceptualizations, as demonstrated by Lenzholzer, Duchhart, and Koh (2013). As suitable photographic examples of the alternative landscapes were not available, this study adopted the approach taken by Chen et al. (2018).

Six digital NBS typologies were created, using Adobe Creative Suite, to evaluate perceptions and preferences toward alternative UGS content. The NBS typologies created include Mixed Native planting (i.e., ecological), Block Amenity, Mown Utility Lawn, Mixed Non-Native Meadow, Tiny Forest (TF), and Winter Meadow Scene (Figure 1).

The "Ecological typology" depicts a habitat-rich design consisting of native herbs and wildflowers, trees, ferns, and a stumpery. This typology can be viewed as a multifunctional

social-ecological model which aims to maximise biodiversity and encourage UGS interaction.



Figure 1: Alternative landscape design scenarios (a) Mixed native planting (i.e., ecological) (b) Block amenity planting (c) Mown utility lawn (d) Mixed non-native meadow (e) Tiny Forest (TF) - Mixed native trees (f) Winter meadow scene. The site is a typical example of a small under-utilised urban space found in UK cities.

The second part of the survey required respondents to rank the different NBS typologies in line with their perceived ES, see supplementary materials. To overcome inconsistencies with ranking responses, the weighted averages for the ranking of each NBS typology were deemed to be an effective way of comparing preferences considering the ES statements presented.

### **2.1.2 Statistical Analysis**

To obtain descriptive statistics, the data collected from a total of 346 respondents was subjected to analysis using Microsoft Excel. To ensure the robustness of our findings, Multinomial, and Chi-squared tests were applied to the survey results using JASP version 0.16.2 (Love et al. 2019). The primary objective of these tests was to evaluate the appropriateness of the null hypothesis and ascertain the statistical significance of the obtained results.

The Multinomial test was employed to assess whether the observed cell counts were uniformly distributed, while the  $\chi^2$  goodness-of-fit test was utilised to determine whether there were any significant deviations between the observed cell counts and a specific expected distribution (Sarafoglou and Kesteren 2018).

In the JASP software, the Multinomial test was conducted by accessing the "Common" analysis menu on the ribbon, followed by selecting "Frequencies" and then "Multinomial Test" (Sarafoglou and Kesteren 2018). To establish statistical significance, a significance level of  $p \leq 0.05$  was selected. The null hypothesis, Pearson's chi-squared test statistic was employed, measuring the discrepancy between the observed and expected cell counts under the null hypothesis,  $\chi^2 = \sum_{i=1}^k \frac{(\text{observed}_i - \text{expectedcount}_i)^2}{\text{expectedcount}_i}$  (Sarafoglou and Kesteren 2018).

### **2.2 Qualitative Methods**

Interview participants were recruited using purposive sampling techniques as the study aimed for a diverse range of perspectives from individuals with experience in UGS stewardship. Volunteers and NGO employees were selected for their direct involvement with to social and

ecological urban systems. Volunteers increase the potential for multi-disciplinary insights and could provide valuable data on social systems and UGS stewardship. NGO employees were included in the interviews to gauge the possible impact of UGS stewardship on wider stakeholders. The use of purposive sampling aimed to maximise the quantity and quality of data collected, as recommended by Vasileiou et al. (2018). A total of twelve semi-structured interviews were conducted. The semi-structured interview technique was adopted to reduce formalities, increase rapport, and collect a larger quantity of data, in line with the method adopted by Hoyle et al. (2017) and Jennings (2005). This method aimed to achieve information power and saturation of data with a lower sample size.

The audio files were transcribed using NVivo Version 12 and Otter. NVivo 12, recognised as a simple and user-friendly way of processing qualitative data (Welsh 2002), was used to code transcript data, and monitor high-frequency terms keywords, and phrases which became 'indicators of important themes' (Nyumba et al. 2018).

### **3. Results**

In terms of the respondents' knowledge and understanding of ES, 50-97% of the survey respondents were found to value UGS functions across all four ES categories. People showed a good level of awareness and understanding of the ES which are key to urban resilience to social and environmental challenges.

The statistical analysis of the data shows a significant preference for the UGS typologies which provide greater ES.

#### **3.1 Responses to Traditional Urban Typologies**

Lawn ( $\chi^2=120.372$ ,  $df=4$ ,  $p < 0.001$ ) and Block Amenity ( $\chi^2=149.850$ ,  $df=4$ ,  $p < 0.001$ ) were identified by respondents as the most familiar NBS typologies in UGS. Ecological typology was identified as the least familiar ( $\chi^2=173.659$ ,  $df=4$ ,  $p < 0.001$ ) followed by TF ( $\chi^2=39.752$ ,  $df=4$ ,  $p < 0.001$ ) and then meadow typologies ( $\chi^2=99.973$ ,  $df=4$ ,  $p < 0.001$ ) (Figure 2).

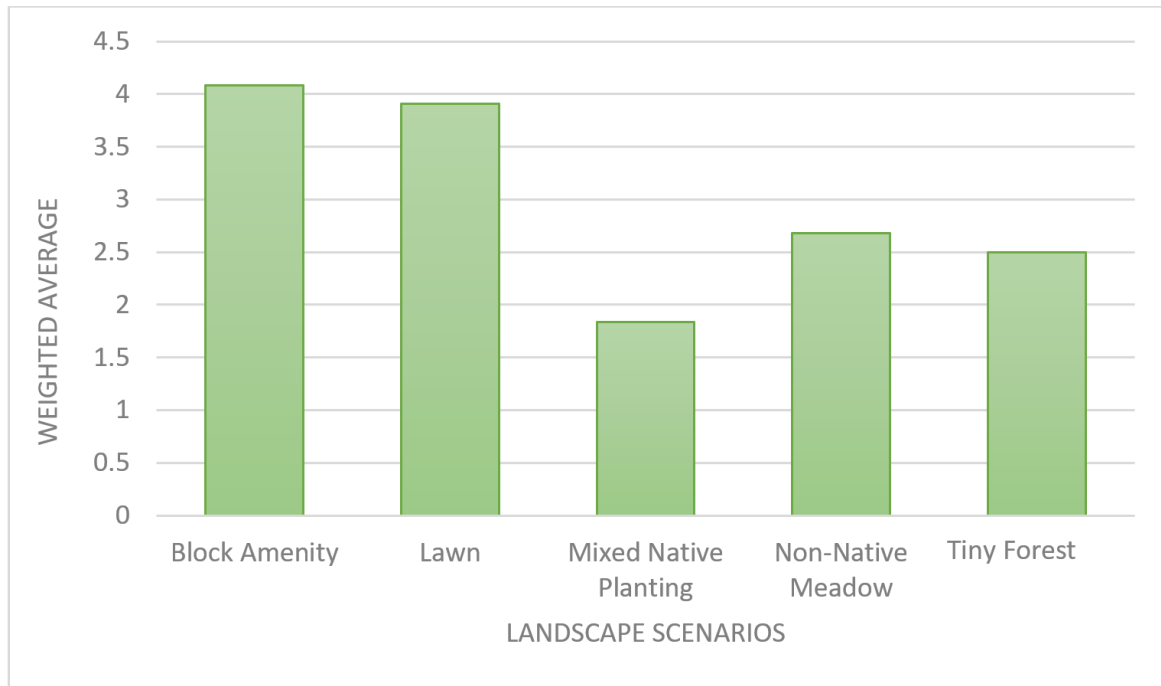


Figure 2: Chart showing the most familiar landscapes in the urban environment.

Opinions on the most fitting NBS typologies were more evenly split amongst rankings with Ecological ranked as the most fitting followed by Lawn and Block Amenity. Statistical analysis of the results provided ( $\chi^2=14.167$ ,  $df= 4$ ,  $p<0.007$ ) for Ecological, and for both Lawn ( $\chi^2=48.311$ ,  $df=4$ ,  $p<0.001$ ) and Block Amenity ( $\chi^2=42.786$ ,  $df=4$ ,  $p<0.001$ ).

The qualitative data indicates that mown amenity grass was perceived to provide the lowest ES and 20% of interviewees referred to the contribution of amenity grass towards disservices in UGS. "(Lawn) doesn't serve a purpose. There aren't even any flowers to attract insects...the worry is that it might get full of rubbish and dogs fouling...generally, I'm not a big fan of lawns".

"The mown lawn looks boring, I mean it will just get messed up, people will use it as a cut-through."

In response to the mown lawn visualisation approximately 50% of interviewees expressed the preference for a reduction in the use of mown amenity grass.

### 3.2 Cultural Ecosystem Services

99.7% of respondents strongly agreed or agreed that exposure to UGS contributes to physical and mental well-being. Only one respondent disagreed and neither agreed nor disagreed with the questions about physical and mental health respectively.

93.3% of respondents strongly agreed or agreed that UGS are important for education and training purposes. This result was found to be statistically significant in a chi-squared multinomial test as  $p < 0.001$  was obtained. Mixed native planting was deemed to be the most educational typology and lawn the least educational. (Mixed native planting  $\chi^2=346.356$ ;  $df=4$ ,  $p < .001$ ; lawn  $\chi^2=594.332$ ;  $df=4$ ,  $p < .001$ )

The more diverse complex planting typology (mixed native planting) was perceived as providing more CES than the other landscape scenarios (Figure 3). It was deemed the most aesthetically pleasing, the best for health & well-being, and the best for creating a sense of place, belonging, and connectedness as well as the most educational and found to be statistically significant with a p value of  $p < 0.001$  across all questions. Lawn was considered to produce the lowest CES in all categories ( $p < 0.001$ ).

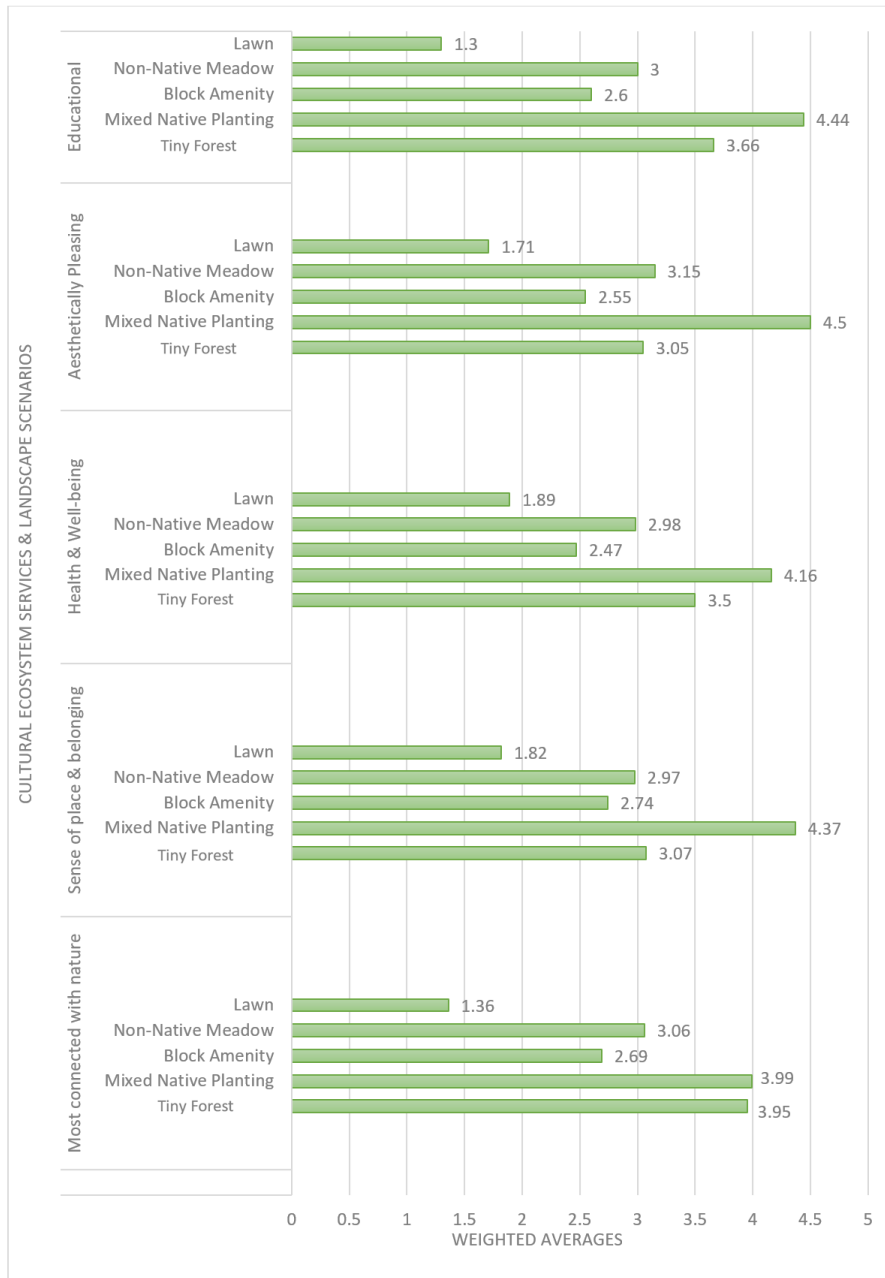


Figure 3: Chart showing landscape perceived as providing best Cultural ecosystem services.

92% of interviewees were not familiar with the term ES, however interviewees referred directly to regulating, supporting, cultural ES with the use of terms including carbon capture, water management, wildlife and habitat support systems and health and well-being. 83% of interviewees thought that alternative urban green spaces such as the TF presented an opportunity for education and training.

People and community were two of the most frequent words used during the interviews.

### 3.3 Provisioning

Over half of the survey respondents perceived provisioning services as important in urban environments (Table 1), however, the positive responses were significantly lower than for all other ES categories.

**Table 1: Perception of Provisioning Services in Urban Environments**

Green spaces provide materials that are useful to people.	Observed	Expected: Multinomial	95% Confidence Interval	
			Lower	Upper
Agree	96	69.000	79.904	113.425
Disagree	33	69.000	23.032	45.439
Neither agree nor disagree	121	69.000	103.636	139.257
Strongly agree	93	69.000	77.090	110.292
Strongly disagree	2	69.000	0.242	7.170

*Note.* Confidence intervals are based on independent binomial distributions.

The TF typology was perceived as best at providing provisioning ES (Figure 4) and lawn perceived as the least beneficial for provisioning services.

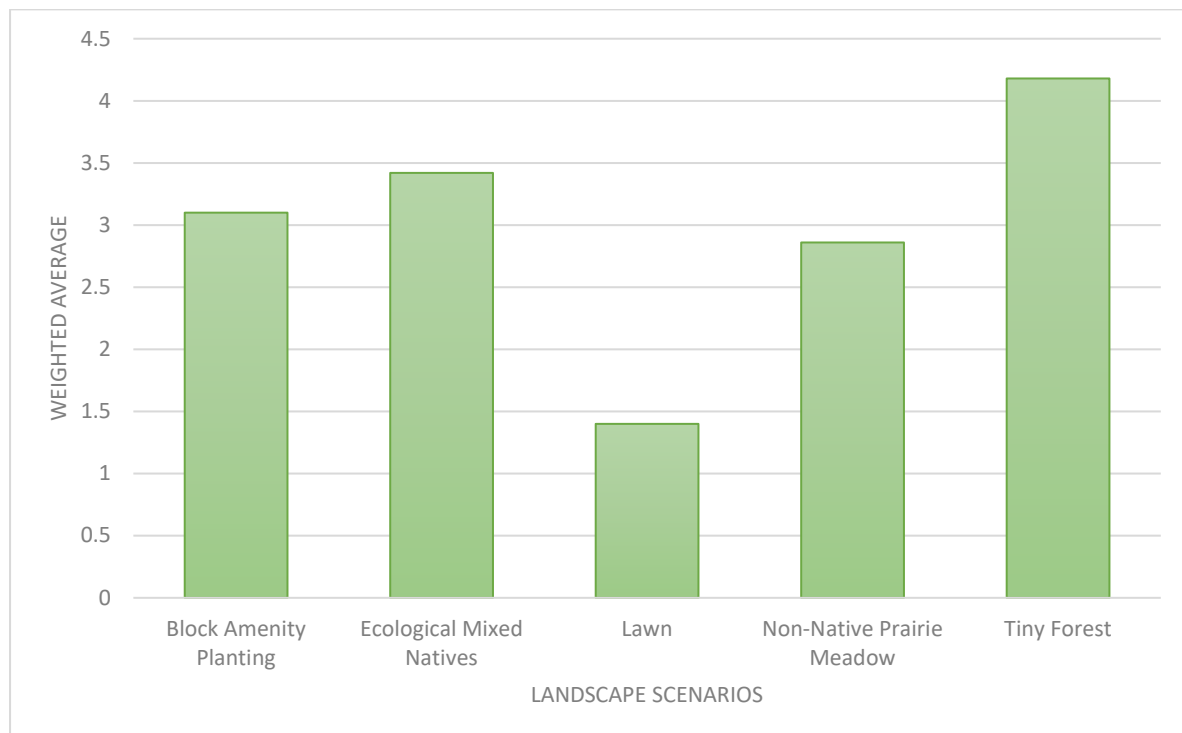


Figure 4: Chart showing landscape perceived as providing best provisioning services

(Lawn  $\chi^2=582.786$ ;  $df=4$ ,  $p < .001$ ; TF  $\chi^2=221.825$   $df=4$ ,  $p < .001$ ).

Over 60% of survey respondents thought that foraging and wild food should be an integral part of the urban environment.

41% of interviewees spoke of the importance of UGS for food security. One interviewee referred to increasing reliance on food banks in UK urban centres and rather desired more opportunities for individuals to be directly involved with ‘grow your own’ provisioning services which could be delivered through UGS. Interviews found a high demand for private allotment gardens across UK towns and cities, but a lack of community garden participation was noted in some areas due to a lack of time and resources.

### 3.4 Regulating

Survey results show that people perceive UGS to be a tool to regulate the urban environment. 91% of respondents strongly agreed or agreed that UGS help to reduce surface water and control flooding, 98% perceived UGS as important for improving air quality in urban centres, 87% perceived UGS as important for reducing noise pollution (Table 2).

**Table 2: Survey Results on the Perception of Urban Green Spaces as Tools for Regulating the Urban Environment**

Green spaces in cities are important for good air quality.	Observed	Expected: Multinomial	95% Confidence Interval	
			Lower	Upper
Agree	42	86.250	30.762	55.537
Disagree	2	86.250	0.242	7.170
Neither agree nor disagree	4	86.250	1.093	10.149
Strongly agree	297	86.250	282.830	308.983

*Note.* Confidence intervals are based on independent binomial distributions.

Lawn is perceived as the worst NBS typology for improving air quality ( $\chi^2=658.766$ ,  $df=4$ ,  $p<0.001$ ).

TF are perceived to be the best NBS typology for providing regulating services in urban centres and scored the highest across all regulating ranking questions ( $p<0.001$ ). Respondents perceived trees to have important functions in urban centres, particularly for improving air

quality and reducing temperatures as well as for regulating the natural cycle of chemicals and nutrients.

A quarter of the interviewees mentioned air pollution and air quality concerns and the role of UGS in the mitigation of these urban challenges. 50% referred directly to CO<sub>2</sub> and carbon capture through NBS typologies, particularly the use of trees. Interviewees referred to water quality (50%), carbon capture (50%), noise pollution (16%), air quality (33%), and soil health (16%).

The lawn was identified in the survey as the worst landscape NBS typology for the creation of healthy soil. Alternative NBS typologies such as the non-native meadow, mixed ecological, and TF were all deemed to be more beneficial than traditional lawn and block amenity planting to support healthy soil formation ( $\chi^2=79.177$ ,  $df=4$ ,  $p<0.001$ ).

### **3.5 Supporting Services**

98% of survey respondents perceived UGS as important for biodiversity and habitat space. Mixed native (Ecological) planting was perceived as the best NBS typology for pollinators and invertebrates and the best for biodiversity and habitat space. The lawn is perceived as the worst typology for pollinators and invertebrates.

### **3.6 Native v Non-native Plant Species**

75% of interviewees preferred the use of native planting with reference to the best environmental fit, supporting local wildlife, and protecting native species against invasive species. 47 % of survey respondents neither agreed nor disagreed with the statement 'non-native plants are ecologically beneficial' and 12% disagreed or strongly disagreed.

In contrast to these findings, one interviewee stated "I really don't care whether they're British trees or non-native trees. I guess there might be some ecological imperative about not introducing anything too aggressive. But other than that, I would welcome the variety".

### **3.7 Spatial Arrangement Considerations**

Qualitative data enabled deeper insights into the spatial arrangement of alternative NBS typologies. 67% of interviewees expressed a preference for incorporating additional NBS typologies, such as wildflowers and additional trees, into existing areas of our urban centres. Rewilding approaches did raise some disservice concerns about the spatial arrangements of alternative NBS typologies. One interviewee raised the question of the suitability of planting trees in small spaces due to possible damage by tree roots and another interview raised concerns about the use of meadow planting and no-mow areas on verges restricting visibility for drivers and the general accessibility of rewilded areas.

### 3.8 Stewardship

The survey found a strong preference for people to be more directly involved in their UGS (Table 3).

**Table 3: Survey Results on Preference for Direct Involvement in Urban Green Spaces**

I would like more opportunities for people to be actively involved in the design, construction, and maintenance of green urban spaces.	Observed	Expected: Multinomial	95% Confidence Interval	
			Lower	Upper
Agree	118	69.200	100.753	136.198
Disagree	4	69.200	1.093	10.150
Neither agree nor disagree	47	69.200	35.135	61.073
Strongly agree	175	69.200	156.323	193.642
Strongly disagree	2	69.200	0.242	7.170

*Note.* Confidence intervals are based on independent binomial distributions.

85% strongly agreed or agreed that there should be more opportunities for people to be involved in the design, planning, and maintenance of UGS,  $p < .001$ ;  $\chi^2 329.983$ . Qualitative findings enabled a greater understanding of the motivations behind stewardship and UGS participation schemes.

"It would be great to have more kinds of community-run gardens and green spaces, not just for people's engagement, but also to make it feel as if people have a sense of ownership in terms of the green spaces that they live around."

Data found that a key motivation for participation in stewardship schemes is social interaction. It provided participants with an opportunity to strengthen existing relationships by 'spending time together with family' and friends as well as providing an opportunity to 'meet new people' across diverse social groups. Active UGS participation was deemed to be fun, assist relaxation, and improve overall health & well-being. Stewardship practices were said to strengthen place attachment and increase feelings of belonging and civic pride. Engagement gave feelings of 'giving something back to the community'. Stewardship was found to be considered educational, an active way of increasing understanding of our natural world and provides a feeling of 'doing something' to contribute towards sustainable communities. Participants also mentioned the transferability of skills to use in other areas of city life.

100% of interviewees thought that green space initiatives should be led by experts to help with the transfer of knowledge and provide support and guidance to bottom-up initiatives. More complex NBS typologies were recognised by respondents as needing more highly skilled maintenance programmes (Beck 2013; Dunnett and Hitchmough 2004; Hoyle, Hitchmough, and Jorgensen 2017). One interviewee spoke of the increased maintenance costs of 'intricate planting'.

### **3.9. Objective Specific Outcomes**

The findings demonstrate an understanding of ES across all four ES categories, cultural, regulating, supporting, and provisioning. This highlights the increasing demands urban citizens expect from their UGS.

Significantly, respondents and interviewees overwhelmingly perceived greater ES value from the complex NBS typologies and additional tree cover to traditional urban landscape elements such as mown amenity grass and the non-native block utility planting of evergreen shrubs.

Data shows a desire for increased involvement and UGS stewardship schemes and a range of additional CES were identified, such as social connectedness, community contribution, place-making as well as presenting an opportunity for engaging with nature and learning new skills to connect with the natural world. The social and ecological impact of stewardship schemes can be seen to increase resilience in the face of social and ecological urban challenges.

#### **4. Discussion**

This study gained valuable data on UK perceptions of ES. It appears to be the only UK study focused on wider perceptions of ES, beyond studies by Houlden et al. (2019) and Hoyle et al., (2017) on health, well-being, and biodiversity. This perceptions study expands on research by Chen (2018, p.202) by providing a deeper understanding of the "complex personal motivations of the general public". Data was collected in all four ES categories, and the CES of UGS were found to be perceived as particularly important when considering UGS.

Building on the study by Houlden et al., (2019), the landscape scenarios provide additional data on different types of NBS and their perceived benefits and provide further insight into the content and context of alternative UGS. Findings help to determine the types of NBS desired by the public which can be applied to shape GI strategies in urban spaces.

In contrast to the study by Hoyle et al., (2017) this study found a strong preference for the use of native tree and plant species in urban centres. However, it appears that more information is needed by the public on the risks and benefits of non-native species.

This paper presents an alternative SES approach to UGS compared with previous studies on urban landscape preferences which have focused on preference heterogeneity and the

Willingness-to-Pay (WTP) funding schemes (Roberts, Glenk, and McVittie 2022; Macháč, Brabec, and Arnberger 2022).

The familiarity of mown amenity grass and block amenity planting in UGS highlights the traditional overuse of these NBS typologies in our urban environments. Block amenity planting, notably evergreen shrubs, can damage an individual's sense of place, ownership, and belonging, perhaps because it is noted by Dunnett and Hitchmough (2004) to be indicative of a lack of care and investment. However, as a typology, it was perceived to have some supporting and regulating functions and therefore should arguably be a component of UGS if supported by additional diverse plant communities.

Public perceptions recognise that diverse planting is more resilient, builds adaptive capacity, and provides a broader range of ES. Findings suggest NBS typologies should include wildflowers, herbs, herbaceous perennials as well as edible and ornamental trees and natural interactive components such as logs for jumping and seating. This can be interpreted as public demand for additional ES from UGS.

#### **4.1 Ecosystem Services**

Lower positive responses for provisioning ES could indicate they are the least valued or understood in terms of direct relevance to individuals in urban environments. This could be indicative of a general detachment from nature reflecting the lack of opportunities for urban residents to interact with natural spaces (Turner, Nakamura, and Dinetti 2004). It could also be due to preconceived ideas that food 'production' must be on a larger scale and is traditionally located on green belt land and beyond (Papworth 2015).

It implies there is a need for a greater understanding of provisioning ES, particularly how to support alternative growing initiatives in cities, outside of individual allotment gardens. The findings suggest it may be more effective to integrate edible produce into a range of UGS

(Russo and Cirella 2019), this fits with the concept of compact green cities (Artmann et al. 2019; Russo and Cirella 2018).

Multifunctional UGS incorporating edible and interactive elements would enable urban 'wild-food' and foraging and support communities where food scarcity is high (Caspi et al. 2012; Sadler, Gilliland, and Arku 2016).

Small, high-quality UGS integrated into urban work-home-leisure routes are arguably more effective at creating CES, particularly in terms of placemaking, increasing a sense of belonging and connectedness (Artmann et al., 2019).

#### **4.2 Spatial Arrangements**

Incorporating more small pockets of NBS typologies would provide greater ES and create valuable urban ES 'Hotspots' (Blumstein and Thompson 2015). Additional NBS typologies could be integrated into existing brown and grey infrastructure to provide more opportunities for communities to connect and interact with nature on work-home routes and in city centres. Small spaces are also more accessible, making areas more manageable for civic stewards. Participants raised the need for accessible UGS and the ability to pass through engaging spaces during everyday activities. Ease of engagement is noted to maximise the ES from UGS (Houlden et al. 2019). Small, engaging UGS prevent disservices from arising as findings support existing research in suggesting that more space is used and interacted with more it is valued and cared for (Costanza et al. 2017; Norton, Costanza, and Bishop 1998). Compact UGS positioned throughout urban centres could contribute significantly to green-blue infrastructure and have the combined ability to create ES hotspots and corridors to mitigate the negative effects of climate change and counter urban challenges.

#### **4.3 Stewardship**

Stewardship programmes could overcome the funding deficit, as identified by Roberts, Glenk, and McVittie (2022), and provide additional ES if supported by specialist social,

environmental, and landscape professionals to ensure environmental fit and to maximise information and knowledge transfers across disciplines (Masterson et al. 2017).

The additional CES derived from active green space stewardship contributes towards community resilience and urban social-ecological system sustainability.

Consultations, direct involvement, and community information boards explaining the ES behind landscape composition choices may help to gain support for alternative NBS typologies. Greater education of and communication with local governing bodies, local communities, charitable bodies, and management contractors regarding the inclusion and management of UGS could be achieved by applied and supported programmes from experts from the fields of horticulture, ecology, and conservation. Through this, Stewardship, and civic participation in UGS could be used to enhance social capital and to produce an additional layer of social-ecological benefits in line with the SES model.

#### **4.4 Limitations**

The limitations of this study must be taken into consideration. Landscape scenario preferences may have been influenced by the photo attraction effect leading participants to choose the landscape containing the most diverse planting.

Another limitation of the paper is the potential for sampling bias due to the snowballing sampling technique used. This method was selected to overcome the limitations posed by the COVID-19 pandemic, allowing the study to reach a larger number of participants within a short period. However, this technique can lead to a biased sample, as those who are more connected or active on social media may be overrepresented. The survey and qualitative data collection were carried out within the UK, and our findings and conclusions are specific to this geographic context. However, the sample may not be representative of the entire UK adult population, as not all individuals have access to or use social media. Also rapid, low-cost, non-probability sampling methods may result in sampling bias. (Crossley and Russo 2022; Parker, C., Scott,

S., & Geddes 2019). Therefore, caution should be taken when generalising the results to the broader population (Crossley and Russo 2022). Finally, researchers are increasingly adopting alternative methods for investigating the preferences of UGS and NBS, such as Choice Experiment and Best-Worst Scaling (BSW) (Dobbie and Farrelly 2022; Arnberger and Haider 2005; Arnberger et al. 2010; Kim et al. 2020; Macháč, Brabec, and Arnberger 2022). BSW, for instance, minimises the risks associated with hasty rating and the utilisation of simplification heuristics, as well as response style biases (Dobbie and Farrelly 2022). Moreover, it encourages greater consistency in the assessment task (Dobbie and Farrelly 2022). Hence, future research endeavours concerning the preferences for NBS typologies in the UK should thoughtfully consider incorporating these alternative methods to yield more complete and accurate outcomes.

## **5. Conclusion**

The paper aimed to evaluate people's knowledge and understanding of ES and NBS typology preferences. The findings indicated that traditional mown lawns and block amenity planting are failing to meet the ES requirements of UK urban citizens due to their lack of diversity and limited contribution to place-making. Moreover, there is a preference for greater diversity in planting and more complex NBS typologies, which are favoured over traditional planting.

Furthermore, the results suggest that individuals are seeking increased opportunities to directly connect to nature and engage with and contribute to the community. Notably, the integration of compact ES hotspots into urban centres can enhance accessibility and improve site management, particularly for local stakeholders and stewardship groups. Additionally, participation in stewardship schemes can be valuable in creating additional cultural ecosystem services, particularly in the domains of health and well-being. These findings serve as crucial instruments for policymakers and city managers, providing valuable information about the factors driving people's acceptance of and support for specific measures or strategies in UGS

(Teixeira et al. 2022). This, in turn, informs and strengthens decisions and approaches regarding the design, planning, and management of UGS (Teixeira et al. 2022).

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