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# Who values urban community gardens and how much?

Liqing Li [a,*], Dede Long [b,1]

[a] Texas A&M University, United States of America
[b] Harvey Mudd College, United States of America

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ABSTRACT

With the rising interest in urban agriculture (UA), community gardens have emerged as a common instrument in UA policies aimed at addressing issues related to food security, environmental sustainability, and equality in urban development. As an impure public good, they deliver both private benefits, such as fresh produce, and public benefits, including ecosystem services. However, there has been limited research estimating the value of various features of community gardens. Consequently, assessing the benefit–cost ratio of community garden development policies is a challenging task. Furthermore, many existing community gardens might have been established without a comprehensive understanding of public preferences. To address this gap, we adopt a discrete choice experiment to quantify residents' willingness to contribute money and time to community gardens in Los Angeles County, California. Our findings indicate that while residents highly value the gardens' private benefits, they are not inclined to contribute to their public benefits. Additionally, residents' preferences for community gardens differ based on their socioeconomic status and level of accumulated gardening experience.

## 1. Introduction

As of 2020, more than 80% of Americans reside in urban areas (Urban Areas Facts, 2020). Given the accelerating pace of global urbanization, cities have transformed into critical spaces in which contemporary environmental, social, and economic dynamics converge. In this context, urban agriculture (UA) has emerged as one means of tackling the several challenges presented by the drive toward urbanization, including food insecurity, socioeconomic disparities, and environmental sustainability (Morgan and Sonnino, 2010). The COVID-19 pandemic further emphasized the importance of UA by revealing vulnerabilities in the food supply chain and underscoring the need for local food security both in the U.S. and worldwide (Clark et al., 2021).

As an important form of UA practices, community gardens are collaborative projects on shared open spaces where participants jointly maintain the garden and share its produce (USDA, 2020). These gardens offer urban residents the opportunities to grow fresh produce and establish community ties (Guitart et al., 2012). They also can play a pivotal role in enhancing access to affordable, nutritious foods, bolstering food security, reducing poverty, improving health and well-being, and fostering social equality in urban environments (Twiss et al., 2003; Corrigan, 2011; Kirby et al., 2021). Furthermore, community gardens also bring environmental benefits including increased biodiversity, improved environmental equity, and reinforced environmental sustainability (Stocker and Barnett, 1998; Petrovic et al., 2019; Holland, 2004). Despite the documented benefits, limited research has been conducted on investigating public preferences for community gardens, as well as on understanding how these preferences differ across socio-economic groups. We fill this gap in the literature by empirically quantifying who values urban community gardens and to what extent.

Considering the growing interest in UA over the past decade, municipalities have pursued public policies to both support and regulate its development (Meenar et al., 2017). Community garden programs have been used as essential policy instruments in this context. More than 400 UA-related policies are identified in the 40 most populous cities in the U.S. (Halvey et al., 2021). Of these cities, more than 60% offer community gardens managed either by city government staff or non-profit organizations (Halvey et al., 2021). As an important form of UA, community gardens first emerged in the late 19th century as temporary responses to crises like wars or economic depressions, serving as reliable sources of healthy, nutritious produce during times of scarcity (Birky and Strom, 2013). In contemporary times, however,

* Correspondence to: Department of Agricultural Economics, Texas A&M University, College Station, TX, United States of America.
*E-mail addresses:* liqing.li@ag.tamu.edu (L. Li), dlong@hmc.edu (D. Long).

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these gardens have evolved into more permanent fixtures of the urban landscape. Most local regulations related to community gardens primarily started in the early 2000s and have seen a rapid increase since the mid-2000s. For instance, in 2009, recognizing the potential of community gardens, the US Department of Agriculture (USDA) initiated the "People's Garden" program. Designed to promote equity, address food insecurity, and boost conservation, this initiative saw a nationwide expansion in 2022. Its ambitious goals include addressing food insecurity through nurturing fresh food sources and providing environmental benefits through fostering habitats for pollinators and wildlife and carving out verdant spaces for urban communities.

While past research has acknowledged the benefits of community gardens, much of the evidence is still qualitative if not anecdotal (Zezza and Tasciotti, 2010). The literature on the valuation of community gardens' benefits is limited. Voicu and Been (2008) demonstrated that the value of community gardens is capitalized in housing prices using the hedonic price method. While this study offers insights into the overall benefits of community gardens, it does not provide separate estimates for the values of different garden attributes. To the best of our knowledge, only one study by Alemu and Grebitus (2020) has used a Discrete Choice Experiment to examine consumer preferences for various garden's physical attributes, such as distance to a garden, availability of tools provided, and organization of social events. Consequently, existing community gardens may have been developed without a comprehensive understanding of public preferences.

To address this gap in the literature and offer practical insights for policy implementation, we adopt a Discrete Choice Experiment (DCE) to quantify the social values of community gardens in Los Angeles (LA) County, California. Specifically, our experimental design measures a series of gardens' private and public benefits, including their ability to provide fresh produce (the number of households a garden can serve), how the harvested produce is allocated (donation or personal consumption), as well as their environmental benefits (increase in the number of bird species and bee pollinators). Los Angeles County presents an optimal study region in which to evaluate the benefits of community gardens because it has been at the forefront of UA development, implementing incentives for property owners to lease their land for community garden establishment. For instance, in 2016, California enacted the Urban Agriculture Incentive Zone (UAIZ) Act, offering tax breaks to property owners of vacant, unimproved, and blighted land for putting it into urban agriculture use. These policy changes indicate an increasing need in the region to understand residents' preferences for new gardens. Our findings can inform not only policymakers and stakeholders in the study region but also those in other regions seeking to promote community garden initiatives as a means of improving fresh produce accessibility and addressing concerns of social inequality.

We employ a mixed multinomial logit (MMNL) model in the willingness-to-contribute (WTC) space to estimate households' marginal willingness to contribute (MWTC) in terms of both monetary and time costs for selected garden features. Moreover, we use two approaches to examine how different factors and individual characteristics are related to people's MWTC. In the first approach, we regress the individual-specific marginal MWTC for garden attributes on the socioeconomic characteristic variables. In the second approach, we utilize a latent class model to classify respondents into distinct classes based on their characteristics. Both methods allow us to explore preference heterogeneity for community gardens.

Two major findings arise from this research. First, individuals exhibit preferences for different garden features and place significant value on a garden's private benefits, measured by the harvested food. For instance, households are willing to contribute an average of $6 or 1 hour per month per household to consume the harvested produce in the home, rather than donate it to a local food bank, and $3 or over 1 hour per month per household to support a larger garden that can serve 60 households than one serving 30. However, the estimated willingness of people to contribute either time or money to enhance the gardens' environmental benefits is statistically insignificant.

Second, we identify significant preference heterogeneity among individuals, varying across different socioeconomic groups and levels of gardening experience. Specifically, we find that individuals with larger household sizes and more than one year of gardening experience demonstrate a higher MWTC to community garden establishments. Furthermore, we observe preferences for a new garden differ between residents with and without an existing garden in their current neighborhoods. Notably, no significant preference heterogeneity for new gardens was found across different income and racial groups.

This paper makes four major contributions to the literature. First, we contribute to the scarce literature on the valuation of community gardens by providing accurate measures of the social values of gardens. With the constraints in land resources in urban areas, accurately quantifying the values individuals place on gardens is not only crucial for conducting a robust cost–benefit analysis of community garden policies but also essential for designing gardens that fit the local community's preferences to ensure the gardens' long-term success.

Second, we answer the question of who values community gardens and to what extent. Although community gardens have evolved into a social movement addressing food insecurity and inequitable distribution of urban green spaces, it remains uncertain how they are valued by residents with diverse socioeconomic backgrounds. For instance, while Grebitus (2021) shows that low-income households are more likely to participate in community gardens, Bellemare and Dusoruth (2021) suggest that the culture around local and healthy food is often associated with highly educated, wealthy communities. Additionally, participation in urban agriculture has also been shown to correlate with higher education and income (Bellemare and Dusoruth, 2021), which may be partly due to differences in accessibility to urban agriculture. Moreover, interactions between policies aimed at increasing green spaces and socioeconomic characteristics can lead to unintended consequences and backlash effects such as gentrification, which has become a growing environmental justice concern (Wolch et al., 2014). Therefore, we explore how the valuations of community gardens, measured by residents' WTC, differ among different socioeconomic groups.

Third, our measurement for the valuation of community gardens' benefits is unique, as we capture WTC using both monetary and non-monetary costs. Research in developing countries has employed non-pecuniary time contribution to estimate respondents' willingness to pay and "willingness to work" (e.g., Rai and Scarborough, 2015; Gibson et al., 2016; Meginnis et al., 2020; Hagedoorn et al., 2020), where respondents may have limited access to cash income and are not engaged in waged labor in a subsistence economy (Rai and Scarborough, 2013; Gibson et al., 2016). Ando et al. (2020) conduct the first study that estimated residents' willingness to volunteer labor for local stormwater green infrastructure in two major cities in the US. Similar to stormwater management, volunteer time contribution plays an important role in sustaining community gardens, as households need to spend time nurturing and harvesting the plants. Furthermore, using money as a mode of contribution may not fully capture low-income households' preferences due to constrained household budgets.

Fourth, we add to the literature on the valuation of impure public goods. Individuals are motivated to participate in community gardens for private benefits, which range from harvesting fresh vegetables and fruits to enhancing health and well-being, as well as fostering social cohesion (Kirby et al., 2021). At the same time, the efforts that individuals make to obtain these private benefits may also support the provision of public goods such as biodiversity conservation, thereby making community gardens examples of impure public goods. Existing literature on the provision of impure public goods often focuses on goods such as green electricity (e.g., Kotchen and Moore, 2007; Andor et al., 2018), eco-labeled (e.g., Bjørner et al., 2004), and hybrid vehicles (e.g., Kahn, 2007). We complement this literature by estimating the value placed on the private and public benefits in terms of money and time contribution in the context of urban agriculture.

## 2. Methodology

### 2.1. Survey design

To quantify the private and public benefits that the public derives from community gardens, we conduct a stated-preference DCE survey containing a set of realistic attributes to examine residents' MWTC for various garden attributes. Participants were presented with a series of choice questions, where they chose among two community garden alternatives and a status quo, each with varying attribute levels. The attribute levels are randomized across questions and respondents, allowing us to capture individuals' underlying preferences.

#### 2.1.1. Background information

The survey instrument began with a brief introduction to community gardens, outlining their private and public benefits, along with illustrative images to assist participants in visualizing what they were being requested to assess. The choice questions were framed by stating that a hypothetical land revitalization project had been proposed to convert a piece of public vacant land into a community garden in the respondent's neighborhood. The outcome of the project could vary depending on how the community garden is designed. Therefore, the purpose of the survey was to better understand local residents' preferences and support for the proposed garden project.

#### 2.1.2. Attribute and attribute levels

To ensure all respondents had a clear understanding, we defined and presented a list of fixed and variable attributes of the potential garden projects from which the respondents could choose. Among the fixed attributes, we stated that the LA County Parks and Recreation Department would convert a parcel of vacant public land within a 20-minute walking distance from the respondent's home into a gated community garden. Each garden had at least one manager allocating tasks and monitoring participants' volunteering time. Within the garden, the plots and volunteering activities were shared among participants, and failure to complete the required volunteering work would result in a loss of membership. Other fixed features included the availability of tools and guidance for gardening work, the presence of birds, and the types of plants in the gardens.[2]

Next, the survey presented the variable attributes and corresponding levels in the choice scenarios. They were identified by way of three channels. First, we surveyed past literature and compiled a list of key attributes associated with community gardens. Second, to discuss gardens' main characteristics, we conducted conversations with scholars, garden managers, and practitioners, with nonprofit organizations such as the LA Community Garden Council, and with the directors and staff at the LA County Department of Parks and Recreation. Third, we hosted two focus groups in the local LA County communities, where participants were asked to name and describe garden attributes they considered to be important. Based on these discussions, a list of variable attributes was brought together. Variable attributes used in the final choice experiment include environmental benefits measured by the number of birds and bee pollinators, allocation of the harvested produce (donated to local food banks or consumed by the households), garden scale measured by the number of households served, the monthly management fee, and volunteering time. Variable attributes and their levels are presented in Appendix A Figure A1.

[2] The full list is available in the Appendix.

#### 2.1.3. Choice cards and experimental design

We generated 18 choice questions based on the above attributes and attribute levels using a D-efficiency design in Stata (Zwerina et al., 1996), ensuring no choices dominate or are dominated within or across choice questions. All attributes were coded as categorical variables in the experimental design, but the "environmental benefits" attribute and their pecuniary and time costs were treated as continuous in the statistical analysis. Each choice question offered three options: either of two community gardens with various attributes and the status quo option. We explicitly stated that, in the status quo scenario with no community garden, the vacant land would have a minimal number of birds and bees, and no produce would be available for harvesting at the site. To maintain statistical power while reducing the cognitive load on respondents, we divided the 18 choice questions into three blocks, generating three unique survey versions (Caussade et al., 2005). The final design thus consisted of a total of 18 choice questions, each consisting of three blocks of six questions. A sample choice card is presented in Fig. 1.

#### 2.1.4. Hypothetical bias and consequentiality

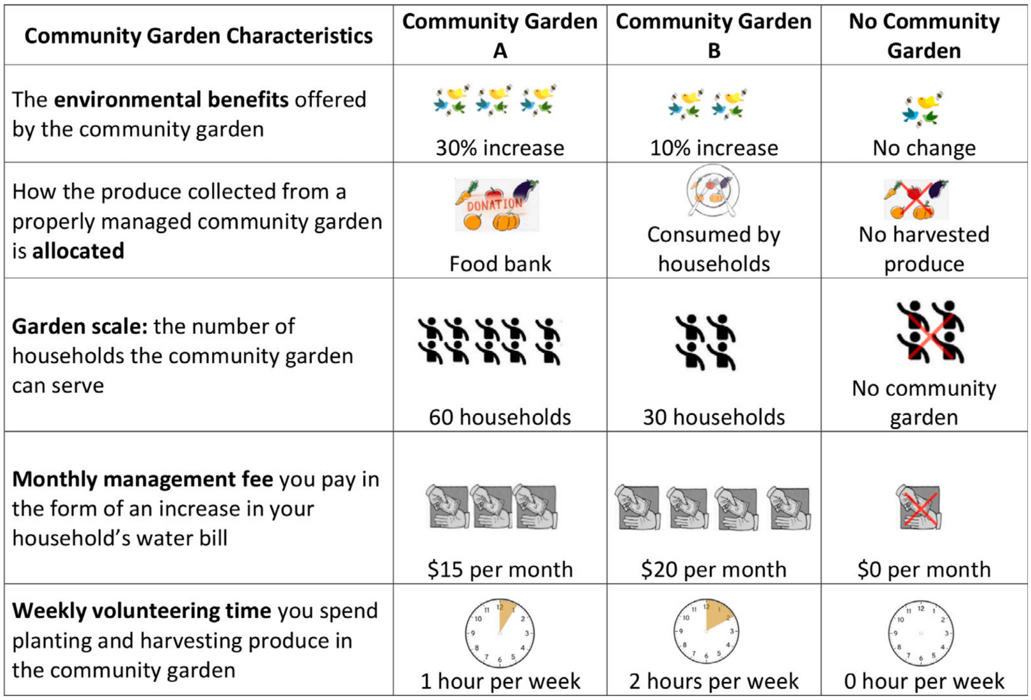
To mitigate hypothetical bias, we adopted two widely applied approaches. First, we included an opt-out message on each choice card (Ladenburg and Olsen, 2014), reminding the respondents that they could choose the status quo. The message read: "If you do not like either community garden A or community garden B, then please choose the 'No Community Garden' option". This allowed the respondents to opt-out if they did not prefer any of the garden options. Second, after the choice questions, we included a certainty follow-up question to address the influence of hypothetical bias on value estimates (Ready et al., 2010). Specifically, we used a one- to ten-point scale ranging from "very uncertain" to "very certain" to ask respondents to express how sure they were of their choices. Choices with a follow-up certainty level lower than seven were re-coded as the status quo in the main analysis (Penn and Hu, 2020). We also include a consequentiality question to evaluate the extent to which the respondents believed their answers would be taken into account by policymakers, other stakeholders of garden planning, and the general public. Respondents rated their beliefs on a one- to five-point scale ranging from "not at all" to "very much".

### 2.2. Focus group and survey administration

We conducted two virtual focus groups via Zoom, each lasting 60 min. Participants were recruited in LA County, California, via Craigslist. Those completing the focus group were rewarded a $20 Amazon gift card. During the focus groups, participants were given 20 min to complete the survey and then discuss such aspects as attribute-level descriptions and the salience of the payment vehicle. Overall, participants reported the survey was easy to comprehend and answer, with unbiased language accessible in layman's terms and credible payment vehicles.

Based on feedback and suggestions we received from the focus groups, we made several adjustments to the survey. We revised the description of the garden size attribute to emphasize that the community garden only meets a portion of a household's fresh produce needs and is complementary to their grocery store purchases. We also use bold and underlined text to direct attention to the most important points.

A pilot version of the survey was sent out in early May 2022 through Qualtrics, through which we obtained 50 complete and usable responses. The pilot survey results allowed us to evaluate the respondents' understanding of the survey questions and make necessary modifications. The main survey was then launched in May and June 2022.



| Community Garden Characteristics | Community Garden A | Community Garden B | No Community Garden |
|---|---|---|---|
| The **environmental benefits** offered by the community garden | 30% increase | 10% increase | No change |
| How the produce collected from a properly managed community garden is **allocated** | DONATION Food bank | Consumed by households | No harvested produce |
| **Garden scale:** the number of households the community garden can serve | 60 households | 30 households | No community garden |
| **Monthly management fee** you pay in the form of an increase in your household's water bill | $15 per month | $20 per month | $0 per month |
| **Weekly volunteering time** you spend planting and harvesting produce in the community garden | 1 hour per week | 2 hours per week | 0 hour per week |

**Fig. 1.** Sample choice question.

### 2.3. Estimate MWTC for garden attributes

We adopt a DCE (Hanley et al., 1998) to estimate respondents' MWTC for different attributes of a hypothetical community garden, measured in terms of both monetary and time contributions. Our conceptual framework was built upon the discrete choice random-utility maximization (RUM) framework (Louviere et al., 2000). We also followed Ando et al. (2020) and had both monetary payment and time spent volunteering entered into an individual's utility function as costs. In other words, individuals chose from a set of community gardens with varying gardening attributes to maximize their utility in the face of both time and money budget constraints.

Respondent $i$ chose a garden scenario $j$ from a set of $N$ choices to maximize utility. The indirect utility of respondent $i$ choosing scenario $j$ was modeled as the following linear function:

$$V_{ij} = \lambda_T T_j + \mu_P P_j + \sum_{k=1}^{k} \beta_k X_{jk} + \epsilon_{ij}, \tag{1}$$

where $X_{jkn}$ is a vector of $k$ garden attributes of given alternative $j$. $T_j$ and $P_j$ capture the time (hours spent volunteering) and monetary costs (the dollar amount of the management fee). Consequently, $\beta_k$ represents a vector of individual-specific random coefficients capturing the marginal utility of choosing given levels of attributes, assumed to be normally distributed. $\lambda_T$ captures the marginal utility of time, while $\mu_P$ represents the marginal utility of money. Error $\epsilon_{ij}$ is an unobserved random component capturing an individual's idiosyncratic tastes and is assumed independent identically distributed (i.i.d) following an extreme value type-one distribution (Louviere et al., 2000).

We estimate Eq. (1) with an MMNL. In contrast to the standard conditional logit model that assumes a homogeneous preference structure for the entire population, an MMNL model allows the parameter coefficients to vary across individuals, thereby accommodating heterogeneous preferences within the population. If we estimate this model in the preference space, we can indirectly calculate respondents' MWTC using the ratio of the attributes' coefficient to the price and time coefficient. Monetary and time WTC was calculated as $MWTC_{money_k} = \frac{\beta_k}{\mu_P}$ and $MWTC_{time_k} = \frac{\beta_k}{\lambda_T}$.

However, preference space estimation may bring post-estimation difficulties in deriving the empirical distributions of MWTC (Carson and Czajkowski, 2019). Therefore, we choose to estimate our model in the WTC space, allowing us to directly specify the MWTC distribution (Train and Weeks, 2005).

Using the definitions of MWTC listed above, we can reparameterize the preference-space utility model in Eq. (1) and obtain the utility in the WTC space (Train and Weeks, 2005):

$$U_{ij} = \lambda_T T_j + \mu_P P_j + (\mu_P MWTC_{money_k})' X_{jk} + \epsilon_{ij} \tag{2}$$

and

$$U_{ij} = \lambda_T T_j + \tilde{\mu_P} P_j + (\lambda_T MWTC_{time_k})' X_{jk} + \epsilon_{ij} \tag{3}$$

These are estimated using the maximum simulated likelihood in Stata's *mixlogitwtp* package (Scarpa et al., 2008; Train and Weeks, 2004). While the MWTC for each garden attribute is specified normally distributed, we assume the coefficient for the monetary cost $P$ log-normally distributed in Eq. (2) and the time cost $T$ log-normally distributed in Eq. (3). The estimated coefficient of $T_j$ in Eq. (2) can be interpreted as the shadow value of time, calculated as the ratio of $\lambda_T$ and $\mu_P$.

### 2.4. Explore heterogeneous MWTC for garden attributes

To investigate how individuals' heterogeneous MWTC is associated with their socioeconomic characteristics and gardening-related experiences, we employ two methods. In the first, we recover the conditional individual-specific means of MWTC from the MMNL model in the WTC space (Greene et al., 2005), then regress the individual-specific MWTC of each attribute on respondents' socioeconomic characteristics using Ordinary Least Squares (OLS) (Li et al., 2021; Li and Ando, 2023). Results provide insights into the differences in MWTCs across socioeconomic characteristics.

In our second method, we employ a standard latent class model to examine how preference heterogeneity is related to individual characteristics. The latent class model assumes unobserved preference heterogeneity among respondents follows a discrete distribution (Boxall and Adamowicz, 2002; Greene and Hensher, 2003; Train, 2009). Under

**Table 1**
Monetary and time MWTC in dollars and hours.

| | (1) | | (2) | |
|---|---|---|---|---|
| | MWTC money ($) | | MWTC time (hour) | |
| | Mean | SD | Mean | SD |
| Status Quo (No Garden) | −21.058*** | 116.200*** | −7.583*** | 33.544*** |
| | (2.539) | (18.108) | (1.048) | −4.976 |
| Env Benefits | −0.058 | 0.235*** | −0.021 | 0.141*** |
| | (0.059) | (0.067) | (0.017) | −0.029 |
| Donate Produce | −5.906*** | 16.155*** | −0.987*** | 3.864*** |
| | (1.138) | (1.794) | (0.276) | −0.539 |
| Larger Garden (60 instead of 30 households) | 2.777*** | 10.428*** | 1.212*** | 2.330*** |
| | (0.792) | (1.412) | (0.262) | 0.384 |
| Time cost | −4.834*** | 4.531*** | −1.500*** | 0.806*** |
| | (0.755) | (0.736) | (0.215) | −0.098 |
| Monetary cost | −2.243*** | 0.060 | −1.061*** | 0.361*** |
| | (0.107) | (0.103) | (0.139) | −0.067 |
| N | 8748 | | 8748 | |
| Prob > chi$^2$ | 0.00 | | 0.00 | |
| Log likelihood | −1804.966 | | −1816.892 | |

*Notes*: Columns (1) and (2) present the monetary and time MWTC for each attribute, using the preferred sample where certainty and consequentiality adjustments are applied. Standard errors are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

this assumption, the respondents are categorized into distinct classes based on their socioeconomic characteristics, where preferences are homogeneous within a class but vary across classes. As shown in existing literature, the latent class model has been widely used and demonstrated as an effective tool to identify consumers and households' underlying preference heterogeneity for both private and public goods (Ortega et al., 2011; Lusk et al., 2018; Muunda et al., 2021). We first classify the respondents into different classes based on their socioeconomic characteristics and gardening experience. We then identify the likelihood that a given respondent belongs to a given class and estimate each class's preferences across the attributes. More information on the latent class methodology is presented in Appendix B.

## 3. Results

Our survey sample consists of complete responses from 486 randomly selected adult residents above 18 years old in LA County, California.[3] Each respondent answered six choice-card questions, providing a total of 2916 DCE choice question observations for our analysis.

Table A2 in the Appendix presents the summary statistics of our sample as well as those in the study area (LA County, California) derived from the 2021 American Community Survey (ACS). One-sample proportion tests were conducted to determine whether the differences between the population and our sample statistically differ from zero. They indicate that our survey sample had a higher proportion of White participants and a lower proportion of minority groups, particularly Hispanics, than in the population. Our respondents were also more likely to be male, have a higher education, and have higher average incomes than the population average. To correct this non-representativeness, we employ target weights on the basis of population-level race, gender, education, and income distributions. All models were estimated using these sampling weights.

### 3.1. MWTC for garden attributes

Table 1 column (1) presents the respondents' MWTC to community gardens, as reflected in their marginal monetary contributions. Estimates are based on Eq. (2), $MWTC_{money}$, assuming that monetary cost follows a log-normal distribution to ensure non-negativity as the monetary cost is considered non-negative and other attributes a normal distribution. Certainty and consequentiality adjustments are applied to mitigate hypothetical bias. Choices with a follow-up certainty level lower than seven are re-coded to the status quo option, and respondents who believe their answers would not be taken into account by policymakers, other actors of community garden planning, or by the general public are dropped from the analysis.[4] Considering that policy-relevant valuations must control for hypothetical biases, we focus our discussions on the Table 1 estimates, which are drawn from our preferred sample. Estimated $MWTC_{money}$ with and without such certainty and consequentiality adjustments are presented in Table A1 in the Appendix. Neither adjustment has much impact on the nature of our findings, except for the size of the status quo coefficient.

All mean MWTC coefficients, from Eqs. (2) and (3), in column (1) are statistically significant at the 1% level except for the coefficient of the "environmental benefits" attribute coefficient, which is specified as the percentage increase in the number of bird species and bee pollinators in a given garden. The insignificant mean MWTC for "environmental benefits" attribute suggests, on average, that respondents do not value a community garden's public benefits. Significant variations in MWTC for environmental benefits are however observed among respondents, given that the standard deviation for this attribute estimate is statistically significant.

Despite the fact that individuals may not value a community garden's public environmental benefits, the coefficient on the status quo (no community garden) option is large and negative, suggesting the respondents would, on average, be willing to pay over $21 to have a new community garden established in the neighborhood, even without considering their various attributes. Monetary MWTC for garden size was positive, implying that respondents preferred a larger garden. Compared to a garden that could serve 30 households, they were

[3] We excluded 107 (14.46%) respondents who did not provide their consent, were not among the target population (i.e., under 18), and did not complete the survey, and 102 (13.78%) respondents who displayed evidence of poor attention and speeding during the survey (i.e., total response time is below half of the median total response time). The participants receive payment for participating in the survey, where the payment amount and payout are determined by the survey firm and unknown to the researcher.

[4] 4.4% of respondents are removed.

willing to pay, on average, about $3 more per month for a garden that could serve 60 households than one serving 30. They also strongly prefer consuming the harvest in their own homes. Specifically, they are willing to pay an additional $6 per month to consume the fruits and vegetables themselves rather than donate them to a local food bank.

The estimated time contribution coefficients based on Eq. (2) are negative and statistically significant, meaning respondents considered the time working in the garden as a cost. This coefficient can be interpreted as the shadow value of their time in community garden activities. The estimate is around $5 per hour, implying that the opportunity cost of time among these respondents was approximately 16% of the average hourly wage rate in LA county.[5]

Note that individuals may have perceived these volunteered hours either as leisure or foregone housework hours rather than working hours. As a result, the shadow value of time can be lower than the wages in the labor market. This possibility was confirmed through our focus group conversations with participants and local community garden managers. Further, our shadow value of time was slightly lower than that commonly used to estimate the scarcity value of leisure time, typically assumed to be one-third of someone's wage rate (English et al., 2018). It also falls below the range of those in the earlier DCE literature that have estimated people's average shadow value of time.[6] A possible explanation of this discrepancy is that the labor contribution to community gardening was often perceived as a volunteering experience, which may result in a lower time cost than surrendering leisure time would, as households may gain positive utility from volunteering (Ando et al., 2020).

We estimated respondents' MWTCs to community gardens, measured by time rather than money contribution, in Eq. (3). We found in Table 1, column (1) that respondents did consider the time spent working at the community garden as a cost. We thus can comfortably assume the time cost to be log-normally distributed in the WTC-space estimation. Results presented in Table 1 column (2) are estimated based on the same certainty and consequentiality adjustments as in column (1). Similar to the monetary MWTC results in column (1), all mean MWTC coefficients measured by time (as opposed to money) contribution are statistically significant at the 1% level except for the coefficient for the "environmental benefits" attribute. These results suggest people are willing to volunteer approximately eight hours per month to have a community garden in their neighborhood. Moreover, they are willing to contribute more than one hour a month to have a larger garden, and for the option of consuming their share of the harvest rather than donating it to a food bank. However, they are not willing to volunteer to improve the gardens' environmental benefits.

To compare people's willingness to contribute to community gardens in terms of money and time, we monetize the MWTV time by multiplying it by successively three different time value measurements: the mean local hourly wage rate ($31), the estimated leisure time rate (1/3 of the local hourly wage), and our shadow value of time estimate in Table 1 column (1) ($4.9). Results reveal that LA County respondents were more inclined to volunteer than to pay for a community garden, regardless of the values of the time conversion measure. For example, while they were willing to pay an average of $21 or volunteer 7.6 hours per month for a community garden in their neighborhood, their monetized time contributions ranged from $37 to $235 as the values of time conversion factors are varied. Furthermore, while they were willing to pay an average of $2.7 or volunteer 1.2 hours per month to have a larger (60 rather than 30 household) garden, the monetized time contribution fell between $6 and $37 depending on the value of the time converter.

### *3.2. Heterogeneous preferences for garden attributes*

*Individual Characteristics Associated with MWTC: OLS Model*

To examine the individual preference heterogeneity for community garden features, we regress the conditional individual-specific means of monetary MWTC for each attribute on socioeconomic characteristics, gardening experiences, and attitudes toward gentrification[7] using an OLS regression. Table 2 presents the results, where the conditional individual-specific MWTC for each attribute, including the no garden status quo, is recovered from the MMNL figures in Table 1 column (1) to create the dependent variables for the regressions in columns (1) through (5). Our findings reveal MWTC heterogeneity among respondents across garden attributes.

In Table 2, some socioeconomic factors are found related to MWTC to community gardens. Females show a strong preference for consuming the produce within homes rather than donating and will contribute an added $2.7 for this option (column (3)). Larger households are more willing to pay for community gardens in general, consistent with much of the literature (Grebitus, 2021). Some city planners recommend placing gardens in retirement communities, as they provide significant benefits to retirees (Scott et al., 2020). However, our results do not show any significant valuation differences between retirees and others in the sample, though they do reveal a lower value of their time, understandable given potentially lower wages and more leisure time. We also find household incomes to be unassociated with feature preferences, as the MWTC for a given one does not differ significantly between low- and high-income households. This underlines the importance among policymakers and urban planners to prioritize those with poor UA access when establishing new community gardens, as they presently are disproportionately distributed across LA County (Watson, 2018)

Our findings also highlight the significance of the past accumulated gardening experience. Those with extensive experience are willing to pay around $16 more to have a garden in their neighborhood, consistent with the literature on how past experiences boost willingness to contribute for various items (Czajkowski et al., 2015). Conversely, results show residents who now have a garden in their neighborhood have generally different garden preferences from those who do not. They are more inclined to donate harvested produce and prefer smaller gardens, suggesting the marginal value of a community garden declines as additional gardens are established in the vicinity. City planners should consider this effect in designing gardens to meet evolving preferences and community needs.

Community gardens offer numerous benefits, including enhanced food security and increased access to green spaces. But introducing a garden to a low-income neighborhood may also raise property values (Voicu and Been, 2008), drawing more affluent households and leading to the displacement of the existing population. Gentrification concerns of local residents are crucial in shaping their valuation of community gardens. In the final part of our survey, we gathered information on attitudes toward gentrification. Results suggest those perceiving gardens to make the neighborhoods more appealing to new and better-off neighbors are more willing to pay for them. However, individuals with negative attitudes toward attracting wealthier neighbors, who believe that gardens might facilitate this, do not value community gardens differently from the general population. This result might be attributed to the limited variation in attitudes toward gentrification, as only 1.5% of respondents fall into this category.

Finally, we investigate time-based MWTCs by regressing their conditional individual-specific means on each attribute, recovered from

[5] The U.S. Bureau of Labor Statistics reported an average (mean) hourly wage of $31 in Los Angeles-Long Beach-Anaheim in 2021. See: https://www.bls.gov/regions/west/news-release/occupationalemploymentandwages_losangeles.htm

[6] For instance, Rai and Scarborough (2015) calculate the labor value as 26% to 52% of local wages.

[7] In the survey, gentrification is defined as the "process of urban development where a neighborhood or specific area of a city develops in a short period of time. The process whereby the character of a poor urban area is changed by wealthier people moving in, improving housing, and attracting new businesses, typically displacing current inhabitants in the process".

**Table 2**
Association between individual characteristics and monetary MWTC for garden attribute.

| | (1) Status quo (No garden) | (2) Env benefits | (3) Donate produce | (4) Larger garden | (5) Shadow value of time |
|---|---|---|---|---|---|
| Female | −3.072 | 0.001 | −2.696** | −0.077 | −0.087 |
| | (6.981) | (0.006) | (1.053) | (0.719) | (0.212) |
| Hispanic | −10.918 | −0.004 | 0.175 | −1.882 | −0.412 |
| | (11.253) | (0.009) | (1.698) | (1.159) | (0.342) |
| Democrat | −11.066 | 0.008 | 0.200 | 1.118 | 0.460** |
| | (6.747) | (0.006) | (1.018) | (0.695) | (0.205) |
| Married | −8.750 | −0.012 | −1.459 | −0.351 | −0.121 |
| | (8.801) | (0.007) | (1.328) | (0.906) | (0.268) |
| Homeowner | 3.323 | 0.003 | 0.443 | 0.053 | −0.025 |
| | (8.954) | (0.008) | (1.351) | (0.922) | (0.272) |
| Currently Have Gardens | −9.202 | −0.009 | 2.591** | −1.321* | 0.045 |
| | (7.542) | (0.006) | (1.138) | (0.777) | (0.229) |
| Donation | −2.557 | −0.003 | −0.681 | 0.334 | 0.123 |
| | (8.055) | (0.007) | (1.215) | (0.829) | (0.245) |
| Rich Gardening Exp | −13.797** | 0.008 | −0.508 | 0.027 | −0.171 |
| | (6.833) | (0.006) | (1.031) | (0.704) | (0.208) |
| Low-income | −3.867 | −0.010 | 1.185 | 1.141 | 0.121 |
| | (9.655) | (0.008) | (1.457) | (0.994) | (0.294) |
| High Education | −11.354 | −0.003 | 0.541 | −0.292 | 0.078 |
| | (8.134) | (0.007) | (1.227) | (0.838) | (0.247) |
| Household Size | −5.413** | −0.002 | 0.634* | 0.334 | −0.016 |
| | (2.370) | (0.002) | (0.358) | (0.244) | (0.072) |
| Retiree | 6.427 | −0.013 | −2.144 | 0.157 | −0.891*** |
| | (10.511) | (0.009) | (1.586) | (1.082) | (0.320) |
| Garden Gentrification | −32.186*** | −0.004 | −0.568 | 1.371* | 0.106 |
| | (7.874) | (0.007) | (1.188) | (0.811) | (0.240) |
| Negative Attitude | −20.841 | 0.001 | −2.576 | 1.255 | 0.537 |
| | (15.034) | (0.013) | (2.268) | (1.548) | (0.457) |
| Garden Gentrification ×Negative Attitude | −9.882 | −0.006 | −4.410 | −0.729 | −0.539 |
| | (30.735) | (0.026) | (4.637) | (3.165) | (0.935) |
| Constant | −8.610 | −0.026** | −5.356** | 1.482 | −4.153*** |
| | (13.968) | (0.012) | (2.107) | (1.438) | (0.425) |
| *N* | 486 | 486 | 486 | 486 | 486 |

*Notes*: This table presents the results of the OLS regression, where we regress the conditional individual-specific means of monetary MWTC for each attribute on socioeconomic characteristics, gardening experiences, and attitudes toward gentrification using an OLS regression. The dependent variables for the regressions are the conditional individual-specific means of monetary MWTC, including the status quo (no garden), recovered from the MMNL figures in Table 1 column (1). "Garden Gentrification" is coded as one if respondents think the establishment of community gardens would lead to gentrification. "Negative Attitude" is coded as one if respondents have negative attitudes toward gentrification. Standard errors are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

the MMNL results from Table 1 column (2), on respondents' personal characteristics. Table A3 results in the Appendix suggest a narrative consistent with what we have observed in Table 2.

*Individual Characteristics Associated with MWTC: Latent Class Model*

In addition to individual-specific MWTC and OLS estimates, we explore preference heterogeneity with a latent class model. As explained in Section 2, this consists of two components: a regression that identifies the likelihood that a respondent belongs to each class and another regression that estimates each class's preferences over each attribute.

The latent class model classifies respondents into two classes based on individual characteristics.[8] Table 3 column (1) presents the estimated preferences for different features of urban community gardens among respondents in the two classes. The negative and significant coefficient of the no garden status quo in class 1 shows that respondents in this class gain positive utility by having a community garden in their neighborhoods. On the contrary, respondents in class 2 would value reverting to the no-garden status quo. Moreover, while respondents in class 1 also gain positive utilities from a larger garden with increased environmental benefits and harvested produce that can be consumed within the household, people in class 2 do not value any features of a community garden. Furthermore, even though respondents in both classes consider a monetary contribution as a cost, only those in class 1 regard their time in the garden to be a cost. We, therefore, label those in class 1 as "garden lovers" and those in class 2 as "garden protesters". The latent class model is estimated with both certainty and consequentiality adjustments.[9]

Column (2) of Table 3 shows how individual characteristics play a role in dividing respondents into classes they are most likely to fall into. Note that class 2 (garden protesters) is the reference group in this analysis, so the parameter estimate signs and statistical significance indicate how likely a respondent in class 1 (garden lovers) will have a certain character (e.g., be female), relative to those in class 2 (garden protesters). The results suggest that garden lovers are more likely than garden protesters to have a community garden currently in their communities, have gardening experiences, and believe that establishing community gardens may lead to gentrification. Regarding respondents' demographics, class 1 members (garden lovers) are more likely to identify as Democrats and have larger household sizes. However, the two classes are not significantly different from each other regarding other demographic characteristics such as income and education. Overall, these findings are consistent with what we have observed

[8] The latent class model does not converge when the number of classes is set at 3 to 10.

[9] 83% of respondents are classified as garden lovers while 17% of respondents are classified as garden protesters.

**Table 3**
Latent class model: marginal utility and class membership determinants.

| | (1) Marginal utility for garden attributes | | (2) Class membership determinants | | |
|---|---|---|---|---|---|
| | Class 1 (Garden lovers) | Class 2 (Garden protesters) | | | |
| Status Quo (No Garden) | −3.465*** | 1.241* | Female | −0.120 | (0.294) |
| | (0.180) | (0.658) | Hispanic | 0.326 | (0.433) |
| | | | Democrat | 0.498* | (0.278) |
| Env Benefits | 0.010** | −0.003 | Married | 0.230 | (0.335) |
| | (0.004) | (0.012) | Homeowner | −0.146 | (0.346) |
| | | | Currently Have Garden | 0.649* | (0.338) |
| Donate Produce | −0.255*** | −0.278 | Donation | −0.104 | (0.313) |
| | (0.042) | (0.303) | Rich Gardening Exp | 0.647** | (0.283) |
| | | | Low-income | −0.191 | (0.344) |
| Larger Garden | 0.222*** | 0.441 | High Education | 0.457 | (0.316) |
| (60 instead of 30 households) | (0.043) | (0.290) | Household size | 0.323*** | (0.115) |
| | | | Retiree | −0.328 | (0.367) |
| Time Cost | −0.087** | −0.057 | Garden Gentrification | 0.722** | (0.326) |
| | (0.034) | (0.176) | Negative Attitude | 0.258 | (0.321) |
| | | | Constant | −0.741 | (0.594) |
| Money Cost | −0.038*** | −0.107*** | | | |
| | (0.006) | (0.038) | | | |
| N | 8748 | | | | |

*Notes*: Column (1) presents the marginal utility (preferences) for each garden attribute among two classes. Column (2) shows how individual characteristics play a role in dividing respondents into classes they are most likely to fall into, class 2 (garden protesters) being the reference group. The model is estimated with both certainty and consequentiality adjustments. Standard errors are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

**Table 4**
Monetary and time MWTC in dollars and hours for garden lovers.

| | (1) MWTC money ($) | | (2) MWTC time (hour) | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Status Quo (No Garden) | −67.260*** | −5.658 | −25.132*** | 3.017* |
| | (9.404) | (4.012) | (2.984) | (1.570) |
| Env Benefits | −0.012 | 0.410** | 0.017 | −0.016 |
| | (0.101) | (0.193) | (0.017) | (0.014) |
| Donate Produce | −7.146*** | 18.219*** | −2.223*** | 3.946*** |
| | (1.416) | (3.365) | (0.259) | (0.450) |
| Larger Garden | 4.257*** | 12.764*** | 1.032*** | −2.414*** |
| (60 instead of 30 households) | (1.153) | (3.236) | (0.174) | (0.347) |
| Time cost | −3.965*** | −6.946*** | −0.241*** | 0.426*** |
| | (0.899) | (1.355) | (0.027) | (0.048) |
| Monetary cost | −2.378*** | 0.379 | −0.977*** | 1.347*** |
| | (0.279) | (0.300) | (0.158) | (0.152) |
| N | 7254 | | 7254 | |
| Prob > chi2 | 0.000 | | 0.000 | |
| Log lik. | −1464.113 | | −1470.050 | |

*Notes*: We use a sub-sample of respondents who are classified as garden lovers based on results from the latent class model in Table 3. We estimate garden lovers' MWTC contribute using a mixed logit model in WTC-space. Columns (1) and (2) present the monetary and time MWTC for each attribute, where certainty and consequentiality adjustments are applied. Standard errors are in parentheses. *p<0.1, **p<0.05, ***p<0.01.

from the OLS analysis above that explores the relationship between individual-specific MWTC and respondents' individual characteristics.

Since "garden lovers" are the primary potential users of community gardens and also the most likely group to volunteer for garden maintenance, understanding their preferences becomes crucial. Therefore, we proceed to estimate the MWTC of garden lovers, both in terms of money and time. To ensure that the results are comparable to the findings in Table 1, we estimate the MWTC using a mixed logit model in WTC-space based on Eq. (2) and (3). Both certainty and consequentiality adjustments are applied in the analysis. Table 4 column (1) presents the garden lovers' marginal monetary contributions, while column (2) presents the marginal time contributions. Similar to the findings for the preferred sample presented in Table 1, all mean MWTC coefficients are statistically significant at the 1% level except for the coefficient of the "environmental benefits" attribute. Moreover, compared to an average individual in LA county, garden lovers' MWTC for each attribute demonstrates a consistent pattern, with coefficients of larger magnitude in absolute value. For example, garden lovers are willing to pay over $67 or volunteer 25 hours per month to have a new community garden in their neighborhood. In addition, compared to a garden that could serve 30 households, garden lovers are willing to pay about an additional $4 per month or volunteer one additional hour per month for a garden that can serve 60 households. They are also willing to contribute an extra $7 per month or two additional hours per month to consume the fruits and vegetables themselves rather than donating them to a local food bank. Overall, as expected, garden lovers are willing to contribute more time and money to establish a community garden than the general public.

## 4. Conclusion

UA is increasingly playing a pivotal role in addressing challenges related to food insecurity, sustainability, and equality in urban development. Given the rising interest in UA, the importance of its policies and programs is evident in recent legislative actions. For instance, the 2018 Farm Bill mandated the creation of the Office of Urban Agriculture and Innovative Production within the US Department of Agriculture (USDA), tasked with encouraging and promoting community gardens and urban farms (Agriculture Improvement Act of 2018). Assessing the value residents place on community gardens is crucial for understanding the benefit–cost ratio of such programs and guiding future garden development.

We conducted a DCE survey in LA county to estimate people's MWTC for community gardens by both monetary and time-spent means as well as to explore their preference heterogeneity. Our findings have several important implications for urban agricultural planning and community garden establishment in urban areas.

First, our results provide estimates of the values people place on community garden attributes, assisting the planning efforts by governmental agencies and non-governmental organizations involved in promoting UA. We find that an average individual in LA County values community gardens positively and is willing to contribute an average of $21 or around 7.6 hours per month per household to have a garden in their neighborhood. Moreover, we offer critical information on residents' preferences for garden size and harvested produce allocation. On average, residents are willing to contribute more money and time to have a larger garden and to consume the harvested fruits and vegetables within their homes rather than donating them to local food banks. Given that individuals in LA County value community gardens and prefer to consume the harvested fruits and vegetables within their homes, it may suggest that community gardens can play a vital role in enhancing local food security by providing residents with direct access to fresh produce. We also demonstrate that compared to the average individual in LA County, "garden lovers" have a higher MWTC overall. They are willing to contribute both more time and money to have a community garden in their communities.

Second, we shed light on individuals' willingness to contribute to the public co-benefits of impure public goods. As a form of urban greenspaces, community gardens are unique in so far as they motivate individuals to participate in growing fresh vegetables and fruits to harvest for their own personal use. This specific private benefit, in return, contributes to the provision of public goods such as improvements to the broader ecosystem. We find that people value gardens' private benefits, but they are not willing to contribute money or time to improve environmental benefits (public co-benefits). This aligns with the economic theory that public goods are often under-provided. Unlike other forms of urban greenspaces like parks, even if someone may not directly contribute toward improving gardens' environmental benefits, the pursuit of harvested fresh produce (private benefits) can indirectly support the provision of public goods, thus promoting environmental sustainability. Furthermore, it is critical to note that our choice experiment only measures people's willingness to contribute to ecosystem services, such as the presence of pollinators and birds, capturing just a fraction of the public benefits provided by community gardens. This limited scope may contribute to the negligible valuation of environmental benefits observed in our study. As forms of urban green space, community gardens can provide additional public benefits, including local air purification, climate regulation, and stormwater remediation (Cabral et al., 2017). Since these benefits are not specified as attributes within our DCE design, their values may not be fully reflected in individuals' MWTC for garden attributes. Instead, these benefits could be reflected in people's overall willingness to support the establishment of a new community garden in their neighborhood over the status quo (no garden option).

Third, our findings provide valuable insights into urban planning by highlighting the diverse preferences for gardens among different groups. We find that one's past gardening experience plays a significant role in shaping preferences. To enhance people's interest and participation in community gardens, governmental agencies and non-governmental organizations might consider promoting activities that help individuals gain gardening experience, such as organizing workshops, offering educational resources, or providing mentorship programs to cultivate a connection with gardening and improve residents' gardening skills.

Our findings also indicate that the value people place on newly established gardens in their neighborhoods varies. Specifically, when a new community garden is added to a neighborhood that already has existing gardens, local residents prefer smaller gardens and are more willing to donate the harvested produce, suggesting the marginal value of a community garden may be influenced by the current availability of gardens in the neighborhood. Urban planners should consider this when determining the number and location of community gardens to ensure that they effectively meet the diverse needs of residents in the area. However, we acknowledge the challenge lies in identifying the current locations of gardens in many U.S. cities. Mapping efforts of existing urban agriculture sites in major cities have often been constrained to data from institutional lists and voluntary site reports. More recently, Taylor and Lovell (2012) suggest analyzing high-resolution aerial images from Google Earth to map urban food production locations. Considering the significance of understanding the locations of existing gardens for policy design, future research is needed to address the data scarcity regarding garden locations.

Lastly, while community gardens are often viewed as a strategy to address issues of social inequality, access to UA remains unevenly distributed in many US cities, including LA (Watson, 2018; Siegner et al., 2018; Butterfield and Ramírez, 2021). Low-income households, in particular, often lack access to community gardens (Taylor and Lovell, 2012). Existing literature indicates that participation in urban agriculture is positively associated with education (Bellemare and Dusoruth, 2021), which may be partly due to the differences in accessibility to these spaces. However, our findings do not reveal heterogeneous preferences across income or education. It is thus important for urban planners to consider the preferences of all residents when making land use decisions.

We acknowledge that there are limitations to this research. While the study focuses on a major metropolitan area, which is representative of the recent UA movement, we did not extend our examination to a broader region. This may limit the external validity of our conclusions. Compared to other major U.S. cities, LA has a significant Hispanic presence and a lower population density due to its sprawling layout and extensive suburban areas (Census, 2020). Variations in demographic compositions and population density may be associated with differences in valuation for community gardens. Nevertheless, our findings can be viewed as an important initial step in quantifying the benefits offered by community gardens and urban agriculture in general. Moreover, future studies could investigate the distribution of existing urban community gardens alongside the demographic makeup and population density of the neighborhoods in which they are located. This could shed light on whether existing policies were implemented in a manner that aligns with residents' preferences. Though these possibilities represent interesting opportunities for advancement, they fall outside the scope of our current work. Furthermore, community gardens may be more likely to thrive in areas where private green space is scarce. However, due to data limitations, we acknowledge that we are not able to track geographic variations on an individual respondent level. Consequently, we cannot investigate whether individuals' preferences for community gardens vary depending on the availability of other private green spaces nearby. Future research can further explore how intra-city variation influences preferences for community gardens.

## CRediT authorship contribution statement

**Liqing Li:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Dede Long:** Conceptualization, Data curation, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing.

## 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.

## Declaration of generative AI in scientific writing

During the preparation of this work, the author(s) utilized ChatGPT to correct grammatical errors in the Introduction section. After using this tool/service, the author(s) reviewed and edited the content as necessary and take full responsibility for the publication's content.

## Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.foodpol.2024.102649.

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