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Non-growers' perspectives on home gardening: Exploring for future attraction

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Abstract*. To achieve urban sustainability, growing vegetables at home is a practical necessity. Understanding why people are hesitant to participate in urban vegetable growing is vital to reviving this practice. An in-person survey was conducted among 244 people who do not garden at home in Sri Lanka's Colombo district to determine their perception of not gardening. Analysis was performed with exploratory factor analysis followed by binary logistic regression. According to the study, unrealized benefits and knowledge and experience challenges cause demotivation. The respondents had favorable attitudes toward urban agriculture; their interests appear to be aligned with urban agriculture and motivation should be able to entice them. The most viable way to attract them and ensure that they reap the economic and social benefits of urban home gardening appears to be to provide knowledge and hands-on experience. Younger people, private sector workers, and single homeowners are specific population segments that can be targeted for this motivation effort. The analysis further revealed that agriculture demonstrations in an urban setting inspire non-growers to practice urban agriculture.*

Keywords*. Attitudes, home gardening, non-growers, perception, urban agriculture, urbanization.*

Abstract*. Untuk mencapai keberlanjutan kota, menanam sayuran di rumah adalah kebutuhan praktis. Memahami alasan mengapa orang ragu untuk berpartisipasi dalam penanaman sayuran perkotaan sangat penting untuk menghidupkan kembali praktik ini. Survei langsung dilakukan di antara 244 orang yang tidak berkebun di rumah di distrik Kolombo Sri Lanka untuk menentukan persepsi mereka tentang tidak berkebun. Analisis dilakukan dengan analisis faktor eksplorasi yang dilanjutkan dengan regresi logistik biner. Menurut penelitian, manfaat yang belum direalisasi dan tantangan pengetahuan dan pengalaman menyebabkan demotivasi. Responden memiliki sikap yang baik terhadap pertanian perkotaan; minat mereka tampaknya selaras dengan pertanian perkotaan dan motivasi harus dapat memikat mereka. Cara yang paling layak untuk menarik mereka dan memastikan bahwa mereka menuai manfaat ekonomi dan sosial dari berkebun di rumah perkotaan tampaknya adalah dengan memberikan pengetahuan dan pengalaman langsung. Kaum muda, pekerja sektor swasta, dan pemilik rumah tunggal merupakan segmen populasi tertentu yang dapat menjadi sasaran upaya motivasi ini. Analisis*

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lebih lanjut mengungkapkan bahwa demonstrasi pertanian di perkotaan menginspirasi non-petani untuk mempraktikkan pertanian perkotaan.

***Keywords**. Berkebun di rumah, bukan petani, persepsi, pertanian perkotaan, sikap, urbanisasi..*

Introduction

The district of Colombo, Sri Lanka's most populous area, is beset by social, economic, and environmental problems. The negative effects of urbanization on Colombo have been proven empirically and statistically. Loss of green cover, increased urban heat island (UHI) effect, excessive solid waste accumulation, and poor air quality have been found as significant environmental degradations (Estoque et al., 2017; Li & Pussella, 2017; Maheng et al., 2019; Ranagalage et al., 2017). Colombo district has the highest percentage of urban residents (78%) in Sri Lanka, followed by Batticloa district (29%). Just 21% of urban households receive 55% of urban income. Hence, there is a wide disparity in income distribution in the urban sector. Moreover, urban sector households spend more on prepared foods (17%) compared to rural (11%) and estate sector households (6%) (Department of Census and Statistics Sri Lanka, 2021). As a result, urban agriculture (UA) emerges as a viable solution. Urban agriculture has shown signs of reducing the negative effects of urbanization while maintaining Colombo's sustainability by diversifying its role. This provides grounds for urban planners to be optimistic.

A large body of literature has addressed the environmental, social, and economic aspects of UA. Numerous studies have shown that UA generates non-food and non-marketable goods, all of which may be beneficial to the urban environment (Artmann & Sartison, 2018; Specht et al., 2013). Food security is clearly one of the UA's greatest economic benefits according to studies conducted in metropolitan areas (Alaimo et al., 2008; Algert et al., 2016; Jongwe, 2014; Yeudall, 2007). Self-produced food allows households to save money on food purchases (Algert et al., 2016). Urban agriculture can help the urban poor in two ways: it can help them earn money (Debela & Mohammed, 2020; Kutiwa et al., 2017) while also protecting their nutritional status (Gockowski et al., 2003). Modern technology, such as hydroponic systems, can ensure food safety in UA. UA also secures social benefits such as improved community interaction (Litt et al., 2011), psychological and physical well-being (Akpinar, 2016; Bellows et al., 2008; Beyer et al., 2014; Guite et al., 2006; Kondo et al., 2018; Nutsford et al., 2013; Soga et al., 2017; Twohig-Bennett & Jones, 2018; Zick et al., 2013), improved micro-climates, reduced food miles (Weber & Matthews, 2008), reduced heat island effect (Estoque et al., 2017; Susca et al., 2011), reduced transportation emissions, and conservation and recycling of local resources (Food and Agriculture Organization, 2014; Heather, 2012; Ruma & Sheikh, 2010). State-of-the-art urban agriculture adds aesthetic value, enhances the scenery, and contributes to the beautification of cities through the use of plants (Irwan & Sarwadi, 2006). When the advantages of urban agriculture are taken into account, a strong link is formed between the two concepts of urban agriculture and urban sustainability.

Despite the benefits, UA is still largely unrecognized, or it is treated as an informal activity in the overall development of Colombo district. Although the amount of arable land available for cultivation in Colombo is decreasing, particularly for community gardening, potential still exists for home gardening. Even under these circumstances, Colombo residents' engagement in home gardening is low. Only 10% of households in Colombo's district participate in UA, as evidenced by (Land Use Policy Planning Department of Sri Lanka, 2020. Fortunately, residents with limited space can opt for vertical or roof top gardening. Finding out how urban dwellers perceive urban agriculture could suggest practical solutions to overcome possible barriers. Studies have been conducted that examined UA attitudes and impediments among urban gardeners (Home & Vieli,

2020; Kirby et al., 2021; Kirkpatrick & Davison, 2018; Ruggeri et al., 2016), planners, and consumers (Jürkenbeck et al., 2019), or a mix of stakeholders (Castillo et al., 2013; Nadal et al., 2018; Olazabal et al., 2011; Sanyé-Mengual et al., 2020). However, so far, urban residents who are non-growers have received little research attention (Chalmin-Pui et al., 2021).

Numerous benefits of UA have been evidenced, and many more are intuitively known to the general public. A better understanding of the obstacles that discourage people from starting home gardens is necessary if we are to succeed in persuading more people to do so. Therefore, this research focused on how non-growers view UA to find ways to entice them to participate. This is not only related to possible barriers to practicing but also to how they perceive UA in general. This will improve the prospects of UA, which is capable of mitigating some of the negative effects of urbanization, allowing cities to be sustainable. The method employed in achieving the research aim was exploratory factor analysis (EFA) followed by binary logistic regression.

Literature Review

The study's scope limited the literature review to UA perceptions and attitudes. The literature on UA perceptions reveals that the stakeholder groups of concern in urban and peri-urban areas include the general public, UA practitioners, non-practitioners, UA project leaders, and stakeholders. The researchers' approaches and fundamental conclusions can be summarized as follows.

Sroka (2018) investigated residents' perceptions of the benefits of urban and peri-urban agriculture in Polish metropolitan areas. The respondents were asked to rate their level of agreement with the benefits (on a 5-point Likert scale). The city dwellers had little knowledge of agriculture and believed that agriculture's contribution to the city was negligible. Over 35% of them were uninterested in or unable to maintain a backyard garden or even grow vegetables on their balconies. The benefits of UA were rated particularly low by city dwellers. Peri-urban residents had a much more positive perception of agriculture and were aware of its benefits. The evaluation found a link to higher agricultural awareness and knowledge. UA is an unfamiliar concept in Poland and residents are skeptical of the benefits that can be gained from UA, according to Sroka.

According to the study on public attitudes toward UA by Shamsudin et al. (2014), perception statements (on a 7-point Likert scale) were developed along with environmental improvements, socioeconomic considerations, and health benefits. Malaysian urban residents place considerable value on benefits in economic and environmental terms, knowledge, safety, and security. Relationships between public attitudes toward UA in Malaysia exist due to the values it generates and prior knowledge. As a result, it is critical that the general public develops or maintains a favorable attitude toward this practice. Age, household size, and education level have all contributed as socio-demographic factors shaping the action, which was found by a logistic regression model. Furthermore, younger respondents were more motivated by environmental activities.

Perceptions of backyard food gardening in South Florida were investigated by Zahina-Ramos (2013) among growers and non-growers, with the use of brief statements (no Likert scale rating). The non-food growers were receptive to backyard growing, but they reported barriers such as a lack of knowledge to manage pest incidences and diseases, not knowing what to grow at different times of the year, low productivity, and climatic extremes. Food growers were frustrated by low productivity.

Ngahdiman et al. (2017) studied the factors influencing urban inhabitants to practice UA, based on 21 statements encompassing a wide range of benefits, knowledge and experience, and sources of inspiration. The study showed that the respondents had favorable opinions of UA and planned to practice it in the future. A positive outlook toward UA, confidence in practicing, social environment, and peer influence were the four latent factors generated by EFA (exploratory factor analysis). Age, gender, educational level, and household size were also likely to influence urban dwellers' intention to practice UA.

Sanyé-Mengual et al. (2020) compared the perspectives of UA project leaders, stakeholders, and the general public to assess the perceived ecosystem services (via Likert-scale associated statements) of agriculture in urban and peri-urban areas in Italy. According to the findings, the general public and UA stakeholders agreed on the importance of socio-cultural ecosystem services, while provisioning services were ranked lower. The most significant sociocultural and environmental ecosystem services they were concerned with were health, pollination, education, and the development of new forms of recreation.

The aforementioned literature examined the perspective of the urban public on UA but not specifically that of non-growers. Therefore, it is important for future awareness endeavors to learn how particularly the group of non-growers perceives UA.

Methodology

The methodology used in the study is outlined in five subsections. The conceptual framework of the study is described first, followed by a brief introduction of the study location and the sampling in the second and third sections, respectively. The survey instrument is discussed in the fourth section. The final section provides information about the pilot study as well as the two analytical approaches used: exploratory factor analysis and binary logistic regression.

Conceptual framework

Given the benefits of urban agriculture, a conceptual framework based on assigned and held values (Figure 1) was constructed using the approach of Seymour et al., (2010), which considers natural resource management perspectives. Ideas or beliefs that people consider important are referred to as 'held values' (Lockwood, 1999). These values are typically broad and conceptual, but they govern personal behavior (McIntyre et al., 2008). Lockwood (1999) highlights that people's ideas, opinions, and judgments are influenced by their held values. To understand why people engage in specific environmental behaviors, examining their held values is helpful. In contrast, 'assigned values' are more focused on the relative value of specific natural places, traits, or phenomena (McIntyre et al., 2008). Assigned values are influenced by a variety of variables, including people's perceptions. Further, assigned values can be stated in monetary or non-monetary terms and are significant to economic and psychological approaches. We were also curious about how people view and appreciate particular green spaces, particularly related to urban agriculture. Understanding how people perceive UA is aided by the concept of values. Assigned values are less transitory and can be influenced by held values, which in turn shape how people view UA. Urban dwellers' perceptions are influenced and shaped not only by these values but also by a variety of external factors. As a consequence, data from the socio-demographic profile were used as external factors that influence perception. As the conceptual framework shows, the more or less comparable variables will have an effect on those who do not practice but more so on the component-lack side: lack of identified value, knowledge and experience gaps, and attitudes.

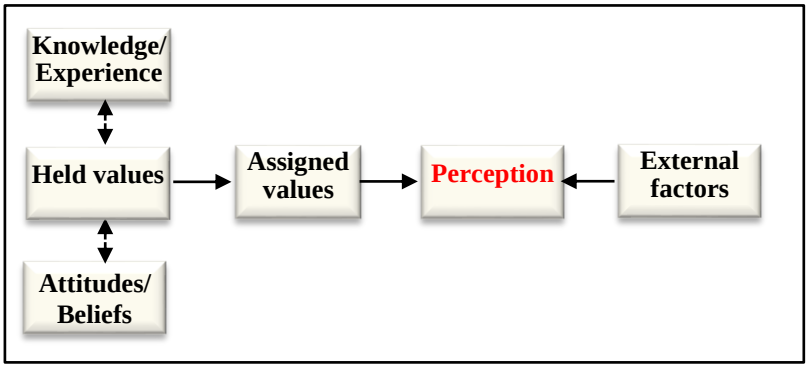

Figure 1. Factors influencing perceptions toward urban agriculture (Adapted from 'Understanding the role of assigned values in natural resource management,' by E. Seymour, A. Curtis, D. Pannell, C. Allan, and A. Roberts, 2010, *Australasian Journal of Environmental Management*, *17*(3), p. 149. Copyright 2010 by Tailor & Francis.)

Study area

Colombo, one of the three districts in the Western Province of Sri Lanka has the country's highest urbanization rate, at 78%. Despite occupying only 6% of Sri Lanka's total land area (699 km^2), it houses nearly 50% of the country's urban population and 14% of its total population (Department of Census and Statistics Sri Lanka, 2020). The district encompasses Colombo City, Sri Lanka's commercial center; hence, the district's recent urbanization tendency is undeniable. The rest of Colombo has the potential to practice UA, even though that context is restricted to the city. The Provincial Director of Agriculture and the District Director of Agriculture are working to improve the practices of the Colombo district's current UA practitioners and to raise awareness among all residents. Due to the scarcity of community gardens in the Colombo district, the focus of this study was on small-scale UA farming practices for vegetables and leafy vegetables in general. A range of home gardening techniques were taken into consideration, from more traditional ones such as backyard gardening and pot cultivation to more innovative ones such as green walls, greenhouses, and rooftop gardens. Fruits, herbs, flowers, and ornamental plants were excluded from the study. Fruit cultivation is not visible on Colombo's limited land parcels and herb cultivation is also low. Flowers and ornamental plants are outside the scope of food consumption. The target group considered here were almost certainly people who represent a family that was not involved in UA at the time of the survey and whose families were not frequent growers and are hence referred to as 'non-growers'.

Sampling

The literature on sample adequacy presents a variety of viewpoints and numerous rules of thumb for EFA analysis. There are two concerns about sample selection. Firstly, the researcher must draw an adequate sample size, i.e., threshold number (Comrey & Lee, 2013; Hair et al., 2010; Tabachnick & Fidell, 2013) or sample-to-variable ratio (*N*:*k*) (Kass & Tinsley, 1979; MacCallum et al., 2001) to proceed with the analysis. Secondly, the sample size must be checked during the factor analysis, which can be done by using the Keiser-Meyer-Olkin (KMO) test (Williams et al., 2010). This study adopted a sample to variable ratio (*N*:*k*) of >5:1 and later met the condition outlined by KMO. The random sampling technique was used to draw a sample size of 244. Potential respondents were chosen at random from a list provided by the Colombo Divisional Secretariat, which consisted of inhabitants of Colombo district. The list was compared to the list of growers maintained by Agriculture Instructors to exclude growers from the sample. The next

random number was chosen in case of coincidence. The respondents were invited to an in-person survey that was held at the Colombo District Secretariat. The survey was conducted from July to October 2020. A total of 280 people were invited but only 252 participated in the survey (with 8 of those partially). This amounts to a rejection rate of 13%.

Survey instrument

The survey included demographics and perceptions of UA (main section). The responses on perceptions were recorded on a 4-point Likert scale: *strongly agree (4)*, *agree (3)*, *disagree (2)*, and *strongly disagree (1)*. The 'neutral' option was eliminated, as the respondents could hardly perceive the difference in-between. The elimination of the neutral category was consistent with the findings in cases where five response categories were provided (Bishop, 1987; Moors, 2008). Perception statements were developed after reviewing the literature (Ngahdiman et al., 2017; Sanyé-Mengual et al., 2020; Shamsudin et al., 2014; Zahina-Ramos, 2013) to analyze the perceptions.

Data analysis

Prior to the main survey, a pilot survey (an in-person survey) with 25 respondents who were not practicing UA (in addition to the 244 in the main survey) was conducted to ensure the reliability and validity of the initially set of 26 statements, which is required in the EFA process. The survey participants were invited to the Colombo District Secretariat on January 22, 2020. The adequacy of the statements was concluded after generating a Cronbach's alpha value within the acceptable range (0.891). Then, a bivariate correlation matrix was screened to ensure the validity of the statements. The statement, 'Time is the most crucial constraint for me to engage in UA,' was correlated only with two items and thus excluded from the list of statements. The main survey included 25 of the 26 statements that were found to be reliable.

The next two subsections, respectively, discuss the analytical methods used in the main survey data, which consisted of exploratory factor analysis and binary logistic regression.

Exploratory factor analysis (EFA)

Exploratory factor analysis (EFA), being a multivariate statistical analysis technique, allows a model to be generated from a relatively large set of latent constructs, which are represented by a set of items known as statements or variables (Watkins, 2018). As the name suggests, the researchers have no expectations regarding the number or nature of the variables (Williams et al., 2010). This study assumed the same phenomenon and aimed to reduce a large number of variables to a smaller set of underlying factors. Such a model is capable of categorizing and summarizing the important information contained in the variables (Henson & Roberts, 2006; Pett et al., 2003; Thompson, 2006).

A sequence of steps needs to be followed when conducting EFA (Pett et al., 2003). The initial step, sample adequacy, was discussed in the previous section. Following that, one of seven methods, namely principal component analysis (PCA), principal axis factoring (PAF), principal factoring, maximum likelihood, unweighted least squares, generalized least squares, and image factoring, can be chosen (Pett et al., 2003). In this study, we chose PCA over PAF, two of the most popular approaches (Russell, 2002; Thompson, 2006), because PCA's underlying technique of data reduction (Pett et al., 2003) was one of the research goals of this study. PCA outperforms other methods in terms of low noise sensitivity and the absence of the need for prior model theory

(Gorsuch, 2015; Thompson, 2006). The third step proposes better ways to determine the number of factors to be retained. Four simultaneous inspections are suggested in the literature: eigenvalue criteria >1, total variance explained, scree plot, and parallel analysis (Costello & Osborne, 2005; Hair et al., 2010; Pallant, 2007; Thompson, 2006). The fourth step in the process is choosing the appropriate data rotation method, oblimin (oblique type) or varimax (orthogonal type). The common procedure is to use oblimin and look for correlations greater than 0.3, and if they are smaller to use varimax rotation (Hair et al., 2010; Thompson, 2006). A trial-and-error method was then used to obtain a clean pattern matrix by eliminating cross-loaded items. Finally, the Cronbach's alpha values were used to ensure the validity of the data. The data were analyzed using IBM SPSS version 25.

Binary logistic regression

The examination of the external components that contribute to perception, as depicted in Fig. 1 of the conceptual framework, was the focus of this analysis. In the binary logistic regression, two types of response variables, i.e., intended actions (derived from EFA) and socio-demographic profile data (which serve as external factors that influence perception) were utilized. The estimation was done with STATA (V.15). The empirical model is shown in Equation 1 and the estimated model is shown in Equation 2. Table 1 shows the explanation and definition of the variables used in the binary logistic regression.

$$\text{Logit}\ (Y) = \text{natural log}\ \ (\text{odds}) = ln\ (\pi/1-\pi) = \alpha + \beta X_i \quad (1)$$

where $i = 1$

$$ln\ (\pi\ /1\text{-}\pi) = \beta_0 + \beta_1 X_1\ (\textit{Unrealized benefits}) + \beta_2\ X_2\ (\textit{Knowledge \& experience}) + \beta_3 X_3\ (\textit{Attitude}) + \beta_4 X_4\ (\textit{Interests}) + \beta_5 X_5\ (\textit{House Type}) + \beta_6 X_6\ (\textit{Profession}) + \beta_7 X_7\ (\textit{Age}) \quad (2)$$

Table 1. Variables for testing non-growers' intention to practice urban agriculture

Variables	Coding System
Response Variable	
Future intentions to engage in UA	1 = Yes, if the respondent has future intention to engage in UA, 0 = No, if the respondent has no future intention to engage in UA
Explanatory Variables	
F1 (Unrealized benefits)	Factor score generated by EFA (continuous)
F2 (Knowledge & experience)	Factor score generated by EFA (continuous)
F3 (Attitudes)	Factor score generated by EFA (continuous)
F4 (Interests)	Factor score generated by EFA (continuous)
House Type	1 = Single house, 0 = Otherwise (flat and attached house)
Profession	1 = Private sector, 0 = Otherwise (all other professions considered)
Age	1 = ≥ 40, 0 = Otherwise (< 40)

Results and discussion

The first section provides a synopsis of the socio-demographic profiles of the respondents. The descriptive statistics of the 25 items are discussed in the second section. The next section discusses the underlying factors that contribute to individuals' perception of UA, followed by the factor scores. The factors that have an impact on future practice are discussed in the final subsection.

Table 2. Socio-demographic profile of the respondents

Demographic variables (*n*=244)	**Percentage**
Gender	
Male	44.3
Female	55.7
Age (years)	
20-29	15.6
30-39	33.6
40-49	24.6
50-59	13.9
60+	12.3
Education	
Tertiary	36.9
Secondary	56.6
Primary	6.5
Profession	
Government	27.5
Semi-government	0.8
Private sector	34.8
Self-employed	7.8
NGO	2.5
Retiree	8.2
Housewife	12.7
Full time student	1.6
Unemployed	4.1
Household income (LKR/month)	
<50,000	22.5
50,001-100,000	45.1
100,001-150,000	23.8
>150,000	8.6
Housing type	
Single	54.9
Flat	30.7
Attached	14.4

Note: NGO = non-governmental organization

Demographic Profile

Table 2 shows the socio-demographic characteristics of the respondent group. The majority of the respondents were female. Approximately 49% of the sample belonged to the 20-39 year age category with 57% having a secondary education. Private sector employee (35%) was the most frequently reported occupation, followed by public sector employee (28%). The upper middle-income category (45%) was the most prevalent among the respondents. The findings on the demographic variables were comparable to the Colombo district in 2020 (Department of Census and Statistics Sri Lanka, 2020). However, household income was not similar to the study's categories, and type of profession was not included. Our data show that 37% had tertiary education while this is 8% in the DCS data. The study sample was urban, whereas Colombo has rural areas, which could be the reason.

Descriptive statistics of the items

Initial validity and criterion checks were performed on the data, as presented in Table 3. First, the data were checked for normality via skewness ((± 3) and excess kurtosis (± 10); these were within

acceptable normality ranges (Kline, 1994; Tabachnick & Fidell, 2013). The Pearson correlation matrix (a 25 × 25 bivariate correlation matrix) found adequate factorability (bivariate correlations > 0.3). Further, Bartlett's Test of Sphericity had a significance value of $p < 0.05$, confirming factorability (Hair et al., 2010; Tabachnick & Fidell, 2013). No Pearson correlations exceeded 0.85, indicating no multicollinearity. The KMO value of 0.871 confirmed (reference value > 0.5) EFA sample adequacy (Williams et al., 2010).

The mean values generated for the items in Table 3 show the most likely underlying reasons for the respondents not practicing UA. In general, the mean value tends toward 4 when there is strong agreement, which indicates the type of obstacle, and vice versa. However, the interpretation is wholly dependent upon the statement. For instance, the statement 'Want to learn new knowledge about urban agriculture (A25)' possessed a mean value of 3.19, but this is hardly an obstacle; rather, they agree because they want to learn about UA. Accordingly, the study found that land scarcity followed by knowledge-associated issues were the most controlling factors for engagement in UA. The mean values generated by the analysis, which were greater than 3.00, prove this: space related issues (A5, A23, and A24) and knowledge issues (A4, A6, and A25). Meanwhile, the variables that do not incur barriers to engagement in UA are also worth looking at. The items that recorded a mean value less than 2.00 (A12, A13, A18, and A19) reflect non-barriers.

Table 3. Descriptive statistics for the statements

Code	Statement	Strongly Disagree %	Disagree %	Agree %	Strongly Agree %	Mean	SD	Skewness	Excess Kurtosis
A1	No prior experience	5.74	22.95	52.05	19.26	2.85	0.79	-0.42	-0.12
A2	I haven't seen how it works in an urban setting	5.33	36.89	38.52	19.26	2.72	0.84	0.02	-0.74
A3	Cultivation is a challenge for me	4.51	24.18	51.23	20.08	2.87	0.78	-0.34	-0.21
A4	No knowledge about zero land agriculture	2.87	13.93	55.74	27.46	3.08	0.72	-0.58	0.41
A5	I believe zero land farming is costly	11.89	18.44	18.44	51.23	3.09	1.08	-0.75	-0.87
A6	No knowledge to manage pests and diseases	2.46	11.89	60.66	25.00	3.08	0.68	-0.58	0.83
A7	No perceived social benefits	10.25	46.72	12.70	30.33	2.63	1.02	0.21	-1.29
A8	No perceived economic benefits	10.66	34.02	54.10	1.23	2.46	0.70	-0.69	-0.39
A9	No intention to start cultivating	17.21	63.93	18.85	-	2.02	0.60	-0.01	-0.21
A10	Awareness programs are sufficient	6.56	35.25	39.34	18.85	2.70	0.85	-0.05	-0.70
A11	I am satisfied with my living environment	6.56	29.51	33.61	30.33	2.88	0.92	-0.26	-0.94
A12	It is a farmers' job	29.10	65.98	4.10	0.82	1.77	0.56	0.27	1.22
A13	For me, cultivating is a real hassle	22.54	68.85	8.61	0.00	1.86	0.54	-0.09	0.18
A14	No or lack of motivation due to previous low yield	23.77	63.52	11.48	1.23	1.90	0.63	0.38	0.70

A15	Cultivation does not relax me	9.02	39.34	20.49	31.15	2.74	1.00	0.00	-1.26
A16	I don't bother about the vegetable bill	6.97	35.66	55.33	2.05	2.52	0.66	-0.62	-0.11
A17	Not easy to handle aftercare	11.89	34.84	51.23	2.05	2.43	0.73	-0.55	-0.47
A18	I'm a tenant, so no way	25.00	64.75	8.20	2.05	1.87	0.63	0.60	1.46
A19	I mostly eat fast food, so it is not important	25.82	66.80	6.97	0.41	1.82	0.56	0.11	0.59
A20	I prefer to grow flowers and ornamental plants	1.64	29.51	36.07	32.79	3.00	0.83	-0.17	-1.13
A21	Flowers in bloom release my mind	1.64	42.62	31.56	24.18	2.78	0.83	0.25	-1.18
A22	In my spare time, I have plenty of other interests	2.87	37.30	32.79	27.05	2.84	0.86	0.04	-1.13
A23	No land/land is insufficient	7.38	18.44	20.08	54.10	3.21	0.99	-0.89	-0.51
A24	This home's layout is unsuitable for urban agriculture	6.97	24.18	16.80	52.05	3.14	1.01	-0.69	-0.93
A25	Want to learn new knowledge about urban agriculture	1.23	7.79	61.89	29.10	3.19	0.62	-0.46	0.90

Note: SD = standard deviation. Kurtosis is defined in two ways: i) kurtosis for a normal distribution = 3, ii) kurtosis for a normal distribution = 0. Most software (SAS/EXCEL/SPSS) uses the second form (Warner, 2007). The kurtosis equation is modified by subtracting 3. Therefore, it can be referred to excess kurtosis, which can be either – or +, unlike the case in the first definition, which is always +.

Latent factor structure

After the validity checks, data extraction performed with PCA resulted in six factors, which possessed eigenvalues >1. Performing simultaneous checks of variance explained, scree plot, and parallel analysis, the number of latent factors was kept at four. Since oblimin rotation failed to meet the correlation condition (>0.3), varimax rotation was performed to yield the final outcome, which was checked with Cronbach's alpha. The factor structure generated from the EFA is presented Table 4. The variables that fall into each latent factor were examined thoroughly, followed by labeling the best corresponding factor. All four factors contributed 68.3% of the total variance to the total factors influencing perception towards UA practices. The results demonstrate that the primary determinants for non-growers are prior knowledge, assigned values, attitudes, and interest toward UA. Consequently, it is essential that non-growers adopt or maintain a positive attitude toward this practice. The conceptual framework (Fig. 1) is in line with the connections between prior understanding, values, and attitudes toward UA. The benefits may be reflected in the positive correlation between the respondents' attitudes and the assigned values group. The following is the interpretation of the variables within the appropriate factor.

Table 4. Results of EFA

Code	Statement	Factor loading	Communality	Cronbach's alpha
	Unrealized benefits			
A8	No perceived economic benefits	0.798	0.670	
A16	I don't bother about the vegetable bill	0.792	0.647	
A24	This home's layout is unsuitable for urban agriculture	0.761	0.653	
A15	Cultivation does not relax me	0.741	0.825	0.899
A7	No perceived social benefits	0.674	0.667	
A23	No land/land is insufficient	0.659	0.544	
A11	I am satisfied with my living environment	0.637	0.734	
	Variance explained – 22.6%			
	Knowledge and experience			
A4	No knowledge about zero land agriculture	0.870	0.772	
A3	Cultivation is a challenge for me	0.793	0.758	
A1	No prior experience	0.777	0.804	
A6	No knowledge to manage pests and diseases	0.743	0.588	0.895
A2	I haven't seen how it works in an urban setting	0.702	0.739	
A5	Want to learn new knowledge about urban agriculture	0.673	0.534	
	Variance explained – 19.4%			
	Attitudes			
A13	For me, cultivating is a real hassle	0.864	0.780	
A12	It's a farmers' job	0.845	0.743	
A19	I mostly use fast foods hence it's not important	0.794	0.653	0.848
A9	No intention to start cultivating	0.755	0.663	
A14	No or lack of motivation due to previous low yield	0.668	0.527	
	Variance explained – 15.4%			
	Interests			
A22	In my spare time, I have plenty of other interests	0.758	0.783	
A20	I prefer to grow flowers and ornamental plants	0.753	0.682	0.750
	Variance explained – 10.9%			
	Total variance explained by four factors – 68.3%			

Unrealized Benefits (*F1*): The first factor extracted was labeled Unrealized Benefits. The seven statements in this factor accounted for 22.6% of the total variance. The items loaded on this factor essentially represent two aspects: benefits, which are not well perceived, and constraints, which are discovered to be prevalent in UA practice. Constraints refer to issues with space availability. In their study, (Sanyé-Mengual et al., 2020) found similar results: realization of benefits by three different societal groups (stakeholders, project leaders, and general public) in an urban area. Moreover, another study revealed space-related issues among the urban general public (Ngahdiman et al., 2017).

Knowledge and Experience (*F2*): The second extracted factor, with six variables, explained 19.4% of the total variance. This factor also represents two aspects: a direct relationship with lack of knowledge and an experience-related aspect. The requirement for novel technology in a city environment emphasizes the significance of education and outreach efforts. The ease of farming depends on experience according to Ngahdiman and his colleagues (Ngahdiman et al., 2017).

Attitudes (*F3*): Five variables were composed to make the fourth factor, labeled Attitudes, explained 15.4% of the total variance. The responses indicate that the respondents did not support the negative attitudes that are associated with this structure. Shamsudin et al., (2014) in their study derived held and assigned values, which are associated with attitudes and beliefs. This finding is in line with ours with two factors: F1 and F3. A similar study has been conducted in Malaysia (factor analysis and a 6-point Likert scale) for roof top farming and found that benefits, environmental awareness and consciousness, attitudes, and perception matter in urban agriculture (Then & Hong, 2022).

Interests (*F4*): The final extracted factor consisted of only two statements and contributed 10.9% of the total variance. Some respondents, despite having other interests, can be drawn to UA, as evidenced by the items.

According to the conceptual framework, non-growers' perception of UA was affected by assigned and held values, knowledge, experience, and attitudes. As expected, they expressed agreement or disagreement based on the context.

Patterns and mean values within latent factors

The statements/items were found to possess a distinct pattern as to which the latent factors belong to. Thus, these statements as a combined statement represent a better understanding of the nature of the perception and are discussed below within the latent factors. The estimation is similar for combining the same pattern statements into an aggregation (a type of combined statement) to determine whether the overall context of the pattern is towards agreeing (score 3 + score 4) or disagreeing (score 1 + score 2). The mean values of statements belonging to a specific latent factor were screened to determine which statements have mean values smaller than three or greater than three (Table 3). Once similarly scored statements were identified, the raw data in the database were revisited, and the statements' counts (the number of 1s, 2s, 3s, and 4s) were aggregated into two components: agreeing (score 3 + score 4) and disagreeing (score 1 + score 2). The combined statement now had two values for the agreeing and disagreeing scores. The percentage value was then estimated to reflect the combined statement weights towards the agreeing or disagreeing scales. Later, a combined mean value was estimated for the combined statement.

Unrealized Benefits (*F1*): Using unweighted factor scores averaged across the entire sample, variable behavior, and mean values can be easily captured. Two distinct patterns were observed. In the first pattern, five variables (A7, A8, A11, A15, and A16) received 54% towards the agreeing score, with a mean value of 2.65. The underlying reason is that urban residents who do not already engage in UA do not believe it provides a wide range of benefits. This is a strong point that can be used to promote UA in future programs in the Colombo district, letting people who do not grow crops know what other benefits they can get from it. In the second pattern, A23 and A24 covered space-associated issues, hence the constraints. The score was towards the agreeing rating (72%), with a mean of 3.17. People in cities who have problems with land availability can learn about zero-land cultivation, vertical agriculture, or rooftop agriculture, which gives them a chance to try it out and learn by doing. The primary reason for benefits not being realized is that they

have not been conveyed with the potential benefits versus the costs. Secondly, there are myths about the practice: space requirements, costs, time involvement, and low production.

Experience and Knowledge (*F2*): The variables showed two patterns. The first scenario had three variables A4, A6 and A25. All three statements had an aggregated mean of 3.12 with 86% in favor of agreement. The second scenario had three statements (A1, A2 and A3), all related to the idea that everything should be started from the beginning to perform properly in an urban environment. The variables had an aggregated mean score of 2.81 with 54% in favor of agreeing (agree/strongly agree).

Attitudes (*F3*): All five phrases represented certain negations towards UA. The statement's aggregate mean was less than 2.0, with 66% disagreeing and 24% strongly disagreeing. The respondents did not cultivate due to negative attitudes towards UA. Therefore, the potential exists for motivation to explore their attitudes to promote agriculture.

Interests (*F4*): Variable A22 was scored on the agreeing side by approximately 60%, and variable A20 at around 70%. These two items possessed a mean of 2.92. Approximately 70% stated that they would prefer to engage in some type of cultivation that might potentially be used for future promotion of UA.

Factors influencing future practice

Using a binary logistic regression model, we estimated the likelihood of non-growers practicing UA in the future. The results of the estimates are reported in Table 5. The model was statistically significant with an χ^2 statistic of 45.58, as opposed to a critical value of 14.07 with 7 degrees of freedom ($\alpha = 0.05$). Having a *p*-value generated (0.000) that was smaller than the considered level of α (0.05) further confirmed that the null hypothesis can be rejected ($\beta's = 0$) and the model can be considered to be statistically significant at a 0.05 α level. The goodness of the model fit is further indicated by the pseudo-R^2 value of 0.166.

Concerning the dependent variable, the majority of respondents (75%) expressed agreement that they would participate in UA in the future, while only a quarter (25%) did not. In addition to the four latent factors derived from the EFA, there were six factors available to include as explanatory variables in the logistic regression model: gender, age, education, profession, income, and house type. Following a trial-and-error procedure, the model deemed to have the most reasonable explanatory variables was retained and included here as the best. Single or multiple inclusions of the variables gender, income, and education were either not significant among the tested models or their inclusion resulted in a lower model fit, resulting in their exclusion from the final model. Furthermore, despite their insignificance, the factors F3 and F4 were retained to preserve the model fit statistics. The factors Unrealized Benefits and Knowledge and Experience were discovered to be two significant latent factors in the best-fit model. The external variables profession, age, and house type were found to be significant. Younger respondents tended to be more driven by environmental activities. This is consistent with the literature; as age, household size, and education level in the study of Shamsudin et al. (2014), and as age, gender, educational level, and household size in the study of Ngahdiman et al. (2017). However, the type of external factors is strongly related to country context. Factor 1, Unrealized Benefits, had a negative coefficient. In the scenarios where unrealized benefits were high (towards agreeing), the score was high. This factor increased as the respondents agreed more, because we used ratings of 3 for agreeing and 4 for strongly agreeing. As the unrealized benefits increased, the score increased, and the probability of practicing in the future decreased. In contrast, the coefficient for factor 2 was positive. Thus, the greater the score of the factor, the greater the chance and expected

probability of practicing UA in the future. Thus, increased knowledge and experience is expected to benefit UA practice in the future. When evaluating the perceptions of urban and peri-urban residents, Sroka (2018) found lack of agricultural knowledge and awareness in practicing UA. Non-food growers are receptive to backyard food growing according to Zahina-Ramos (2013), who investigated perceptions of backyard food gardening in South Florida but reported lack of knowledge as one of the major barriers.

Table 5. Binary logistic regression estimation

Variables	**Coefficient**	**Std. Err.**	**z**	**P>z**	**[95% CI]**		**Odds Ratio**
F1 (Unrealized benefits)	-0.548	0.178	-3.090	0.002 ***	-0.896	-0.200	0.178
F2 (Knowledge & experience)	0.301	0.173	1.740	0.082 *	-0.038	0.641	0.173
F3 (Attitude)	-0.006	0.170	-0.040	0.971	-0.339	0.327	0.170
F4 (Interest)	-0.242	0.174	-1.390	0.164	-0.583	0.099	0.174
House type	0.806	0.384	2.100	0.036 **	0.054	1.558	0.384
Profession	1.256	0.340	3.690	0.000 ***	0.590	1.922	0.340
Age	-0.709	0.349	-2.030	0.042 **	-1.393	-0.025	0.349
Constant	-1.978	0.391	-5.060	0.000 ***	-2.743	-1.212	0.391

LR $chi^2(7)$ = 45.58
Prob. > chi^2 = 0.000
Log likelihood = -114.42
Pseudo R^2 = 0.166

Note: * Significant at 10%, ** 5% and ***1% level
Std. Err. = standard error; Prob. = probability

Considering the house type, the single houseowners had a 69% chance and an expected probability of practicing UA in the future. Single homeowners can easily be attracted because they have a better layout for planting than attached and flat house structures. In terms of profession, the private sector workers had a 77% chance and an expected probability of practicing UA in the future. The attraction of private sector workers is because their sedentary lifestyles necessitate some sort of relaxing activity; growing edibles could relieve their stress. The negative coefficient value for age means that the odds ratio is smaller than 1, i.e., the odds of the test group (<40) were lower than the odds of the reference group (≥40). The older age group (≥40) had 51% lower odds of practicing UA in future than the younger group. The younger generation is more interested in the indirect benefits of urban agriculture and with increased awareness, demonstrations, and hands-on experience, they will be easily enticed. Younger respondents were the group most motivated by environmental activities of UA as in Shamsudin's study as well. According to McClintock (2013), younger respondents are motivated by environmental concerns in relation to UA, which is consistent with our study findings. Thus, the significant variables depicting age, house type, and profession of non-growers in an urban setting can be used in planning future UA programs in Colombo district.

Some similarities were found with previous studies, but the people who took part in these were the general public in urban areas. In the study of Ngahdiman et al. (2017), four factors were generated by EFA: ease in practicing UA; positives towards UA; role model (encouragement); and societal environment (peer influence). The four factors were incorporated into a binary logistic model (Y = intention to practice UA) with socio-demographic data. Groups with higher education, females, increased household size, and older generations were found to be more likely

to take part in UA, while latent factors also had an influence. Furthermore, Shamsudin et al. (2014) used a six-factor EFA model followed by multiple regression to explain public attitudes toward UA. Age, household size, and education were found to be the significant explanatory variables in their regression model with the dependent variable of households' attitudes toward UA. However, in our study, the profession, age, and house type were only evident with matters in UA, which was the sole study context base. The most comparable finding was that the latent factors generated by EFA had an effect on the UA determinants.

Conclusion

This study examined the perceptions of non-growers on urban agriculture. Latent perspectives on urban agriculture were identified by exploratory factor analysis. Four latent factors explained 68.36% of the variance. Unrealized Benefits and Knowledge and Experience were recognized as the two factors most influencing the future practice of urban agriculture among the four. The urban population segments that can be targeted are the younger generation, private sector workers, and single house owners. Urban planners can take steps to support urban agriculture by examining possible segments. The findings from this study show that underperformance is linked to specific problems in the urban setting of Colombo. The strategies must focus on the issues of not realizing benefits or overcoming knowledge and experience challenges. Vertical farming and its economic and social advantages can be better conveyed through awareness program. As a result, non-growers are more likely to be encouraged to try UA because barriers such as land, costs, space, low output, and time are no longer seen as impediments. In addition, the study found that urban farming demonstrations inspire non-growers. Respondents' attitudes toward urban agriculture are not necessarily negative and thus encouragement will lead to more involvement in the future. Non-growers' features and interests can be taken as positives towards promoting urban agriculture. Orienting non-growers towards UA will support Colombo's sustainable development.

The study had some limitations, such as not taking into account the negative effects of UA; however, some case studies have proven that the benefits outweigh the potential costs and threats (Specht et. al. 2013). Future studies, particularly from the perspective of growers, can be conducted with consideration of the negative impact, i.e., the intensive use of fertilizers and pesticides, which may pose health risks. Expanding the study's scope to include growers, government officials, and policy planners is a feasible and worthwhile goal that should be pursued. The policy directives will be strengthened as a result of the overall representation. Furthermore, the application of extraction techniques other than principal component analysis will allow for the verification of the accuracy and precision of the outcome.

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