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ORIGINAL ARTICLE

Food diversity and environmental aspects of home and community gardens in highly urbanized areas of Sao Paulo megacity

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Abstract

Urban agriculture (UA) has been shown to provide several benefits to cities such as regional food production, increased biodiversity, and income generation, especially in peri-urban areas. However, little is known about the impacts of UA within the urban sprawl of megacities in the Global South, which have different social and territorial configurations than cities in the Global North. This report aimed to characterize spaces, types and quantities of cultivated plants, cultivation practices, economic impacts, and socio-environmental benefits of home and community gardens in the dense central areas of Sao Paulo megacity, with more than 11 million inhabitants and few planting spaces. An online survey applied to 143 gardeners in 2023 revealed that although having limited spaces (up to 10m^2), 172 different food plants were cultivated, predominantly herbs, nonconventional food plants, and leafy vegetables. Sixty-seven percent of the gardeners had in each meal up to 25% of the food consumed were garden products but most of them were not able to estimate the associated savings in weekly purchases. The gardens also attracted insects and animals, which were perceived positively by most people. Twenty-two (16%) gardeners maintained beehives in domestic or community gardens, and more than 70% of the gardeners reported the practice of composting. While limited in scale, urban

Abbreviation: UA, urban agriculture.

gardens in central and highly urbanized areas of Sao Paulo demonstrated potential to improve access to fresh food, enhance biodiversity, and promote sustainable practices. Our data helped to characterize the typology of UA from a megacity perspective for conditions prevailing in the Global South.

Plain Language Summary

Urban agriculture promotes agroecological practices, enhances biodiversity, combats food insecurity, and improves socio-environmental conditions. This report aimed to characterize spaces and cultivation practices, economic impacts, and socio-environmental benefits of home and community gardens. A questionnaire was applied to gardeners, and data on demographics, types and quantities of cultivated plants, and associated impacts were collected. Results showed that although they have limited spaces (up to 10 m^2), 172 different food plants were cultivated, predominantly herbs, nonconventional food plants, and leafy vegetables. Sixty-seven percent affirmed that in each meal up to 25% of the food consumed contained garden products but most of them were not able to estimate the associated savings in weekly purchases. While limited in scale, urban gardens in central and highly urbanized areas demonstrate significant potential to improve access to fresh food and promote sustainable practices.

1 | INTRODUCTION

Urban agriculture (UA) has been advocated as a valuable approach to combat food insecurity in cities (Koscica, 2014) by promoting access to biodiverse and fresh food, stimulating agroecological practices (Nagib & Nakamura, 2017), and supporting subsistence of urban farmers (Monzini & Orsini, 2025). Indirect benefits of UA include increased plant and insect biodiversity, decrease in heat islands, improved management of organic residues, and increased social cohesion (Galhena et al., 2013; Korpelainen, 2023; Payen et al., 2022).

The production of food in cities can take place in several locations and scales, varying from plots in peri-urban areas or near the fringe of the city, in green areas within the urban sprawl, indoors, in façades, or on roof tops (Giacchè et al., 2020; Thornton, 2020). The production methods also vary considerably, making it generally difficult to compare the yields. In peri-urban areas, especially in low- and medium-income countries, UA may contribute to increased food diversity and decrease in food insecurity (Adedayo, 2014; Gray et al., 2014; Marshall et al., 2009). UA can have the same yields as conventional agriculture (Payen et al., 2022) for certain crops, and may be important for subsistence, especially in low- or middle-income groups, where informal UA may prevail (Swanepoel et al., 2021).

However, in highly urbanized cities such as Sao Paulo, with 11.452 million inhabitants, lack of space within the dense urban sprawl limits food production that will happen mostly in peri-urban areas. Sao Paulo city has 788 commercial agricultural production units in an area of 4.58 hab/ha (where hab/ha is the inhabitants per hectare), mostly located in the less dense southern part of the city (Biazoti et al., 2021), the rural area of the city (Prefeitura do Município de Sao Paulo, 2021). In the past 15 years, however, several small community gardens have popped up in the most urbanized parts of the city due to an increased interest in home food production (Nagib & Nakamura, 2020). In the Sao Paulo regularly updated municipality platform of UA, the Sampa+Rural platform, 204 community urban gardens were registered and mapped (Sampa+Rural, 2024). Especially within the city urban mesh, the primary focus of these gardens is socio-environmental education being an expression of environmental activism through agroecological practices (Nagib, 2020), rather than subsistence or commercial production.

Home gardening, both in rural and urban areas, has been shown to enhance household food security, well-being and plant diversity, especially in low- or middle-income groups (Korpelainen, 2023). In densely urbanized areas of megacities like Sao Paulo central areas, housing space limits the presence of larger home gardens as occurring in rural or smaller cities. Previous studies, mostly conducted in wealthy countries, smaller cities, or peri-urban areas, have aimed to quantify how community and home gardens contributed to meals, food diversity, better socio-environmental practices, and possible economic impacts to the gardeners (Adedayo, 2014; Dorr et al., 2023; Mathewos et al., 2018; Music et al., 2023; Tharrey et al., 2020). A study conducted in five countries from Europe and the United States has shown that although yields in UA varied significantly, production was smaller in leisure-oriented individual gardens than farms and collective gardens (Dorr et al., 2023). Swanepoel et al. (2021) analyzed the impact of household production in the population suffering from severe food insecurity living in informal settlements in Johannesburg, South Africa. Authors could not find a significant impact on food security, although gardeners benefited from dietary diversity.

Our hypothesis was that UA within the center of Sao Paulo would have limited contribution to food production but would bring other benefits such as plant diversity to meals and other socioenvironmental services. Therefore, the objective of this study was, by means of a survey among urban gardeners, to characterize their production, types of cultivation, uses, and economic impacts, as well as the socio-environmental benefits derived from their practice.

Core Ideas

- Urban agriculture promotes agroecological practices.
- Urban gardens in central and highly urbanized areas improve access to fresh food.
- Characteristics of urban gardeners, such as production, types of cultivation, uses, and economic impacts.

2 | MATERIALS AND METHODS

2.1 | Study site and population

The survey was conducted in the municipality of Sao Paulo, Brazil, with an estimated population of 11,452,000 inhabitants, an area of 1521 km^2, and a demographic density of 7528 inhabitants/km^2 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2022).

A questionnaire developed by the authors was applied online via a free-access Google Forms (https://docs.google.com/forms/d/1oaeCJRIra_uCNxtw3GV8C6OfoI3_gOSihAutDCEM_Tc/edit). An internal validation of the questionnaire was performed by all co-authors, providing adjustments when necessary. The questionnaire was publicized and distributed on social media (Facebook and Instagram) and via WhatsApp to community garden groups and urban gardeners, whose participation was voluntary and could be forwarded to other possible urban gardeners who joined the participants' personal contact network.

Among the criteria for participation in the study, individuals were required to live in Sao Paulo city and practice some form of home gardening (even if only in pots or in other suspended structures) and/or participate in one or more community gardens in the city of Sao Paulo. In Sao Paulo city center, community gardens were formed as collective occupations, without the division into individual allotments, as it occurs in several cities (Amato-Lourenço et al., 2021).

The questionnaire was available to response from April to August 2023. The responses refer to situations covering the previous 12 months, that is, the interval between the years 2022 and 2023. The data were then reported as numbers and percentages. The analysis was performed by Microsoft Excel, version 2412 Build 16.0.18324.20092.

2.2 | Questionnaire topics

Participants were asked to inform the place of residence and/or the community garden they were volunteers. Demographic data included age, sex, and occupation. Participants gave their written consent to use the collected data for strict academic purposes.

The topics were selected to answer main questions such as available spaces, type and quantity of plants produced, potential contribution to meals, economic savings, and indirect environmental benefits. A description of each question is given next.

2.2.1 | Type of residence and garden details

Information was collected on gardener age, gender, and occupation; on the location (urban or rural area); on the type of residence (house or flat); on plant swapping (shared or received); and on the number of cultivated plants. The survey also gathered data on the garden structure (directly on the ground, in suspended structures, hydroponics, or aeroponics), area, and harvest destination (self-consumption, sharing, commercialization, and exchange) in home and community gardens.

2.2.2 | Most frequently cultivated and consumed plants

The survey inquired about the most frequently cultivated and consumed plants in the last period 2022–2023, at home or in the community gardens, when applicable. Plants were classified as herbs, nonconventional food plants, leafy vegetables, fruits, medicinal plants, vegetables, tubers, and legumes (pulses). Other questions referred to types and number of plants harvested per day (herbs) or per week. Gardeners were also asked to list the five most consumed nonconventional food plants in their meals.

Nonconventional food plants encompass cultivated and wild species, native or exotic, spontaneous or not, which can be safely used as food, including the nonconventional parts of conventional edible plants but that are not widely commercially available. These species include wild edible plants, edible weeds, neglected and underutilized species, and traditional varieties (Padulosi et al., 2013; Ranieri et al., 2024).

2.2.3 | Technical support and economic impact

Participants were asked whether they received any kind of technical or financial support or assistance for their home or community gardens.

Home or community gardeners were queried about the amount of money saved per month due to their garden production and the reduction in weekly grocery purchases attributable to garden-grown products. Participants were also asked whether the harvested products were intended for self-consumption, sharing, or commercial purposes. These questions were aimed at quantifying the financial benefits and contribution of home or community gardens to household food security.

2.2.4 | Environmental impacts

Cultivation principles, methods used for pest control, and type of fertilizer used were assessed. Gardeners were also asked to report whether they had beehives and whether increased numbers of insects or other animals were found in the home/community garden environment, including a positive/negative perception on the situation. A question related to the practice of composting was also applied.

3 | RESULTS

Of the 161 people who responded to the survey, 143 were eligible for the study, as 18 people were excluded because they answered twice or did not live in Sao Paulo City. There were 41 (29%) men and 101 (71%) women, and the age range was 20–77 years old (one respondent did not identify the gender). The map in Figure 1 shows the spatial distribution of the participants' home addresses and of the community gardens in Sao Paulo city. 97% of the respondents lived in the urban area of the city, and 68% reported living in a house; see Table 1. They mostly lived or participated in a community garden in the western part of the city, which has a high demographic density of 84.7 hab/ha in 2022 (Prefeitura do Munícipio de Sao Paulo, 2022) (Table 1).

TABLE 1 Demographics, occupation, type of home, part of the city, and number of cultivated food plants of the interviewed gardeners.

Variable	*n*
Age (year), median (min–max)	41 (20–77)
Woman, *n* (%)	101 (71%)
Occupation (*n* = 92)	
Teacher	10 (11%)
Architect	6 (6%)
Dietitian	4 (4%)
Physician	4 (4%)
Student	4 (4%)
Gardener	4 (4%)
Freelancer	4 (4%)
Biologist	4 (4%)
Retired	4 (4%)
Other	48 (52%)
Part of the city (*n* = 143)	
Urban area	139 (97%)
Rural area	4 (3%)
Live in (*n* = 142)	
House	97 (68%)
Flat	45 (32%)
Plant swapping	
Shared	41 (28%)
Received	32 (22%)
Number of cultivated plants	
Up to 5	76 (54.3%)
Up to 10	39 (27.8%)
Above 10	25 (17.9%)

Note that 130 reported to have a domestic garden and 64 participated in community gardens, with 51 respondents in both. Domestic gardens were mostly sized up to 10 m^2 (73%), whereas the areas of the community gardens varied from up to 100 and 500 m^2 in 75% of the gardens (Table 2).

People that reported having a home garden planted mostly in suspended structures (54%) for self-consumption (68%), whereas in community gardens, 68% of the cultivation was directly on the ground and for self-consumption, but also for sharing (Table 2).

When respondents were asked to list up to five edible plants cultivated during the last 12 months or the most consumed edible plant coming from the domestic or community gardens, 172 different types of food plants were cited, comprising, in decreasing order of citation frequency, herbs, nonconventional food plants, leafy vegetables, medicinal plants, non-leafy vegetables, tubercles, and legumes (pulses), as shown in Table 3. Nonconventional food plants, fruit, and

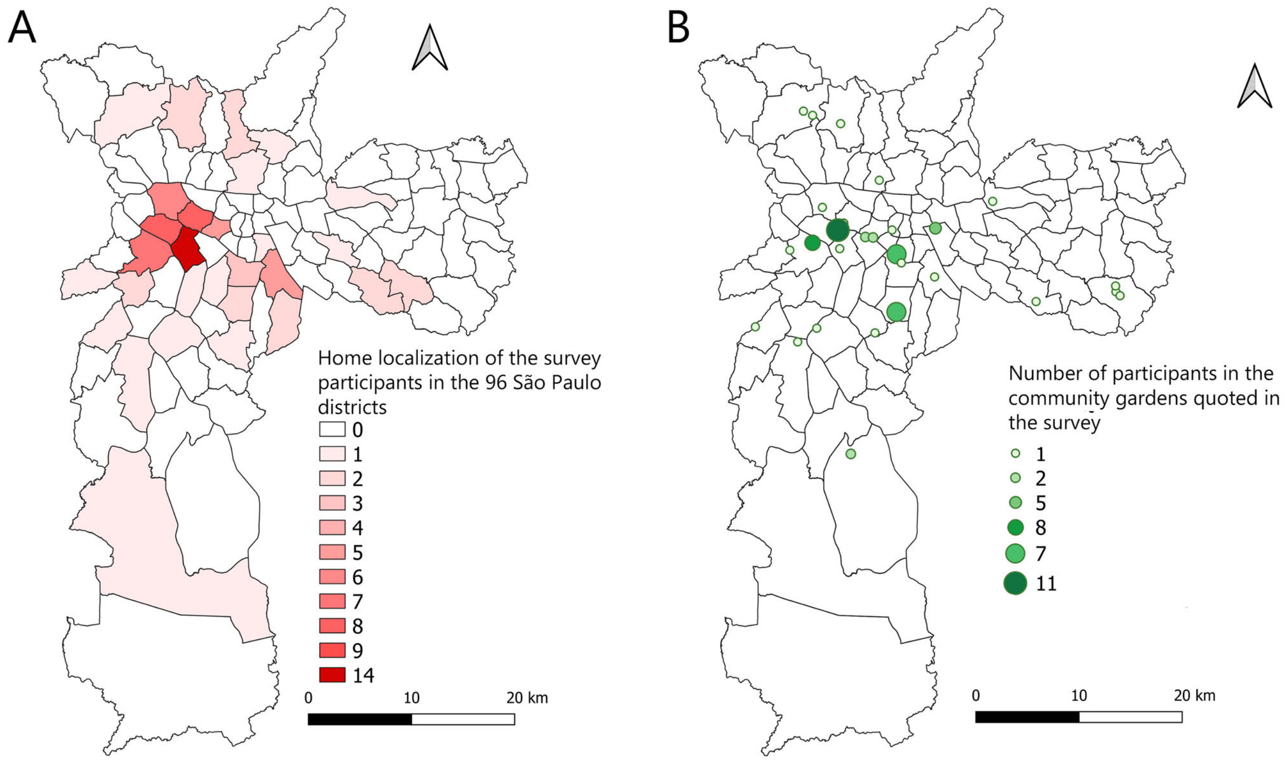

FIGURE 1 Home localization of respondents within São Paulo districts (A) and number of participants in the different community gardens quoted in the survey (B). There was a preponderance of respondents living and participating in urban gardens in the highly urbanized western part of the city. The districts are the smallest administrative boundaries of the city.

TABLE 2 Structure, type of harvest, and garden area of domestic and community gardens.

Home garden structure	**Domestic (n = 130)**	**Community (n = 64)**
Directly on the ground	26 (20%)	44 (68.7%)
Suspended structures	70 (53.8%)	4 (6.2%)
Both on the ground and on suspended structures	25 (19.2%)	12 (18.7%)
Hydroponics, aeroponics, other	9 (6.9%)	4 (6.2%)
Garden area	**(n = 128)**	**(n = 64)**
Up to 10 m^2	91 (73.3%)	–
Between 10 and 30 m^2	20 (16.1%)	–
Between 10 and 50 m^2	5 (4%)	–
Above 50 m^2	8 (6.4%)	–
Up to 100 m^2	–	24 (37.5%)
Between 100 and 500 m^2	–	24 (37.5%)
Between 500 and 1000 m^2	–	12 (18.7%)
Above 1000 m^2	–	4 (6.2%)
Harvest destinated to	**(n = 128)**	**(n = 62)**
Self-consumption	87 (67.9%)	23 (37.1%)
Sharing and commercialization		2 (3.2%)
Self-consumption and commercialization	3 (2.3%)	2 (3.2%)
Self-consumption and sharing	34 (26.5%)	30 (48.3%)
Self-consumption and exchange	4 (3.1%)	5 (8%)

TABLE 3 Number and frequency of food plants most cultivated and consumed in 2022–2023 by gardeners.

Types	Cultivated (n = 837)	Consumed (n = 510)	Food plants (n = 172)
Herbs	339 (40.5%)	236 (46.7%)	32 (18.6%)
Nonconventional food plants	129 (15.4%)	87 (17%)	36 (20.9%)
Leafy vegetables	89 (10.6%)	64 (12.5%)	13 (7.5%)
Fruits	89 (10.6%)	31 (6%)	33 (19.1%)
Medicinal plants	83 (9.9%)	33 (6.4%)	29 (16.8%)
Vegetables	67 (8%)	42 (8.2%)	15 (8.7%)
Tubercles	35 (4.1%)	16 (3.1%)	8 (4.6%)
Legumes (pulses)	4 (0.4%)	1 (0.2%)	4 (2.3%)
Others	2 (0.2%)	–	2 (1.1%)

TABLE 4 Frequency of food plants most cultivated and consumed in 2022–2023.

Herbs (n = 575)		Nonconventional food plants (n = 208)		Leafy vegetables (n = 153)		Fruits (n = 120)	
Basil	110 (19.1%)	Pereskia	60 (28.8%)	Lettuce	43 (28.1%)	Strawberry	16 (13.3%)
Chives	76 (13.2%)	Lamb's ear	20 (9.6%)	Collard green	42 (27.4%)	Banana	12 (10%)
Mint	65 (11.3%)	Tannia	18 (8.6%)	Arugula	23 (15%)	Lemon	12 (10%)
Parsley	63 (10.9%)	Nasturtium	14 (6.7%)	Chicoria	12 (7.8%)	Passion fruit	11 (9.1%)
Rosemary	54 (9.3%)	Roselle	14 (6.7%)	Spinach	8 (5.2%)	Papaya	9 (7.5%)
Coriander	29 (5.0%)	Sorrel	8 (3.8%)	Cabbage	5 (3.2%)	Jabuticaba	7 (5.8%)
Oregano	26 (4.5%)	Malabar spinach	7 (3.3%)	Purple endive	5 (3.2%)	Avocado	6 (5%)
Thyme	23 (4%)	Black sage	7 (3.3%)	Endive	5 (3.2%)	Blackberry	5 (4.1%)
Other	129 (22.4%)	Other	74 (35.5%)	Other	10 (6.5%)	Other	42 (35%)
Medicinal plants (n = 116)		**Vegetables (n = 109)**		**Tubercles (n = 51)**		**Legumes (pulses) (n = 5)**	
Lemon balm/Melissa	35 (30.2%)	Tomato	36 (33%)	Sweet potato	17 (33.3%)	Fava	2 (40%)
Woolly plectranthus	17 (14.7%)	Pumpkin	14 (12.8%)	Beet	14 (27.4%)	Lablab beans	1 (20%)
Lemon grass	15 (12.9%)	Chayote	14 (12.8%)	Taro	6 (11.7%)	Sunflower	1 (20%)
Aloe vera	12 (10.3%)	Cherry tomato	9 (8.2%)	Cassava	4 (7.8%)	Bean	1 (20%)
Lavender	8 (6.9%)	Carrot	8 (7.3%)	Arrowroot	3 (5.8%)		
Guaco	5 (4.3%)	Radish	7 (6.4%)	Yam	3 (5.8%)		
Lemon verbena	3 (2.6%)	Corn	5 (4.5%)	Mangarito	2 (3.9%)		
Rue	2 (1.7)	Pepper	4 (3.6%)	Potato	2 (3.9%)		
Other	19 (16.4%)	Other	12 (11%)				

herbs were the plants cultivated with more diversity (Table 3). The eight most frequent plants of each type cited by the respondents are shown in Table 4.

Herbs such as basil, chives, and mint were the most frequently cultivated and consumed plants. Only 5% of the interviewed gardeners did not obtain any herbs from the garden on a daily basis, and 61% reported collecting one to three varieties of herbs from the garden everyday. Almost 78% of the respondents consumed one to three portions of herbs everyday (Table 5).

Surprisingly, the second most frequently cultivated type was the nonconventional food plants, which are increasingly popular in Brazilian urban centers (Figure 2). Seventy-five types of them were cited in the interviews, and more than 50% of the respondents cultivated one to three types of these plants.

As also shown in Table 5, more than 50% of the respondents cultivated one to three types of leafy vegetables, and almost 75% consumed these vegetables in the week before the questionnaire was applied, varying from one to more than 10 leaves per week. Lettuce, collard greens, and arugula were the most consumed and cultivated leafy vegetables by the respondents, as shown in Table 4. Fruits, medicinal plants, vegetables, tubercles, and legumes (pulses) were less frequently harvested weekly by the urban gardeners when compared to herbs, nonconventional food plants, and vegetables (Table 4).

Plant swapping occurred among gardeners, and 28% reported that they frequently shared seedlings, whereas 22% mostly received seedlings (Table 1). Fourteen percent of the respondents reported receiving some sort of financial support,

TABLE 5 Types, portions or quantities (units) consumed by gardeners per day or week of herbs, nonconventional food plant, leafy vegetable, vegetable, and fruits.

Unit	Herbs (day)		Nonconventional food plants (week)	Leafy vegetable (week)		Vegetable (week)		Fruit (week)	
	Types ($n = 135$)	Portions ($n = 121$)	Types ($n = 136$)	Types ($n = 135$)	Quantities ($n = 98$)	Types ($n = 131$)	Quantities ($n = 76$)	Types ($n = 111$)	Quantities ($n = 56$)
1–3	83 (61.4%)	94 (77.6%)	75 (55.1%)	75 (55.5%)	–	70 (53.4%)	50 (65.7%)	48 (43.2%)	31 (55.3%)
4–6	27 (20%)	20 (16.5%)	23 (16.9%)	18 (13.3%)	34 (34.6%)	8 (6.1%)	11 (14.4%)	8 (7.2%)	12 (21.4%)
7–9	16 (11.8%)	6 (4.9%)	13 (9.5%)	11 (8.1%)	28 (28.5%)	5 (3.8%)	12 (15.7%)	2 (1.8%)	6 (10.7%)
Above 10	2 (1.4%)	1 (0.8%)	2 (1.4%)	–	36 (36.7%)	1 (0.7%)	2 (2.6%)	–	7 (12.5%)
Do not cultivate	7 (5.1%)	–	23 (16.9%)	31 (22.9%)	–	47 (35.8%)	–	53 (47.7%)	–

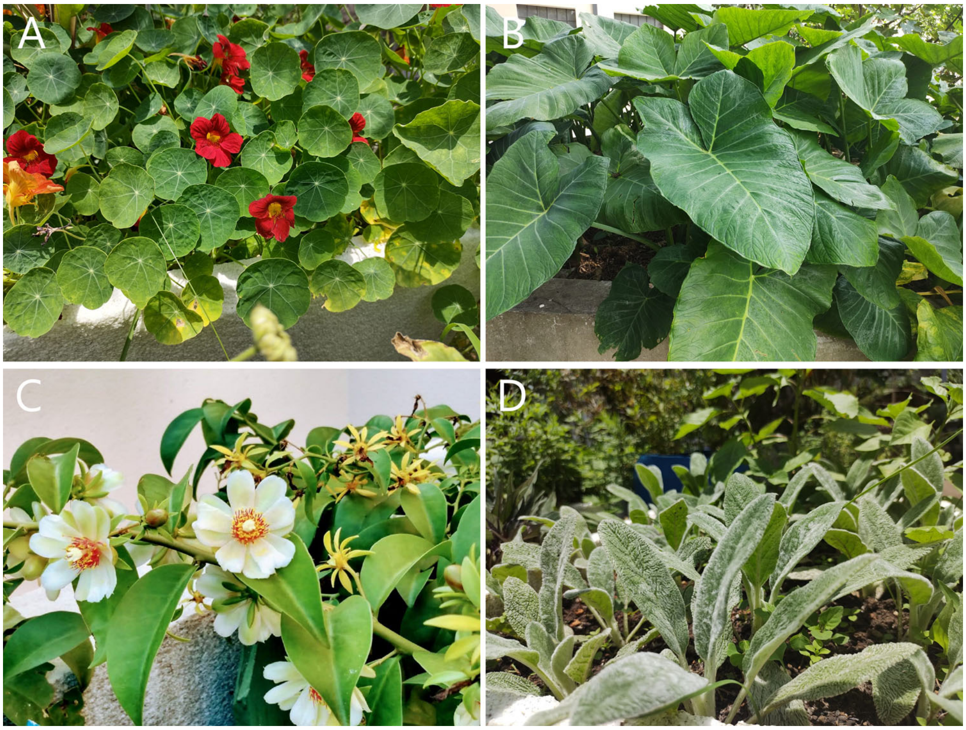

FIGURE 2 Examples of the most consumed nonconventional food plants by the respondents. (A) *Nasturtium*, (B) Tannia (*taioba*), (C) *Pereskia*, and (D) Lamb's ear.

TABLE 6 Percentage of gardeners that receive any kind of technical support, presence of bee box, composting and insects/animals in the gardens.

Variable	Yes	No
Receive technical support	21 (14%)	122 (86%)
Have a bee box	22 (16%)	114 (84%)
Composting	97 (71%)	39 (29%)
More insects in the garden	75 (60%)	50 (40%)
Other animals in the garden	48 (41%)	70 (59%)

technical assistance, or supplies for the community gardens (Table 6). Commercialization of garden products was limited to two respondents, with the majority of gardeners sharing with family members, neighbors, friends, or charitable organizations.

When asked about the cultivation principles adopted in their garden, 100% of the 142 respondents said they adopted agroecological/organic or permacultural principles. Only one respondent (1/117 answers) said to use synthetic pesticides to control pests in the garden. When asked about the type of fertilizer used, only 11% used chemical fertilizer not approved for organic cultivation. Most of the respondents (89%) used compost, manure, bokashi, or certified mineral fertilizers for organic production.

Twenty-two (16%) respondents maintained beehives in domestic or community gardens, and more than 70% of the

TABLE 7 Economic impacts of home gardening on Brazil's minimum wage (R$1212.00 in 2022).

Variable	%
Percentage of the meal containing home or community products (*n* = 135)	
Up to 25%	91 (67%)
Up to 50%	9 (7%)
Not able to estimate	35 (25%)
Percentage of the minimum wage saved per month (*n* = 132)	
About 3%	30 (22%)
Between 3% and 15%	33 (25%)
More than 15%	4 (3%)
No savings	4 (3%)
Not able to estimate	61 (46%)
Amount reduced in weekly purchases (*n* = 129)	
Up to 25%	36 (27%)
25%–50%	7 (5%)
No savings	7 (5%)
Not able to estimate	79 (61%)

respondents reported the practice of composting (Table 6). Seventy-five respondents thought that their gardens attract more insects, and 55% of them considered it in a positive manner. Flies, ants, mosquitos, and caterpillars were among the animals considered as nuisances. Forty-eight respondents considered that their gardens attracted more animals, 58% of the total considering it desirable. Birds, lizards, snails, bees, spiders, bats, rats, and butterflies were the most frequently cited animals.

Note that 67% of the respondents affirmed that in each meal 10%–25% of the food consumed contained garden products, but a larger proportion were not able to estimate the associated savings in weekly purchases. Nevertheless, 25% of the respondents answered that they saved weekly between 3% and 15% of the minimum wage with their garden products (Table 7).

4 | DISCUSSION

In this survey, we were interested in assessing the cultivation, production, uses, and ambient benefits of urban, household, and community gardens within the urban mesh in the central areas of Sao Paulo megacity, where free space to plant is scarce. Our survey showed that urban gardeners lived in houses, mostly in the western part of the city, and were predominantly women. Household gardens were small, up to 10 m^2 in most cases, whereas cultivation in community gardens occurred in areas ranging from 100 to 500 m^2 mainly using agroecological practices. Despite the small gardening areas, a diversity of 172 plants was reported to be cultivated, with herbs, nonconventional food plants, and leafy vegetables being the most common. Because of this, gardens had limited contribution to meals but were associated with a small decrease in weekly purchases in 32% of the people. Gardening stimulated other environmentally positive practices such as composting in 71% of the respondents and bee raising in 16% of them. Taken together, home and community gardens within the dense urban areas contribute to increasing access to fresh food in limited forms, preserve plant diversity, and also add ecosystemic services to improve living conditions.

Our survey showed that urban gardening in large urban centers has limited capacity in increasing food production due to its small scale. Most studies analyzing UA yields in cities have been conducted in the Global North or in deprived areas in Africa, being difficult to compare to our study conditions. The majority of available studies, including ours, showed the importance of gardening to maintain local biodiversity and increase social bonds around food (Dorr et al., 2023; Music et al., 2023). There are few reports that specifically aimed to quantify the different impacts of UA within the urban mesh, especially in low- and medium-income countries. In South Africa, household production in urban gardens did not significantly impact food security, although it did increase dietary diversity in the participants.

Herbs and spices were the most cultivated and consumed plants by urban gardeners, most likely because herbs occupy little space and are easy to thrive. Since herbs can be used daily even in small quantities, they provide access to fresh spices in place of ultra-processed condiments, helping to decrease the amount of salt in meals and valuing regional food culture. Basil, chives, and parsley were the most frequently consumed herbs, being also the most common seasoning in Brazilian meals. Basil is a melliferous plant and improves bee pollen, bringing a benefit to biodiversity in cities (Chwil, 2012; Malberbo-Souza et al., 2020). In addition to their culinary uses, the herbs melissa and bushy lippia were the most frequent herbs used as medicinal plants in this survey. Bushy lippia, a native South American shrub, and melissa, native to the Mediterranean and Asiatic regions, have several medicinal properties and are widely used in Brazil, mostly as infusion (Camillo, 2017; Lorenzi & Matos, 2021).

The second most cultivated and consumed plants were nonconventional food plants, defined as edible vegetables that are uncommon, infrequently used by most people, and non-widely commercially available—whether exotic, native, wild, spontaneous, traditional, or cultivated (Ranieri et al., 2024). In a report analyzing cultivated plants in 10 home gardens of Toronto, only one gardener reported cultivating exotic species (Music et al., 2023). There are some reasons to explain this unusual finding. Brazil has a large biodiversity, and in Sao Paulo, a movement toward the valorization of these often-neglected plants has been underway since some years (Rezende, 2020). Another important aspect is that these plants are frequently easier to grow, occurring sometimes spontaneously, and do not require intensive care with fertilization or watering. *Pereskia, lamb's ear, tannia* (*taioba*), and *nasturtium* were among the most cultivated and consumed. Having a home garden cultivated with nonconventional food plants increases food biodiversity and nutritional content. Wild edibles such as *pereskia* and *nasturtium* have higher nutritional content than conventional leafy vegetables (Mariutti et al., 2021; Ranieri et al., 2024). Indeed, having a home garden cultivated with nonconventional food plants was related to better nutritional values, such as iron and vitamins A and C, in the population of the Pacific Islands (Carter, 1994; Food and Agriculture Organization of the United Nations [FAO], 2021). Among the least cultivated by urban gardeners were beans, tubercles, and vegetables that require more space and special requirements of soil and luminosity.

Despite the microscale of cultivation, in 67% of the gardeners, 25% of the meals contained home or community gardens products, contributing to the increase of fresh greens not treated with pesticides, enhancing the nutritional quality of meals. The majority (61%) could not estimate the reduction in weekly purchases, but 27% estimated reductions of up to 25%. These data reveal the potential that large urban spaces could bring to increase food diversity and reduction in expenses. Indeed, a study conducted in Paris and Montreal observed that gardeners cultivating plots larger than 100 m^2 reported to have significant levels of self-procurement for fruits and vegetables (Pourias et al., 2015).

Our data reassure that UA in Sao Paulo is associated with environmental benefits. Brazil has the highest number of species of stingless bees (meliponines) recorded, with approximately 240 valid species (Nogueira, 2023). Because they are under threat in urban areas, a number of initiatives have emerged to increase social awareness to the threatened bees and even to rescue threatened beehives (the nongovernmental organization SOS Abelhas Sem Ferrão [SOS Abelhas Sem Ferrão, 2018] is representative of this trend). Gardeners in Sao Paulo seem to be responsive to this issue as beehives (meliponines) are found in 22 gardens. The observation that more than 50% of respondents perceived the attraction of insects and other animals as a positive aspect reflects the ecological role of gardens, despite the challenges posed by pests. In Sao Paulo, composting is yet an uncommon practice, with absence of public policies to domestic composting in the city, being only 0.3% of all organic residues currently composted (Polis, Composta Cultiva, 2021). The fact that in our study 70% of the gardeners composted their residues highlights the beneficial ecosystem values linked to UA. Indeed, a study conducted in Portugal has shown that after 8–10 months engaging in urban gardening, all participants were composting. This is in contrast to the beginning of the study, when 83% of the participants did not compost organic leftovers (Nova et al., 2020).

An important limitation of this study was that our survey reached predominantly the western part of the city, which may have affected the representativeness of the data. This limitation can be attributed to the absence of strategies to expand the questionnaire's reach through social media with paid advertisements. The western region of Sao Paulo, which is part of the expanded center, is the city region with an older population, with higher levels of formal education including higher education and higher per capita household income. This is also the region with the highest number of flats (37%) in the city and several (noncommercial) community gardens are present in this part of the city, as the community garden movement in Sao Paulo was initiated mainly by residents living in this area (Nagib, 2019). There were no formal validity tests for the questionnaire. As a result, the sample may not reflect the population diversity of Sao Paulo city, limiting the generalization of the results to other areas of the city. Future studies should use more effective outreach strategies to ensure a more representative sample.

5 | CONCLUSIONS

This study contributed to the understanding of the typology of UA occurring in the context of a megacity in a medium-income country. Microscale UA production in highly urbanized areas of megacities like Sao Paulo, although providing limited food production due to the small cultivation spaces, creates access to a high biodiversity of plants that complement meals with fresh herbs and vegetables and promote agroecological practices. Interestingly, a large proportion of gardeners of Sao Paulo cultivated nonconventional or traditional food plants, preserving alimentary traditions and plant diversity, which seems to be a particular feature when compared to urban gardeners in developed countries with less plant diversity (Music et al., 2023; Nagib, 2020). Such resilient microspaces, if expanded, could enhance their ecosystem services and help megacities mitigate future climate challenges.

AUTHOR CONTRIBUTIONS

Gustavo Nagib: Conceptualization; resources; writing—original draft; writing—review and editing. **Jôse Mára de Brito**: Formal analysis; writing—review and editing. **Tiana Carla Lopes Moreira**: Formal analysis; writing—review and editing. **Vitória Oliveira Pereira de Leão**: Conceptualization; methodology; writing—review and editing. **Marcelo Martins Seckler**: Formal analysis; writing—review and editing. **Valéria de Marco**: Writing—review and editing. **Thais Mauad**: Conceptualization; formal analysis; funding acquisition; methodology; project administration; supervision; writing—review and editing.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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