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Effects and productive performance of urban agriculture on collective and environmental health in the city of Rio de Janeiro, Brazil

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Abstract *Urban agriculture may help promote key indicators, such as improvement of environmental health and food security and reduction of social inequality. The present article aims to help understand the current situation of urban agriculture in the city of Rio de Janeiro by focusing on the Hortas Cariocas Program (HCP). To this end, two approaches were adopted. The first one was qualitative and based on a descriptive exploratory method that was used to survey and analyze the impacts caused by the program on the communities involved. The second one was quantitative and based on data envelopment analysis (DEA), which was used to assess and understand the program's productive performance from 2007 to 2019. The program's performance showed two peaks, one in 2012 with 80.21% and the other one in 2016 with 100.00% of the productive performance score. The behavior of the annual performance scores can be explained by the increases in the number of people who got directly involved (number of producers) and in the occupied area (number of seedbeds), as they reflect the socio-environmental character of the HCP.*

Key words *Sustainable development, Community gardens, Food security*

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Introduction

Regular and permanent access to food in quantity and quality is a fundamental right that must be ensured to all human beings. In 2015, this topic was addressed at the United Nations Conference on Sustainable Development, which aimed to propose sustainable development goals and targets by 2030. The scientific community has ever since made major efforts to develop methodologies aimed at food security and sustainable development for the world's population[1].

On the American continent, there are historical evidences of agro-urban landscapes that were created by the Inca and Mayan civilizations[2]. According to the Food and Agriculture Organization of the United Nations[3], 85% of the economically vulnerable population in Latin America was found in urban areas. In Brazil, the Brazilian Institute of Geography and Statistics[4] estimates that approximately 85% of the Brazilian population lives in urban environments. In the southeastern region of Brazil, approximately 93% of the population lives in urban areas[4]. The high population concentration in urban centers, combined with social issues, undermine food security, support services and infrastructure, as well as culture and leisure of certain groups.

Inadequate nutrition is one of the main factors that contributes to the increase of chronic non-communicable diseases (NCDs) as a global health issue[5]. Some studies point out alarming rates of food insecurity throughout Brazil, which have been further aggravated by the COVID-19 pandemic[6].

Urban agriculture is the beginning of urban restructuring, of creating greener cities and contributing to food and nutrition security[7]. Urban agriculture plays a key role to balance urban ecosystems, to promote sustainability in cities, to improve the quality of life and healthy nutrition[8,9].

In this context, urban vegetable gardens have been described in several Brazilian cities. The Hortas Cariocas Program (HCP) was developed by the City of Rio de Janeiro and has been its most renowned one to date[10]. It aims to encourage the practice of sustainable and organic agriculture in the city and to provide high quality food at affordable prices to the needy population that lives in the vicinity of the gardens. In addition to urban vegetable gardens located in poor communities, the HCP is in charge of Rio's school gardens as well, which are learning spaces that focus on environmental education, food education and natural sciences.

However, this production modality has only achieved a small percentage of its potential[11]. More advanced studies are required, especially on positive and negative impacts caused by urban agriculture[12], in addition to a systematic assessment of the contribution of urban agriculture to food security[13]. A literature review identified the need for additional studies that address knowledge gaps on the results of urban agriculture, mainly regarding food insecurity, poverty and inequality[14].

Therefore, the present article mainly aims to stress the importance of urban agriculture as a mechanism to promote food, nutritional and health security in needy communities. It also highlights elements that could be improved to optimize agricultural practice and make it more popular in urban environments.

This article may contribute to understand the impacts and productive performance of urban agriculture in the city of Rio de Janeiro by analyzing and relating aspects of production with its effects on environmental and collective health of the population involved.

Material and methods

The present study was developed in two steps. The first one used a descriptive exploratory method[15] to qualitatively analyze the economic, environmental and social impacts and to understand and characterize the HCP. This analysis was performed during field visits from July 2018 to December 2019 based on a descriptive research methodology that included extensive direct observation and photographic data collection. This step helped understand the program's production process, including participation of its members, training, preparation of areas, planting, harvesting and food consumption in all HCP gardens. Figure 1 shows the marked and numbered locations of the 40 vegetable gardens and the CAPO and PRJ Support Points, which operationally and logistically support the HCP.

In the second step, a Data Envelopment Analysis – DEA[16] was performed to obtain a quantitative analysis of production performance. Data were collected in January 2020 and obtained from the monthly reports published by the coordinator and manager of agroecology and organic production of the City of Rio de Janeiro between 2007 and 2019. The Integrated Decision Support System (SIAD) software program, version 3.0[17] was used to calculate efficiency scores for the intended performance analysis.

This methodology was chosen because it allows to incorporate quantitative data at different scales without transformations and to generate scores that facilitate the analysis of agricultural activity[18]. Based on analysis of available data, we decided to use the CCR model (an acronym of the initials of its authors, Charnes, Cooper and Rhodes, who created it in 1978), which assumes constant returns to scale and according to which the increase in resources leads to a proportional increase in products. The model orientation focused on outputs. Thus, the assessment of a production unit's efficiency is made by comparing what was produced with what could have been produced[16,19].

Based on the definition of efficiency proposed by Farrell[20] as the maximum ratio between a weighted sum of products and a weighted sum of resources, DEA uses that concept to perform a comparative analysis between the efficiencies of a set of production units or decision maker units (DMUs). Used as a tool to measure efficiency, this approach considers several resources and products to calculate productive efficiency scores and allows to achieve the intended performance evaluation over the years.

To evaluate the HCP in this study, every year between 2007 and 2019 was considered as a DMU. Inputs include used materials or resources and outputs include HCP products. They were selected from the variables that best represented the character of the intended analysis. Therefore, inputs included the number of facilitators and the amount of money invested in the HCP per year. Outputs included the program's annual food production in kilograms, which allowed to cover the entire production process.

The number of facilitators of every DMU was defined by the average number of technicians present every month per assessed year. Investments were defined by the monthly sum, in Brazilian Reais, per assessed year. Thus, we considered monthly allowances paid to producers and building materials used at the gardens, such

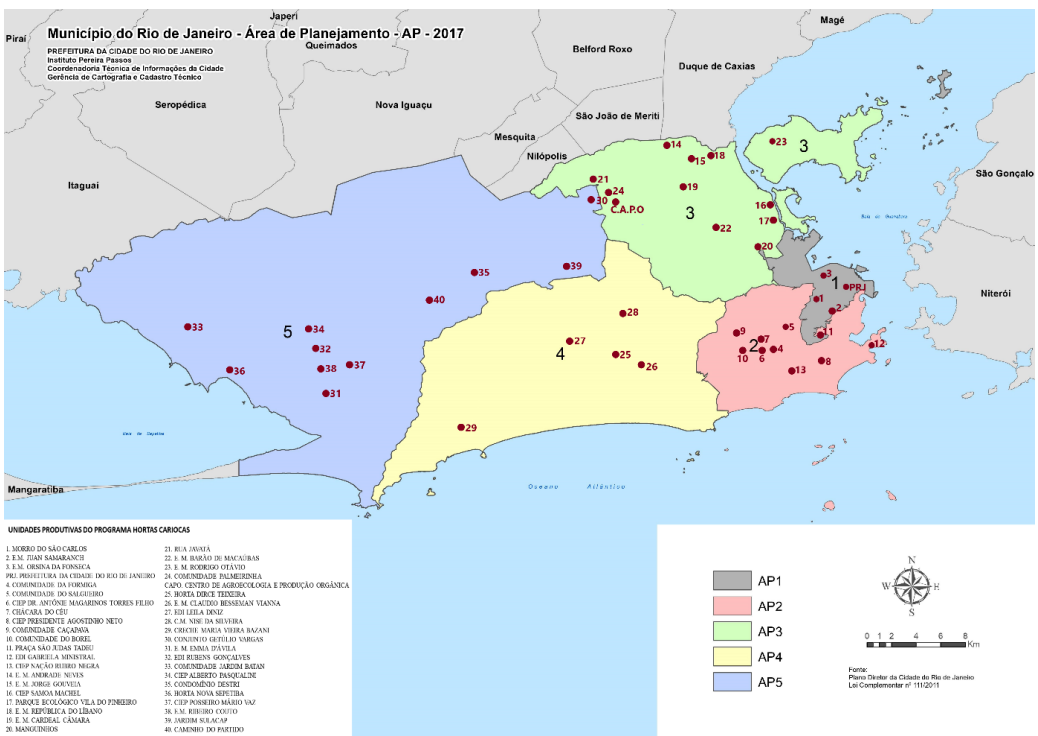

Figure 1. Location of vegetable gardens and HCP Support Points in the five Planning Areas (PA), city of Rio de Janeiro.

Source: Authors, adapted from the Master Plan of Rio de Janeiro's City Administration.

as netted shade material and bed bricks, seeds, etc. These variables account for resources used to train people and to build the HCP spaces.

Yearly production is the sum of agricultural items (lettuce, carrots, tomatoes, spinach, basil, gherkin, eggplant, sweet potatoes...) in kilograms produced per months of every analyzed year. This variable reflects the result of people's interaction with the space, i.e., the targets of the HCP.

Table 1 shows the used variables and the efficiency scores revealed by the output-oriented DEA-CCR model applied to each DMU.

Results and discussion

Combining two approaches expanded the scope of this study. It allowed us to analyze the collected data in both a qualitative and a quantitative way and to take into account the several dimensions covered by the HCP.

Qualitative analysis of the HCP

The descriptive exploratory method allowed us to perform a qualitative evaluation of the program's economic, social and environmental impacts. Field visits revealed that HCP gardens are located in idle lands of the communities. We were informed that those spaces had been used by the parallel power for the sale of illicit goods, were neither controlled by the police, nor included in the city's master plan. Building vegetable gardens improves the aspect and landscape and, as a result, neighboring areas increase in value and popularity (Figure 2). Interventions by community members resignifies, revitalizes and changes not only those spaces, but also the agent groups[9].

The Hortas Cariocas Program (HCP) is a multifunctional urban garden program based on an organic production system free of agrochemicals. Producers are trained to use agroecological practices aimed at soil, pest and disease management, promoting sustainability in several ways (Figure 3). This practice is found in the production areas of the HCP's vegetable gardens, which are cultivated based on a diversity of species. Interactions that result from this arrangement provide better conditions and consequently higher yield throughout the entire year. That productive diversity strengthens both the efficiency and sustainability of agricultural activities[21].

Producers who join the HCP receive financial support from the City of Rio de Janeiro, as well as agricultural training and access to produced food (Figure 4). This fact corroborates a study that found that one of the main motivations of urban agriculture is nourishment, followed by financial benefits[13].

In addition to receiving the City's financial support, producers sell part of their production at local fairs or at their own gardens to improve their revenue (Figure 5). However, only vegetable gardens located in communities may sell their produce, as the municipal school gardens' entire production is used by community school kitchens to prepare meals. As a matter of fact, an important number of gardens achieve their emancipation after some time and no longer depend on public resources. Urban agriculture is a strategy to increase the revenue of beneficiary families, allowing them to use their income for other purposes[13]. For example, unemployed people that rely on social welfare programs may become economically active and contribute to urban economic activities.

Planting of native species, which is promoted by the HCP, as well as crop rotation that respects seasonality of species boosted local biodiversity and brought about changes in the microclimate and local evapotranspiration. In this sense, vegetable gardens, parks, spaces covered by vegetation in general and initiatives such as the Hortas Cariocas may act as flood mitigators. In a natural environment, rainwater seeps into the ground and supplies the aquifer. Therefore, the presence of vegetation is essential, especially to avoid the degradation of watersheds, since they directly affect the quality and quantity of available water[22].

In urbanized environments, waterproof soils cause puddles or irregular water flows that result in major issues. A study conducted in New York assessed the impact of parks and community gardens and found that they retain approximately 45 million liters of rainwater[23] that otherwise could cause floods and landslides.

The HCP areas we visited also teach how to compost organic waste that is usually indiscriminately discarded. Old tires and pet bottles are used to form beds, which helps reduce urban waste. Thus, garden environments encourage different types of interaction between man and nature, raising awareness of the environment and the different ways of consumption. Many members of HCP vegetable gardens communities had never planted a seedling or picked fruit from a tree before joining the program, which provided them with that kind of experience. Manny authors consider urban agriculture as an essential pedagogical strategy to learn gardening based on direct contact with food and nature[24].

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Table 1. Variables and efficiencies revealed by the DEA-CCR model applied.

DMU	Year	Number of Facilitators (average/year)	Annual investment (BRL)	Annual production (kg)	PE Productive efficiency (%)
		input 1	input 2	Output	
1	2007	2.00	203,794.22	3,291.34	9.78
2	2008	2.00	354,490.84	11,256.55	21.65
3	2009	2.00	391,055.79	17,351.72	33.37
4	2010	2.00	495,033.97	21,613.59	41.56
5	2011	2.00	408,959.82	36,021.23	69.27
6	2012	2.00	375,944.57	41,709.16	80.21
7	2013	2.67	595,656.96	47,629.22	68.61
8	2014	5.00	612,315.63	44,705.03	44.23
9	2015	5.00	738,624.39	89,737.81	73.60
10	2016	5.00	787,516.61	130,001.29	100.00
11	2017	4.42	824,702.33	108,430.57	94.35
12	2018	7.25	911,258.91	109,068.87	72.51
13	2019	9.33	989,050.23	116,533.97	71.38

Source: Authors.

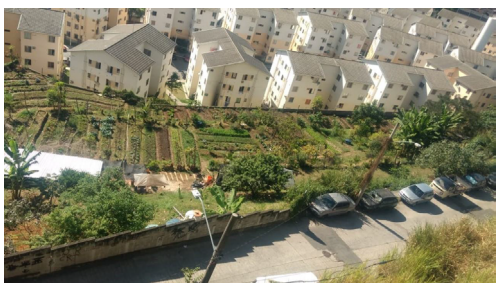

Figure 2. Revitalization and visual improvement of land that has been taken care of by the HCP.

Source: Authors.

Figure 4. Beds in their production stage.

Source: Authors.

Figure 3. View of cultivated beds.

Source: Authors.

Figure 5. Point of sale of a part of vegetable garden produces.

Source: Authors.

Implementation of green areas, such as parks and gardens, provides a more pleasant environment for the neighboring population. The presence of natural elements, such as trees, plants and water sources form landscapes that people enjoy more than the usual urban environment[25]. Thus, the HCP encourages creating natural environments and recreation in them, encourages physical activity and contributes to the physical and emotional well-being of the population involved (Figure 6). Some studies report that agriculture in urban areas directly impacts the local population, as it is not only a source of food, but also an aesthetically pleasing and favorable environment for recreational and cultural activities[26].

The development of these spaces also gave rise to a new area of interest: nutrition education in agriculture[27]. Therefore, urban agriculture may be an important training strategy as it is based on a direct contact with food and nature. Gardens, in their function of educational environments, bring people closer to food and nature, promote horizontal learning and sharing of experiences[24].

Due to the city's subsidies and technical assistance provided by specialized professionals, the HCP maintains organic food production at an affordable price in communities. It allows offering a variety of food to community consumers, improving quality of life and hence life expectancy. Community garden members eat 1.4 times more fruits and vegetables than people who do not take part in any activity of that kind[11].

Analyzing the HCP's activities showed that the lack of intermediaries between producers and final consumers makes products cheaper and more accessible. Changes in consumption habits, especially the replacement of foods produced in conventional ways by organic ones, has stimulated the market of these products that feature a high added value. Products are sold at accessible prices to the community that lie below average market prices. Thus, urban agriculture favors food security, improves the diet of the local population and may thus been seen as a socioeconomic tool that reduces food expenses of the local population[13]. In addition to providing food to the vulnerable population, it is also a potential source of income and helps improve urban environments[28].

In terms of production, urban agriculture can be up to fifteen times more productive than rural farms. As the cultivars have a short life cycle, an average of 20 kg of food per year can be produced in a space of one square meter[7]. According to data from program reports, the HCP currently produces an average of 10 tons of food per month in all 40 active gardens of the program.

Figure 6. Landscape changes that result in recreational use and promotion of well-being.

Source: Authors.

Health promotion also involves strategies for the development of urban food systems[29], since they provide healthy food for a part of the population that would not have access to it otherwise. In a city like Rio de Janeiro, characterized by great social inequality, programs such as the HCP are essential to address nutritional vulnerability. Besides, they are an additional source of income for poor communities. Thus, encouraging urban and peri-urban gardens contributes to reducing poverty and ensuring food security[30].

Productive performance of the HCP

Results of the quantitative analysis of the HCP's performance evaluation 2007-2019 reveal an average performance of 60.04%. Productive efficiency (EP) corresponds to the standard efficiency score in percentage, revealed by the applied DEA model (Table 1). Productive efficiency peaks were found in 2012 and 2016 (Figure 7).

The remaining quantitative variables, which were obtained from the data recorded over the years by the HCP and which are external to the applied DEA model, were considered as products of intermediate steps. They served to explain the behavior of the created scores, since they may influence the HCP's production process in some way or another (Table 2). This allowed to follow and understand the HCP's productive performance during the observed time period.

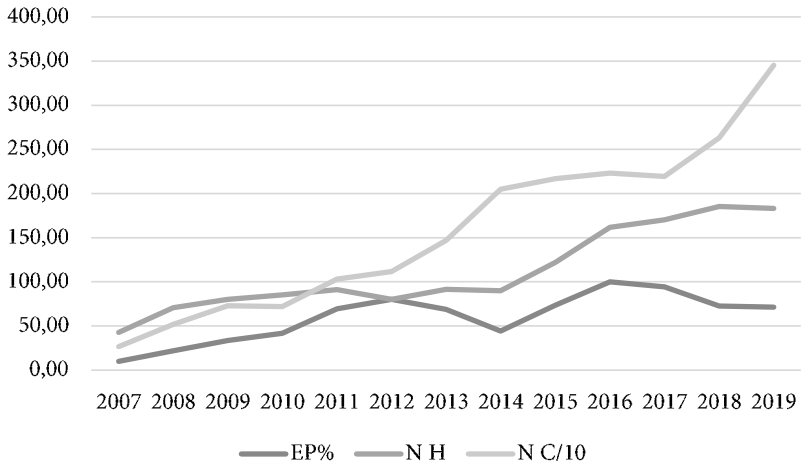

Figure 7. Behavior of Productive Efficiency (EP), Number of Beds (NC/10) and Number of Producers (NH) from 2007 to 2019.

Source: Authors.

Table 2. Variables external to the DEA model, intermediate DMU products.

DMU	Average monthly amount						
	Year	NH – No. of producers	Production units	NC – No. of beds	No. of items produced	Emancipated gardens	Inactive gardens
1	2007	42.42	6.33	264.17	37.00	0.00	0.00
2	2008	70.64	13.08	517.64	40.00	0.00	0.00
3	2009	80.00	17.33	729.75	40.00	0.00	0.00
4	2010	85.17	19.33	717.42	37.00	0.00	0.00
5	2011	91.25	26.25	1,030.08	39.00	0.00	0.00
6	2012	80.17	30.33	1,114.42	36.00	0.00	0.00
7	2013	91.33	30.33	1,468.50	36.00	6.00	9.00
8	2014	89.75	26.17	2,050.00	34.00	1.00	0.00
9	2015	121.92	29.00	2,168.92	34.00	0.00	3.00
10	2016	161.83	30.75	2,231.25	33.00	1.00	0.00
11	2017	170.09	28.45	2,192.91	33.00	2.00	2.00
12	2018	185.42	33.42	2,632.92	33.00	1.00	3.00
13	2019	183.17	39.92	3,453.17	36.00	0.00	1.00
Min		42.42	6.33	264.17	33.00	0.00	0.00
Max		185.42	39.92	3453.17	40.00	6.00	9.00
Med		111.78	25.44	1582.40	36.00	0.85	1.38
D P		47.50	9.10	950.59	2.55	1.68	2.57

Source: Authors.

Table 2 shows the variations in the number of gardeners and the number of beds, allowing to understand the behavior of the productive performance of the gardens, as they express the social and environmental character of the program, reflect the number of people directly involved (producers) and the area occupied (number of beds) in relation to the HCP production pro-

cess over time. The same kind of highlight was observed in a study on urban agriculture production in Guelph, Canada, which found that to increase production, the city needed to invest in training of producers and in expanding arable land[11]. In addition, the lack of equipment, public policies and skilled labor were found to be the main obstacles to the development of organic urban agriculture[31]. Therefore, the HCP relies on the support of the City Administration of Rio de Janeiro, which provides financial and material resources, such as seeds, fertilized land, material for the development of gardens and training of producers.

A growing increase in efficiency took place between 2007 and 2012 (Table 1 and Figure 7), which is possibly due to the increase in the number of beds, but which is not accompanied by the number of producers (Table 2). This led to a reduction in productive performance in the following years (2013 and 2014). In other words, the decrease in production in 2013 and 2014 may be due to a decrease in the number of admissions of new producers in relation to the increase in the number of beds. It was found that the study area is not necessarily proportional to the productive potential, since the added beds could be in the process of planting or post-harvest preparation[32]. The opening of new work fronts directly influences monthly investments, since it requires purchasing blocks and supplies for the new beds as well as increasing the number of producers.

From 2014, admission of new facilitators to the program led to a new cycle of performance increase (Tables 1, 2; Figure 7).

Two productive efficiency peaks took place in 2012 and 2016. This behavior can be explained by the fact that the expansion of the area (beds) and participants (producers), in addition to an increase in resources (inputs), which was motivated by the results of these peak years, lead to a decrease in the efficiency scores of the following years. Training of new participants and preparation of new areas that, over time, started to produce, took these rates to a new level (Figure 7). Those expansions cause cycles which, due to new areas and the admission of new participants, require time to start the planting, to produce and yield results that reach productive efficiency.

From a technical point of view, the ideal moment to emancipate a garden is when it reaches its peak efficiency. However, new producers would lack the contact with areas in full production and trained participants and would have to start their own process from scratch. That fact might have been considered in 2016 by the project manager, as the increase in garden emancipation that occurred after the performance peak of 2012 (Table 2) was not repeated. This may explain the improved result of 2016 that took place in the same time interval of two years in the HCP productive performance curve (Figure 7). In other words, expertise of older producers who remained in the program and became acquainted with the new ones may have contributed to this result.

The number of items produced showed little variation, despite the diversity of items produced among gardens and throughout the year. Diversification of items, respecting the seasonality of the cultivars, is directly associated with the increase in the productivity of the gardens[32], since it may reduce the need for nutrient supplementation and the number of idle beds.

Final considerations

In the city of Rio de Janeiro, which is characterized by highly urban cultural features, the Hortas Cariocas Program (HCP) showed significantly positive impacts, such as improvements in food and nutritional security, environmental education and quality of life. Thus, we conclude that the HCP contributes to promoting the environmental and collective health of the communities involved.

As for the program's productive performance, the largest expansions of cultivated areas coincided with a decrease in efficiency rates in 2013/2014 and in 2018/2019. This may be due to the period that is required for stabilization and implementation of vegetable crops cycles, as well as the subsequent production phase and harvest, until consumption of these products. Therefore, we may conclude that the variation in the productive performance of the HCP over the years was inherent to the socio-environmental goal of the program, which was achieved through the propagation and expansion of the cultivated area and the increase in the number of people involved, including its resultant improvements and benefits identified by the present research.

Collaborations

RSS Camelo, E Oliveira and TB Machado contributed to the conception, design, analysis and writing of the manuscript. CM Hüther and CR Pereira contributed to the analysis and writing of the manuscript. All authors reviewed and approved the final version.

References

1. Organização das Nações Unidas para a Alimentação e a Agricultura (FAO). Agenda de la Alimentación Urbana [Internet]. [acessado 2020 abr 23]. Disponível em: http://www.fao.org/urban-agriculture/es/
2. Corrêa CJP, Tonello KC, Nnadi E, Rosa AG. Semeando a cidade: histórico e atualidades da agricultura urbana. *Ambient Soc* 2020; 23:e00751.
3. Organização das Nações Unidas para a Alimentação e a Agricultura (FAO). Caderno criar cidades mais verdes [Internet]. 2012. [acessado 2019 dez 12]. Disponível em http://www.fao.org/3/i1610p/i1610p00.pdf
4. Instituto Brasileiro de Geografia e Estatística (IBGE). Conheça o Brasil: população rural e urbana [Internet]. 2015. [acessado 2019 dez 4]. Disponível em: https://educa.ibge.gov.br/jovens/conheca-o-brasil/populacao/18313-populacao-rural-e-urbana.html
5. Malta DC, Andrade SSCA, Stopa SR, Pereira CA, Szwarcwald CL, Silva Júnior JB, Reis AAR. Estilos de vida da população brasileira: resultados da Pesquisa Nacional de Saúde, 2013. *Epidemiol Serv Saude* 2015; 24(2):217-226.
6. Fundação Oswaldo Cruz (Fiocruz). Insegurança alimentar e Covid-19 no Brasil [Internet]. 2021. [acessado 2021 maio 11]. Disponível em: https://dssbr.ensp.fiocruz.br/inseguranca-alimentar-e-covid-19-no-brasil/
7. Organização das Nações Unidas para a Alimentação e a Agricultura (FAO). Comité de Agricultura – agricultura urbana [Internet]. 2017. Disponível em: http://www.fao.org/urban-agriculture/es/
8. Batitucci TO, Cortines E, Almeida FS, Almeida AA. A agricultura em ecossistemas urbanos: um passo para a sustentabilidade das cidades. *Ambient Soc* 2019; 22:e02773.
9. Yamamoto T, Moreira CMA. Hortas urbanas como intervenções temporárias: uma breve reflexão. *Mosaico* 2019; 10(16):73-86.
10. Secretaria Municipal de Meio Ambiente da Cidade (SMAC). Hortas Cariocas [Internet]. [acessado 2019 dez 4]. Disponível em: https://www.rio.rj.gov.br/web/smac/hortas-cariocas
11. Codyre M, Fraser EDG, Landman K. How does your garden grow? An empirical evaluation of the costs and potential of urban gardening. *Urban Forestry & Urban Greening* 2015; 14(1):72-79.
12. Mok HF, Williamson VG, Grove JR, Burry K, Barker SF, Hamilton AJ. Strawberry fields forever? Urban agriculture in developed countries: a review. *Agronomy Sustain Develop* 2014; 34:21-43.
13. Poulsen MN, McNab PR, Clayton ML, Neff RA. A systematic review of urban agriculture and food security impacts in low-income countries. *Food Policy* 2015; 55:131-146.
14. Rao N, Patil S, Singh C, Roy P, Pryor C, Poonah P, Genes M. Cultivating sustainable and healthy cities: A systematic literature review of the outcomes of urban and peri-urban agriculture. *Sustainable Cities and Society* 2022; 85:104063.

15. Fonseca RCV. *Metodologia do trabalho científico*. Curitiba: IESDE; 2012.
16. Charnes A, Cooper WW, Rhodes E. Measuring the efficiency of decision-making units. *European J Operational Res* 1978; 2(3):429-444.
17. Angulo-Meza L, Biondi Neto L, Mello JCCBS, Gomes EG. ISYDS – Integrated System for Decision Support (SIAD - Sistema Integrado de Apoio a Decisão): a software package for data envelopment analysis model. *Pesq Operacional* 2005; 25(3):493-503.
18. Emrouznejad A, Yang GL. A survey and analysis of the first 40 years of scholarly literature in DEA: 1978-2016. *Socio-Economic Planning Sciences* 2017; 61:4-8.
19. Gomes EG, Mello JCCBS, Biondi Neto L. *Avaliação de eficiência por análise envoltória de dados: conceitos, aplicações à agricultura e integração com Sistemas de Informação Geográfica*. Rio de Janeiro: Embrapa; 2003.
20. Farrell MJ. The measurement of productive efficiency. *J Royal Statistical Soc* 1957; 120(3):253-290.
21. Oliveira E, Aquino AM, Assis RL, Souza LA, Silva FC. Histórico, atualidades e desempenho produtivo da agricultura fluminense. *Hist Ambiental Latinoam Caribeña* 2021; 11(1):306-328.
22. Demanboro AC, Fabiano B, Longo RM, Bettine SC. Cenários Sustentáveis para a Macrometrópole Paulista. *Soc Natureza* 2019; 31:1-25.
23. Gittleman M, Farmer CJQ, Kremer P, Mcphearson T. Estimating stormwater runoff for community gardens in New York City. *Urban Ecosyst* 2017; 20:129-139.
24. Coelho DEP, Bógus CM. Vivências de plantar e comer: a horta escolar como prática educativa, sob a perspectiva dos educadores. *Saude Soc* 2016; 25(3):761-771.
25. Kelia Leite S, Anélia Renk A, Kissmann C, Vendruscolo G. Preferência visual da paisagem por agricultores do Sul do Brasil. *Soc Natureza* 2020; 32:752-765.
26. Oda K, Rupprecht CDD, Tsuchiya K, McGreevy S. Urban agriculture as a sustainability transition strategy for shrinking cities? Land use change trajectory as an obstacle in Kyoto City, Japan. *Sustainability* 2018; 10(4):1048.
27. Piscopo S. Urban agriculture: an alternative 'classroom' for nutrition education. *J Nutr Educ Behavior* 2016; 48(6):359.
28. Stewart R, Korth M, Langer L, Rafferty S, Silva NR, Rooyen CV. What are the impacts of urban agriculture programs on food security in low and middle-income countries? *Environmental Evidence J* 2013; 2:7.
29. Audate PP, Fernandez MA, Cloutier G, Lebel A. Impacts of urban agriculture on the determinants of health: scoping review protocol. *JMIR* 2018; 7(3):e89.
30. Branco MC, Alcântara FA. Hortas urbanas e periurbanas: o que nos diz a literatura brasileira? *Horticultura Brasileira* 2011; 29(3):421-428.
31. Maas L, Malvestiti R, Gontijo LA. O reflexo da ausência de políticas de incentivo à agricultura urbana orgânica: um estudo de caso em duas cidades no Brasil. *Cad Saude Publica* 2020; 36(8):e00134319.
32. Csortan G, Ward J, Roetman P. Productivity, resource efficiency and financial savings: an investigation of the current capabilities and potential of South Australian home food gardens. *PLoS One* 2020; 15(4):e0230232.

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