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# SEEDING THE CITY: HISTORY AND CURRENT AFFAIRS OF URBAN AGRICULTURE

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## Introduction

The urbanization process results in several consequences for the society and the environment. Currently, cities spread very quickly, and their growth usually is linked to lack of planning and economic crisis all over the world. The urban population, particularly the ones with the lower income, can be affected by lack of water and basic sanitation (ARFANUZZAMAN; RAHMAN, 2017), floods (EAKIN et al., 2016), thermal discomfort (WANG et al., 2019) high prices and food shortages (DAWE et al., 2015; FAO, 2011; FAO, 2017), and unemployment (ZHANG, 2016).

From an environmental standpoint, this growth comes with profound changes in the landscape, such as climate changes (DI GIULIO et al., 2017; LIMA; RUEDA. 2018) fragmentation of natural habitats, soil sealing and biodiversity loss (JUNTTI; COSTA; NASCIMENTO, 2019). Thus, those regions have a constant challenge to provide and maintain the Ecosystem Services – ES. The ES sustain the human population directly or indirectly, and they are categorized as supporting services, cultural services, provisioning services, and regulating services (BROWN, 2013).

Urban gardens emerge in this context as an alternative to fight back food insecurity, especially in countries located in the Southern Hemisphere (ZAAR, 2015). With the high pricing of agricultural products and the cost of transportation, urban food production can improve access to fruits and vegetables, as well as being a viable economic activity (FAO, 2010).

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Besides food provision, community and domestic gardens can generate several ES for the cities. Local temperature decrease (CLEVELAND et al., 2017), biodiversity increase (GUNNARSSON et al., 2016), interaction between the community (MIDDLE et al., 2014), carbon storage, greenhouse gas reduction, and flood mitigation through interception and rainwater infiltration are examples of these ES (CAMERON et al., 2012; CLEVELAND, 2017; GUNNARSSON et al., 2016; MIDDLE et al., 2014; PULIGHE; FAVA; LUPIA, 2016).

Currently, various studies about urban gardening are being developed around the world, focusing on its implementation and management. Thus, this research aimed was to evaluate the main sub-themes related to the urban gardening and to understand the benefits generated by the practice in the face of increasing urbanization. Besides, its importance for the provision of ES in cities was discussed.

## Methods

The study was based on a systematic review of scientific papers, a careful analysis of the related literature, and a selection of the most relevant studies (PICKERING; BYRNE, 2014). Searches on scientific platforms through specific terms and period is a methodology that can be found in several recent studies (AMOS et al., 2018; CHENG et al., 2019; GAGLIARDI; PICCININI, 2019; MOTIEJ[NAIT] et al., 2019; SOGA; GASTON; YAMAURA, 2017).

Hence, the terms “urban gardens” “Urban agriculture”; “Community gardens” and “allotment gardens” were searched in the international indexes Science Direct, Scopus, and Web of Science, as well as the Research gate platform. Only recent case studies were used, considering the 5 years before the finalization of the data analysis (published between 2012 and 2017), and their keywords were identified and grouped using the Iramutec software. After this process, 164 articles were selected.

Iramutec is software that applies statistical treatments where the degree of co-occurrence between words is represented as distances in space. In this way, words can be visualized as points in space, through technological maps, and the distance between them will be represented by their co-occurrence or affinity (IRAMUTEQ, 2013). Although it is more common in the area of communication, this analysis tool can be found in papers with environmental and socioeconomic themes (ALLAIN; PLUMECOCQ; LEENHARDT, 2017; BENITES-LAZARO; MELLO-THÉRY, 2019; BENITES-LAZARO; MELLO-THÉRY; LAHSEN, 2017; DEL CORSO, KEPHALIACOS, PLUMECOCQ, 2015, DUFOUR, RODRÍGUEZ-GONZÁLEZ, LASLIER, 2019, PLUMECOCQ, 2014, TORRES, PREVOT, NADOT, 2018).

Subsequently, articles were grouped according to the HDI of the countries where the studies were conducted (UN, 2016): Countries with very high HDI, countries with high HDI, countries with medium HDI and countries with low HDI UNITED NATIONS, 2016). The paper considered the 2016 report, however, there was no change of category in the countries studied compared to the most recent report. The selection of the HDI for the thematic analysis derives from its overview of countries' development and long-term

trends and is suitable for researchers and actors in policymaking (UNITED NATIONS, 2018).

After organizing into four groups, the central theme of each paper was designated through the title, keywords, and content. The number of occurrences of the central theme of each article was synthesized in a word cloud, where the word size is proportional to the number of times it was identified as the main theme within each group.

## History

Evidence and historical reports suggest that the development of urban agriculture in the world is linked to the practices of city gardening, with the agroforestry sowing of both fruit-bearing and non-fruit-bearing tree species, flowers, greenery, vegetables and medicinal plants (NAIR, 1986). Through archeological findings, ancient Egypt is considered the birthplace of several agricultural practices of the Western world, due to the creation and incorporation of cultures and technologies. Besides the irrigation practices, known as the harbinger of hydraulic engineering, there are also reports of urban agriculture in the region, where fruit-bearing trees and medicinal plants were usual in domestic gardens and the great temples (JANICK, 2010).

The agroforestry gardens were also developed by the Greeks, the Romans, the Byzantines and the Persians (ROSTAMI et al., 2015), often for subsistence purposes in monasteries and convents. By the end of the Middle Age, several countries in Europe had gardens that mixed aesthetic aspects with functional aspects. Even though it was more usual in monasteries and castles, some community gardens started appearing in urban centers and outskirts of towns (ZAAR, 2011).

America also has examples of agro-urban landscapes in its history. The pre-Columbian Maya civilization was established in the Yucatán peninsula from 2.500 BD and had its decline in the 16<sup>th</sup> century due to the Spanish arrival. Even in its different periods (pre-Classical and Classical), most of the cities shared an organization model for urban landscapes, characterized by decentralization and low population density (BARTHEL; ISENDAHL, 2013).

The main cause for this standard is considered as a consequence of the grouping of domestic gardens, which collectively amounted to farms for food production. These cities were named garden cities or green cities (ISENDAHL; SMITH, 2013; ISENDAHL; DUNNING; SABLOFF, 2014). In Asia, the Khmer civilization (9<sup>th</sup> to 15<sup>th</sup> century) also presents evidence of agro-urban cities with rice plantations as the main source of nutrition and cities with low populational density (FLETCHER, 2009).

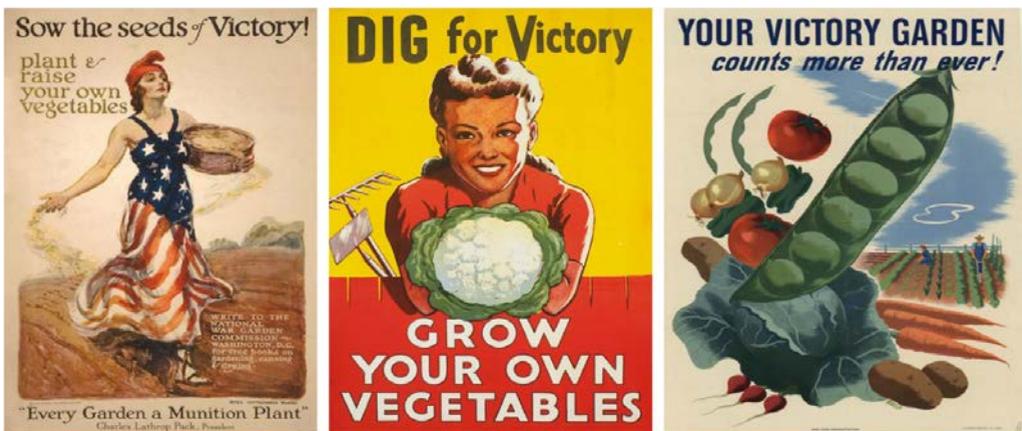
In the Contemporary Age, the occurrence of urban gardens often seems related to food insecurity and in the context of social and economic crisis. In European countries, the industrial revolution brought agricultural modernization between the 17<sup>th</sup> and 19<sup>th</sup> centuries. The improvement in the quality of life and the access to products brought great socio-economic changes by the end of the 19<sup>th</sup> century and the beginning of the 20<sup>th</sup> century, such as major population increase and longer life expectancies in some regions most affected by the industrialization (TEPPER; BOROWIECKI, 2015).

From that point on, countries such as the United Kingdom, France, and Germany saw their cities grow at alarming rates, resulting in food and fuel shortage, as well as problems in basic sanitation and public health. The population lured to the cities came from rural backgrounds, which helped develop and disseminate urban gardens, especially for food production (TURNER; HENRYKS; PEARSON, 2011; GONÇALVES, 2014). However, they were also developed for other purposes in Germany, such as contact with nature and playing outside, and got known as “Leisure Gardens” or “Schreber Gardens” (CABRAL et al., 2017)

In the United States of America (USA), urban gardens became attractive during the crisis in the 1890s, as a source of income and food, motivating the creation of groups called “Vacant Lots Cultivation Association”. The government then started to encourage this practice, offering idle lands to unemployed citizens so they could produce food. After World War I, the great depression which the country went through (1929-1935) brought back this policy, known as “relief gardens” (ZAAR, 2011; DRAKE; LAWSON, 2014)

The world wars were the backdrop for the development of “Liberty and Victory Gardens”, which was the incentive for vegetable and fruit production in public parks and private lands in several countries (DRAKE; LAWSON, 2014; GINN, 2012). In the USA, the construction of family and community gardens was responsible for 40% of the food production in 1945 (ZAAR, 2011). In the United Kingdom, the “Dig for Victory” campaign was created by the British and Scottish Ministry Of Agriculture during World War II to guarantee the population was fed (DESILVEY, 2003) (Figure 1).

**Fig. 1. Propaganda to encourage urban agriculture in programs such as “Liberty and Victory Gardens” and “Dig for Victory”, during the world wars.**



After World War II, some gardens remained, and many others started to appear in Europe. The need to produce food for subsistence continued throughout the economic recovery after the wars and, at the same time, its function of being a green space for leisure grew (TURNER; HENRYKS; PEARSON, 2011; GONÇALVES, 2014).

Some regions, however, went through the reversed process, with the fast-urban expansion that began in the '60s and invaded places that were used for food production. In the central region of Ile-de-France, in Paris, the gardens gave way to the urban facilities during the cities' densification (PETIT; AUBRY; RÉMY-HALL, 2011; SERRET et al., 2014).

The Cold War, even though it was a period of indirect conflict between the USA and the Soviet Union, also influenced the development of urban agriculture. The main example of that influence happened in Cuba, which currently represents one of the biggest success cases in the world, not only regarding urban agriculture but agroecological production, innovation and shared knowledge among farmers as well (LOPES; LOPES, 2012; PALMA et al., 2015).

The market rupture from its main commercial partners, together with the enforcement of an economic embargo promoted by the USA, resulted in a food shortage in the cities. Pesticides and chemical fertilizers used in massive production did not reach the country, and the food produced in the fields could not reach the cities due to the fuel shortage (FEBLES-GONZÁLEZ et al., 2011).

Therefore, there was a need to revolutionize the food production system to feed the population, which is mostly urban (close to 75%). Not only was food produced closer to the final consumer, agroecological practices were also developed and improved by the Urban Agriculture National Council (GNAU) (LOPES; LOPES, 2012). On the other hand, it is important to point out that the first initiatives came from the population itself, that facing the crisis started to farm vacant lots and building structures, later supported and encouraged by the government (BOURQUE; CAÑIZARES, 2000; BOILLAT; GERBER; FUNES-MONZOTE, 2012).

Currently, urban gardens were disseminated and can be found on all continents. The specificities of the places where they are implemented make their use have different goals, however, the economic, environmental and social contribution is a common factor wherever they are found (MIDDLE et al., 2014; PULIGHE; FAVA; LUPIA, 2016).

## **Current context of urban agriculture**

### *Key-word analysis*

Two main groups were evidenced, which are around the terms "food" (pink) and "garden" (blue). In the pink cluster, the relationship between food produced in the cities and food security, environmental and economic issues, sustainability and female empowerment stands out. The concern with food contamination in the urban environment and the relationship between green roofs and carbon sequestration can also be observed. Finally, the analysis of the production chain in urban agriculture is highlighted, with its potential for reuse of inputs, reduction of waste and reduction of costs with transportation (Figure 2).





One can observe that the subject “Community gardens” is predominant in countries with very high HDI. They are found in countries such as Germany (BENDT; BARTHEL; COLDING, 2013), Australia (GUITART; PICKERING; BYRNE, 2014), Canada (WANG; QIU; SWALLOW, 2014), Croatia (SLAVUJ BORČIĆ; CVITANOVIĆ; LUKIĆ, 2016), United States (CAROLAN; HALE, 2016), France (MARTIN et al., 2017), Israel (FILKOBSKI; ROFÈ; TAL, 2016), Czech republic (SPILKOVÁ; VÁGNER, 2016), United Kingdom (DENNIS; JAMES, 2017), and Switzerland (ERNWEIN, 2017).

It is important to point out that, in some countries in Europe, the term “Allotment gardens” is used, where the handling of urban soil is used for gardening, being defined as: “Lots of lands designated by local government authorities for the purpose of cultivating vegetables for internal supply” (GILBERT, 2013, p.104). It’s handling usually falls under regulation codes prescribed by gardening associations or by law, and it is done through the subdivision of the lot in small parcels of land, which are distributed to families or family groups (CABRAL et al., 2017; PANAGOPOULOS; JANKOVSKA; DAN, 2018).

According to Spiková and Vágner (2016), this category is not the same as community gardens and should be considered a more general category. Therefore, the articles that deal with “Allotment gardens” as the main subject were included under the term “Community gardens”.

The Community gardens are spaces intended to produce fruits and vegetables by the community in an urban environment. However, the current papers focused on discussing other benefits about these places, such as socializing and interaction among citizens, recreation and promotion of health, including the reduction of depression and obesity (HARDMAN et al., 2018; MARTIN et al., 2017; SLAVUJ BORČIĆ; CVITANOVIĆ; LUKIĆ, 2016). Besides that, the managing structure of those places is often evaluated (FOX-KÄMPER et al., 2017).

This practice is also studied for its nutritional benefits when implemented in schools (GUITART; PICKERING; BYRNE, 2014); for the possibility of integration between immigrants and the local community (AGUSTINA; BEILIN, 2012); for improving access to fresh food in areas known as food deserts, places where there are little availability and access for fresh and nutritious food (WANG; QIU; SWALLOW, 2014); for expanding green spaces in the cities (FILKOBSKI; ROFÈ; TAL, 2016); and for the resilience of a community after a disaster (CHAN; DUBOIS; TIDBALL, 2015).

### *Countries with a high HDI*

There is a considerable decline in the number of studies published on the urban agriculture subject in countries with high HDI. Respecting the parameters set for the methodology, 22 articles were found. In this group, the subject with most studies is soil contamination in urban gardens. This aspect is considered especially in places with high levels of pollution, such as capital cities and big urban centers, also appearing in several studies from countries with a very high HDI (Figure 3). Factors such as proximity to traffic roads, vertical barriers, and type of species cultivated influence the concentra-

tion of the contaminants of the final product (SÄUMEL et al., 2012; VON HOFFEN; SÄUMEL, 2014).

Amato-lourenço et al. (2016), which conducted the study in Sao Paulo (Brazil), and Li et al. (2014), that used Copenhagen (Denmark) as a case study, concluded that the air pollution resulting from traffic has a direct influence in the absorption of chemical elements in vegetables and that the level of those elements can exceed the recommended values for human consumption. The traffic roads are pointed as responsible for the concentration of metals such as cadmium and lead in vegetables, once that the vehicles are considered the biggest sources of heavy metal pollutions in the cities (AMATO-LOURENCO et al., 2017; CLARKE; JENERETTE; BAIN, 2015; MANCARELLA et al., 2016).

In Madrid, Izquierdo et al. (2015) suggest that the biggest contamination risks affect children that use the gardens for food and recreation or leisure, and the contamination can also vary a lot according to the history of what the land was used for, which can be a risk factor too. There are still other sources that can influence contamination: fertilizers, which can be contaminated by mercury (HUANG et al., 2015), lead-based paint (CLARKE; JENERETTE; BAIN, 2015) and residual water used for irrigation, which might contain bacteria or drugs that increase resistance to antibiotics (BOUGNOM; PIDDOCK, 2017).

However, some studies indicate that the concentration of contaminants in the soil is not a risk when it comes to consuming vegetables and does not exceed the stipulated safe values (MITCHELL et al., 2014; WARMING et al., 2015), apart from the low bio-accessibility of those metals, especially in soils with a high level of organic matter (CAI; MCBRIDE; LI, 2016).

Therefore, contamination in urban agriculture can vary a lot according to the place and all the resources that include the handling unit. But a few measures can attenuate those risks in any situation, for example, I) Opting for places more distant from big traffic roads; II) Using trees or other strategies for vertical barriers; III) Prefer planting fruit-bearing trees, which concentrate fewer contaminants in the eatable parts (VON HOFFEN; SÄUMEL, 2014); IV) Evaluating the origin of the fertilizer being used and V) Importing non-contaminated soil to the area of interest (MITCHELL et al., 2014).

### *Countries with average HDI*

21 articles were found on countries with an HDI average. As can be observed in Figure 3, the main subject approached in that group is sustainability. That issue is approached in sustainable agriculture practices, such as organic techniques for production, discussions on the social, environmental e economic benefits that urban agriculture can offer – in this case, possibly understood as sustainable development (PATER; CRISTEA, 2016), among others. Because it is a term used in different contexts, some case studies will be presented since they approach sustainability in different ways.

In a study conducted in the region of Jakarta (Indonesia), Cahya (2016) evaluates the ecologic, economic, social, institutional and technologic dimensions of sustainability in urban agriculture. Since the three first dimensions were considered less than ideal in

the area, government interventions are mentioned as essential in maintaining the practice in the long term. Still in Jakarta, Rastiyanto Amrullah et al. (2017) evaluates the effect of a program called “Sustainable Home-Yard Food Garden” on the family’s income and the degree of engagement from the participants.

On the other hand, Rana (2015) uses the term sustainability in agriculture applied to the supply chain. In other words, the production near the places of distribution and points of sale results in the independence from external raw materials which are subject to price and availability variations, as well as the necessary fuel for product transportation.

In another approach, Cook et al. (2015) developed a case study in Delhi (India) to understand urban agriculture from the farmer’s point of view and investigated factors that influence the decisions related to handling and plantation. They concluded that “sustainability of urban agriculture should not be assumed”, the authors point out that, to agriculture contribute the construction of sustainable cities, the city must contribute with incentive and support to this practice, a conclusion similar to Cahya (2016).

### *Countries with low HDI*

Finally, the group with an HDI considered low has the least published articles on the subject, with a total of 14 papers. The most approached subject regarding urban agriculture is food security (Figure 3). The studies related to food security reflect the importance of urban and peri-urban agriculture in countries with lower HDI. Sierra Leone, one of the poorest countries in the world, is going through a reconstruction period after the civil war in the ‘90s. Several agriculture fields were abandoned during the war, and the rural population was forced to migrate to cities to survive. Therefore, even today, food production in the cities comes as an important alternative for feeding the population (LYNCH et al., 2013).

In Zimbabwe, urban agriculture also plays an important role in food security, in the context of rural exodus and poverty in the big urban centers. However, it faces the same problems that can be found in several countries around the world: the lack of specific laws, technical assistance programs and government financing (CHAMINUKA; DUBE, 2017; GONDO et al., 2017).

### **Urban gardens and the ecosystem services**

The analysis of ecosystem services in gardens, as far as research is concerned, is often a part of green urban infrastructures, a broader term that includes squares, parks, gardens and forest fragments (KABISCH et al., 2016; ANGULURI; NARAYANAN, 2017). There are also specific infrastructures for water infiltration in the soil, with the intent of reducing superficial channeling and other impacts of soil impermeabilization (KHANKHAJE et al., 2018). Rain gardens are bioretention systems that receive the superficial channeling of rainwater and retain the excess in puddles that are gradually absorbed by the soil (BASDEKI; KATSIFARAKIS; KATSIFARAKIS, 2016; CHAFFIN et al., 2016). Bioswale are similar to rain gardens, consisting of landscape elements to concentrate or remove slime and pollution of superficially channeled water (LI et al., 2016).

It is also worth mentioning that these green spaces developed for retaining and infiltrating stormwater also have the potential for food production, bringing together both ecosystem services in the same unit: food production and water control. According to Richards et al. (2017), rain gardens can be used as plantation gardens, adapting the soil and species to the local interest and characteristics.

However, the benefits of urban culture can go beyond permeable soil. The organic or agroecological production is found in several urban gardens around the world, a characteristic that favors the production and conservation of uncountable environmental services in the cities. The agroecology is the group of ecologic concepts for handling sustainable agroecosystems, which adds to agriculture the ecologic, social and cultural dimensions (GLIESMAN, 2000; ALTIERI, 2004; FRANCIS; WEZEL, 2015).

One of its main foci is the minimal dependency of external chemical intakes and fossil fuel, which can be reached through increasing the complexity of the system, so that “the ecologic interactions and synergy between the biological components create, themselves, soil fertility, productivity, and culture protection” (ALTIERI, 2004, p. 23). The independence from chemical intakes, apart from bringing benefits for the population’s health, also unfolds practices that contribute directly and indirectly to protecting the environment, especially water resources (PORTER; FRANCIS, 2017).

In Cuba, the restricted access to agrochemicals resulted in the development of several agroecological practices. A direct benefit of not using chemical products in agriculture is the non-contamination of the water table. However, the creation of Basic Units of Cooperative Production, which act in collecting solid urban residue to produce organic fertilizers in the country, contributed to reduce the contamination of water resources also by urban solids, just like the “Revolution of the Small Buckets” in Brazil (BOURQUE; CAÑIZARES, 2000; FUNES, 2001; LOPES; LOPES, 2012; MACHIN *et al.*; 2012).

The diversification of cultures, the fair land distribution, the incentive to family and urban agriculture and protection of the genetic patrimony of the species are also characteristics of agroecology (ALTIERI, 2004). From those concepts, it is possible to separate the agroecological production from organic production. A production unit that does not use agrochemicals and does not contaminate the environment can also be called organic, even if it is focused on profit and the exploitation of the rural workforce. Nonetheless, to be considered agroecological, it must also fulfill its functions of social justice and equality (BOILLAT; GERBER; FUNES-MONZOTE, 2012). Thus, it can be concluded that every agroecological production is also organic, but not all organic production is agroecological.

## Final considerations

The beginning of urban agriculture occurred together with the beginning of the civilizations, being extremely important for food security across the centuries. However, this activity is currently recognized for bringing several other benefits to the cities, such as leisure and well-being, organic nutrition and environmental improvement. The discussion regarding urban gardens is growing in literature, and many papers that focused on that subject as the basis for their study were found. Community gardens, sustainability, soil

contamination, and food security are the topics more often used for the debate, but there is still a range of perspectives and visions that can serve as a compass for research in that area.

The contribution of the gardens to produce ecosystem services is one of those topics. As well as other green urban spaces, urban gardens can have great potential for generating ecosystem services. Apart from contributing to support and control services, urban gardens are also responsible for the food and medicinal herbs production service, often organic. Therefore, urban agriculture remains globally disseminated and resisting the offensive and pressure from the urban environment.

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Original Article



# SEEDING THE CITY: HISTORY AND CURRENT AFFAIRS OF URBAN AGRICULTURE

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## SEEDING THE CITY: HISTORY AND CURRENT AFFAIRS OF URBAN AGRICULTURE

**Abstract:** Urban agriculture has its history tied to the development of civilizations. Aiming to identify the benefits generated by the practice and its motivations, a literature review and later analysis of articles describing current experiences, management characteristics and organization aspects was carried out. In countries with a very high HDI, community gardens and the well-being of the population are prominent themes. Countries with high HDI focus on soil contamination and mitigation of pollution impacts, as countries with an average HDI has as main theme the sustainability of the practice. Finally, low HDI countries discuss their importance for food security. Regardless of the objectives that motivate urban agriculture and research in the area, is evidenced its contribution to the environmental, social and economic quality of cities.

**Key-Words:** Community gardens; Food security; Sustainability; Ecosystem services.

## SEMEANDO A CIDADE: HISTÓRICO E ATUALIDADES DA AGRICULTURA URBANA

**Resumo:** A agricultura urbana tem sua história atrelada ao desenvolvimento das civilizações. Com o objetivo de identificar os benefícios gerados pela prática e suas motivações, foi realizado um levantamento bibliográfico e posterior análise de artigos que descrevem as experiências atuais, características de manejo e aspectos de gestão. Nos países com IDH muito alto, as hortas comunitárias e o bem-estar da população são temas de destaque. Países com IDH alto focam na contaminação do solo e mitigação dos impactos da poluição, já países com IDH médio tem como temática principal a sustentabilidade da prática. Finalmente, países com IDH baixo discutem sua importância para segurança alimentar. Independente

dos objetivos que motivam a agricultura urbana e as pesquisas da área, sua contribuição para qualidade ambiental, social e econômica das cidades é evidenciada.

**Palavras-chave:** Hortas comunitárias; Segurança alimentar; Sustentabilidade; Serviços ecossistêmicos.

## SEMBRANDO LA CIUDAD: HISTORIA Y ACTUALIDAD DE LA AGRICULTURA URBANA

**Resumen:** La agricultura urbana tiene su historia vinculada al desarrollo de las civilizaciones. Con el objetivo de identificar los beneficios generados por la práctica y sus motivaciones, se realizó un levantamiento bibliográfico y posterior análisis de artículos que describen las experiencias actuales, características de manejo y aspectos de gestión. En los países con IDH muy alto, los huertos comunitarios y el bienestar de la población son temas destacados. Los países con IDH alto se centran en la contaminación del suelo y la mitigación de los impactos de la contaminación, ya países con IDH medio como tema principal la sostenibilidad de la práctica. Finalmente, los países con IDH bajo discute su importancia para la seguridad alimentaria. Independiente de los objetivos que motivan la agricultura urbana y las investigaciones del área, su contribución a la calidad ambiental, social y económica de las ciudades es evidenciada.

**Palabra-clave:** Huertos comunitarios; Seguridad alimentaria; Sostenibilidad; Servicios ecossistêmicos.

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