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Importance of Small-Scale Food Crop Models in Urban and Peri-Urban Contexts

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Abstract

The rapid urbanization of the 21st century has significantly reshaped global food production and consumption patterns, with profound implications for food security and sustainability, particularly in developing countries. With over 56% of the global population now residing in urban areas (World Bank), cities have become increasingly dependent on rural agricultural systems and food imports. This reliance leads to elevated transportation costs, higher carbon emissions, and heightened vulnerability to global supply disruptions. In response, small-scale food production within urban and peri-urban environments presents a promising solution. Models such as community gardens, rooftop farms, and family farming initiatives not only decrease dependence on external food sources but also support environmental sustainability, bolster local economies, and improve urban residents' quality of life. Despite these benefits, the implementation of urban agriculture faces considerable challenges, including limited access to cultivable land, inadequate infrastructure, and regulatory constraints. Public perception and community engagement are critical factors influencing the adoption and long-term viability of these practices. This article explores the role and impact of urban agriculture in addressing food insecurity, with a specific focus on San Miguel, El Salvador. It highlights the potential of agro-architectural innovations and community-

based approaches in enhancing urban resilience and sustainability. The study concludes with strategic recommendations to foster broader adoption of urban agricultural practices through supportive policies, infrastructure development, and awareness campaigns.

Keywords: Urban Crops; Food Security; Agro-Architecture; Family Farming; Community Agriculture

INTRODUCTION

The rapid urbanization that has characterized the 21st century has radically transformed the way societies produce and consume food. According to (World Bank , 2023), more than 56% of the world's population lives in urban areas, equivalent to approximately 4.4 billion people. This phenomenon has generated a series of critical challenges surrounding food security and the sustainability of food systems, especially in developing countries, where dependence on rural agricultural production and imports has increased. The repercussions are evident: higher transportation costs, associated carbon emissions, and increasing vulnerability to global crises that affect supply chains.

In this context, small-scale food production in urban and peri-urban areas is emerging as a viable strategy to mitigate these problems. Urban agriculture models, including community gardens, rooftop farms, vertical farming systems, and other innovative approaches, not only help reduce dependence on imports but also promote food security and environmental sustainability. These models allow communities to engage in food production, generating a positive impact on the local economy and improving the quality of life of their residents.

However, despite their potential benefits, the adoption of these models faces numerous challenges. The scarcity of cultivable space in densely populated areas, the lack of adequate infrastructure, regulatory barriers, and a lack of technical knowledge are just some of the obstacles that limit the effective implementation of urban agriculture. Furthermore, it is crucial to understand the population's perceptions and attitudes toward these practices, as social acceptance is fundamental to their success.

This research report focuses on the importance of small-scale food production models in urban and peri-urban contexts, with a specific focus on the city of San Miguel, El

Salvador. Through a methodological design that combines descriptive and quantitative approaches, it seeks to identify and characterize the population's perceptions of these models, as well as the barriers they face in their implementation.

The findings of this research will not only contribute to a deeper understanding of urban agriculture and its challenges, but will also offer practical recommendations for promoting food security and sustainability in urban communities. By integrating agriculture into the urban fabric, it is hoped to not only improve access to fresh and nutritious food, but also promote social cohesion and environmental awareness, essential elements for sustainable development in the future.

The main objective is to understand the perceptions and attitudes of the population in urban and peri-urban settings toward small-scale food production models and the challenges these models face.

Urban agriculture is defined as the cultivation of plants within cities; and Peri-urban Agriculture is defined as agriculture carried out on the outskirts of cities; it seeks to use spaces in or around cities for the production of agricultural food.

According to the (Food and Agriculture Organization of the United Nations), urban and peri-urban agriculture can be defined as a set of practices that provide food and other products through agricultural production and related processes (processing, distribution, marketing, recycling, etc.) and that are carried out on land or other spaces in cities or surrounding regions.

Although urban agriculture may seem like a new trend, it is actually very old, developed by civilizations such as the Persian cities, with their floating gardens; medieval monasteries in Europe; and the terraces of the Aztecs and Incas (Agropprod).

In developed countries, urban food production dates back to the last two decades of the 20th century. This organized urban agriculture played a prominent role in times of global crisis, such as during the 1930s and the war and postwar periods, when food control and rationing programs existed in countries like the United States and Canada. However, the rise of commercial agriculture in the 1960s and 1970s led to a decline in this small-scale agricultural production within cities (Ávila Sánchez, 2019).

Since 2000, agriculture has been integrated into urban development projects as a solution to the growing needs of citizens. On the one hand, urban agriculture meets the

demand for fresh, high-quality products. On the other hand, it also establishes new types of relationships in the areas of recreation, landscape, health, and well-being for the population. These urban agricultural projects have even fostered the emergence of educational activities, such as educational school farms. (Faliès & Mesclier, 2015).

Urban gardens perform a variety of functions that significantly contribute to the well-being of communities and the environment. First, they fulfill productive functions by facilitating local food production, which strengthens the food security and food sovereignty of local communities, thereby reducing dependence on external supply chains. Furthermore, these spaces become learning environments, allowing children, youth, and adults to learn about agriculture, horticulture, nutrition, and the environment, promoting greater awareness about food production and environmental care.

Likewise, urban gardens act as meeting spaces, promoting integration and social cohesion within communities. They encourage interaction among residents, strengthening community ties and contributing to a sense of belonging. Finally, from an environmental perspective, gardens help improve soil and water quality, reduce the heat island effect in urban areas, and improve air quality. Together, these benefits make urban gardens a valuable tool for the sustainable development of cities.

Some of the most widely used alternative cropping models for urban areas are: nutrient film hydroponics, floating root hydroponics, substrate hydroponics, rooftop crops, home gardens, kitchen gardens, school gardens, and community gardens.

Nutrient Film Technique (NFT): The nutrient film technique is a method that allows vegetables to be grown in PVC pipes. This system uses nutrient-enriched water, completely eliminating the need for any type of substrate, allowing plants direct access to the minerals necessary for their growth (Agrono Tips, 2020).

Floating root system (SRF): This is a technique that allows vegetables to be grown in wooden or plastic crates using Styrofoam sheets that float in nutrient-enriched water. This approach facilitates both management and the use of available growing space. It is characterized by significant savings in water usage, which can range between 60% and 70%, as well as in planting area, where a 70% to 80% reduction is achieved compared to traditional soil-based cultivation (Cáceres Aravena, 2009).

Substrate hydroponics: This is one of the most widely used techniques for growing vegetables, such as tomatoes, which cannot be effectively grown using other hydroponic

methods. This technique allows the use of various substrates, such as tezontle, agrolite, peat moss, and vermiculite, among others. The term "substrate" refers to any material, whether natural or synthetic, that replaces soil and provides support for the plant. In addition to their supporting function, some substrates can also act as a source of nutrients, especially those of organic origin, such as compost or peat (Castañares).

Rooftop farming: This represents a form of urban agriculture that involves installing small gardens or greenhouses on the rooftops of buildings, encompassing residential, commercial, and industrial spaces. This practice allows for local food production, even in densely populated urban environments where land availability is limited.

A prominent example of rooftop farming is Brooklyn Grange Farm, an urban farm located in New York City, founded in 2010. According (Brooklyn Grange), the farm promotes sustainable urban living through the creation of green spaces, educational programs and events, and expanding access to locally grown produce in New York City communities.

Home gardens: These are small spaces designed for growing vegetables, herbs, fruits, and other foods at home. These can be located on patios, balconies, terraces, or even inside homes, allowing individuals to grow their own food, even in urban environments with limited space. The operation of a home garden is based on basic principles of gardening and small-scale farming. The process begins with selecting plants and seeds suited to the climate and available space. The soil is then prepared, crops are sown or planted, and they are watered and cared for regularly.

Community gardens: Rooted in the protests and proposals of social movements in Berlin in the 1980s, these movements promoted self-management projects and defended the importance of urban green spaces. The first community gardens emerged in a context of conflict with local authorities, often through the occupation of public spaces, in parallel with lobbying and negotiation efforts (Fernández de Casadevante & Nerea Morán , 2014).

METHODS

The research is classified as applied descriptive research, as it aims to analyze small-scale food production models in urban and peri-urban contexts. This approach seeks to

identify alternatives to address challenges related to food security and the sustainability of food systems.

Regarding data processing, a quantitative method is used. This method is based on the collection and analysis of numerical data, which allows for the description, explanation, and prediction of phenomena related to food production in urban and peri-urban settings.

The hypothesis to be answered is that the population considers the implementation of small-scale food production models in urban and peri-urban contexts important to improve food security and family finances.

The sampling type is purposive or opinionated, taking into account pre-established criteria such as: The respondent must be of legal age, live in urban or peri-urban areas, be literate, and have a device with internet access. Exclusion criteria include people who do not live in urban areas and are under the age of majority, who cannot read (unless accompanied by someone who can read the instrument to them), and who do not have a device with internet access.

Although the research is geared toward urban and peri-urban areas in general, the city of San Miguel, El Salvador, will be used as the base population for this study. This city has a population of 242,246, with a 95% confidence level and a 5% margin of error. The sample size is 384.

The data collection instrument was a questionnaire, and the method used was a survey. This survey was conducted digitally through the Kobo Tool Box platform.

Table 1. Number of related questions according to the variable of interest.

Variable	Related questions
Interest	11
Knowledge	5
Application or uses	1
Preferences	5
Economy	3

RESULTS

A total of 387 respondents were recruited, of which 209 were women, representing 54% of the respondents, and 178 were men, representing 46%. The majority of the participants who took part in this survey were young people between the ages of 18 and 40. The breakdown was as follows: participants aged 18 to 30 represented 61% of the

respondents, those aged 31 to 40 represented 19.6%, those aged 41 to 50 represented 11.4%, and those over 50 represented 8%.

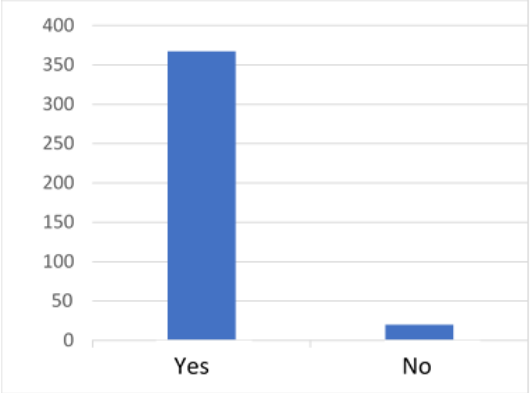

Figure 1. Number of people interested in growing their own food at home.

Of the 387 people surveyed, 367, or 95%, would be interested in growing their own food at home, and 20, or 5%, would not be interested in doing so.

Table 2. Reasons why people don't want to grow their own food

Reasons	Frequency	Participant equivalence
I don't have space	13	13 of 20 people
I don't have time	13	13 of 20 people
I don't have knowledge	4	4 of 20 people
I haven't thought about it yet	2	2 of 20 people

Of the 20 people who said they wouldn't want to grow their own food because they don't have enough space in their homes and don't have the time, and because they don't know how to do it.

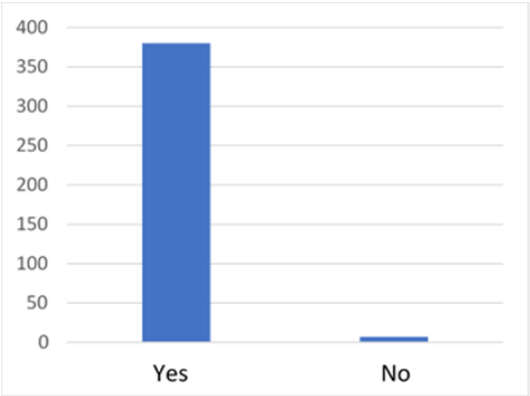

Figure 2. People who are interested in learning how to grow their own vegetables and/or fruits.

380 people, equivalent to 98% of the sample, stated that they would like to learn how to grow their own vegetables and fruits. It should be noted that when asked if they would be interested in harvesting their own food at home, 365 people answered yes. For this question, seven participants were added who had answered that they would not be interested in harvesting their own food; but they would like to learn how to do it.

Table 3. Learning methods that the population chose to receive training for implementing home-grown crops.

Learning methods	Participant equivalence	Percentage
In-person explanation	222 of 387 prefer an in-person explanation	88%
Explanatory videos and audios	217 of 387 prefer explanatory videos and audios	85%
Texts and written instructions	43 out of 387 people prefer texts and written instructions	17%

The majority of those who would prefer to learn how to harvest are through in-person explanations, explanatory videos, and audio recordings, while a small number opt for texts and written instructions. This means that if a training program is being conducted for citizens, these methods could be the most effective, combined with a hands-on workshop in which experts guide participants.

Those who said they did not want to learn how to harvest vegetables and/or fruits mentioned it due to a lack of time and space in their homes and because they consider it a difficult process.

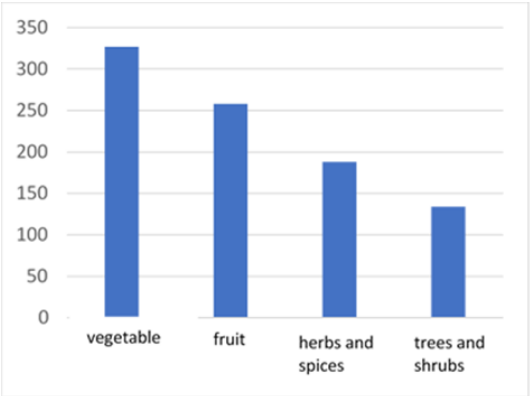

Figure 3. Interest in what type of plants to harvest from the population.

The population prioritized their interest in learning how to harvest vegetables, with 327 out of 387 people (84%), fruits with 258 people (67%), and herbs/spices and trees/shrubs (49%) and 35% respectively.

The most preferred vegetables to harvest among the sampled population were tomatoes, which had the highest preference, with 345 people (89%), followed by green chilies (263) (68%), onions (241) (62%), carrots (217) (56%), radishes (177) (46%), pipianes (166) (43%), and other types of vegetables (58) (15%).

Among the most preferred fruits, there is lemon with 240 people equivalent to 62%, followed by watermelon 221 people with 57%, orange 217 people equal to 56%, mango with 208 people 54%, banana 183 with 47%, plantain 176 with 45% and other types of fruits 35 participants in the survey equal to 9%.

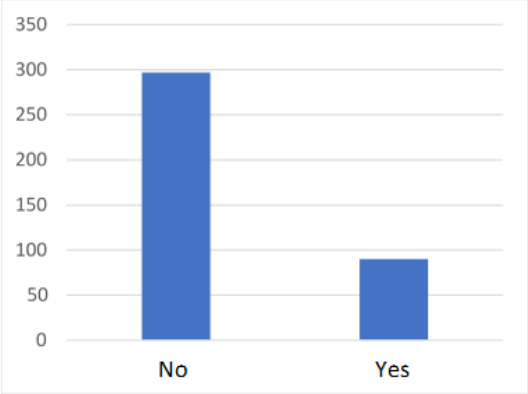

Figure 4. They have information to start their own garden in their home.

297 people, or 77%, lack information on how to start their own garden at home. 90 people do have information. This can be seen as an opportunity to conduct training and awareness campaigns on the importance of urban gardens and how they can benefit families.

When asked if they had enough space to grow crops in their homes, 280 people, or 72%, stated that they do have space in their homes to build a home garden. 107 people, or 28%, stated that they do not have space in their homes, which makes it difficult for them to implement these gardens.

Of the 107 people who stated that they do not have space in their homes, 89 of them said they would be willing to use alternative growing methods such as hydroponics.

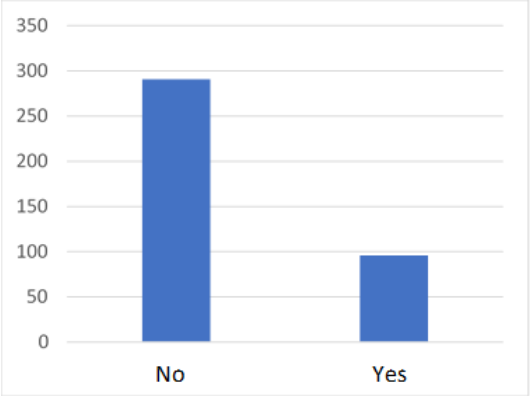

Figure 5. They have knowledge in the use of seeds for cultivation.

291 people lack knowledge of how to use seeds for planting. This data is very important for decision-making regarding training and strengthening the population's crop skills. 96 people do have knowledge. Similarly, 257 people are unaware of the types of plants that can be planted in their region. This is very important for selecting which ones can provide the greatest production, taking into account the area's sun, shade, humidity, heat, or cold conditions. This is another point to consider when implementing training or capacity building for members of society interested in growing crops in urban areas. 130 people say they do know the types of plants that can be planted in their region.

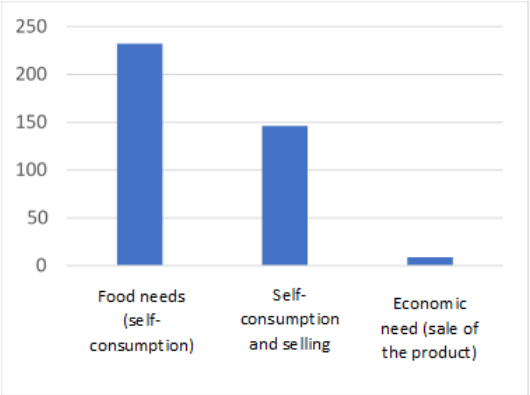

Figure 6. Main function that the population would give to the home garden.

60% of the sample stated they would use their home garden for personal consumption, 38% for both personal consumption and sales, and 2% for sales only, which is used for income.

This is because 141 people say they spend more than $30 on fruits and vegetables in a month, 117 people spend between $11 and $20 per month, 94 people spend between $21 and $30 per month, and 35 people spend between $1 and $10. Comparing the monthly

cost of fruits and vegetables, as shown in Fig. 6, 60% use their home garden for personal consumption.

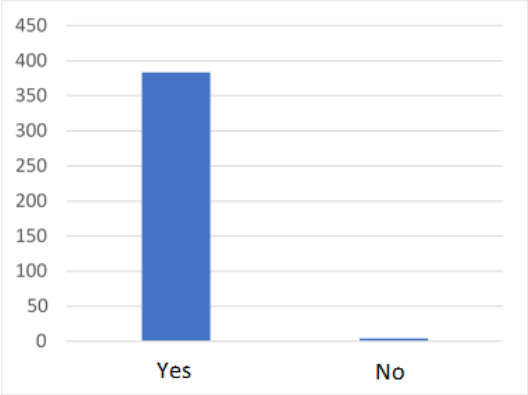

Figure 7. Population perception of the benefits of urban gardens in terms of food quality.

383 people, equivalent to 99%, believe that implementing home gardens could improve food quality in urban households.

DISCUSSION

The incorporation of agriculture into urban and peri-urban spaces has a direct impact on the food security and food sovereignty of local communities. By bringing food production closer to consumers, it reduces dependence on globalized food systems, improving access to fresh and nutritious products. This is critical to addressing the food challenges affecting many urban centers, contributing to the achievement of SDG 2.

From an environmental perspective, urban and peri-urban agriculture plays a key role in the construction of green architecture and the integration of nature into built environments. These food production spaces can help mitigate the heat island effect, improve air quality, increase biodiversity, and close nutrient and water cycles, thereby reducing the ecological footprint of cities. This directly contributes to the achievement of SDG 11 by making cities and communities more sustainable, resilient, and inclusive.

Furthermore, these gardens serve as educational and learning spaces, promoting environmental awareness and connecting urban communities with food systems and natural cycles, encouraging citizen participation and the ownership of green spaces—critical aspects for achieving more livable and equitable cities.

While challenges and constraints exist, such as limited space, pollution, and a lack of adequate policies, the integration of agriculture into urban and peri-urban environments is a key strategy for moving toward more sustainable and resilient urban development that improves the quality of life of populations and the health of city dwellers.

It is essential to recognize that the integration of agriculture into urban and peri-urban environments is not a new trend, but rather has deep historical roots. Ancient civilizations such as Persian cities, medieval European monasteries, and pre-Columbian societies had already developed forms of food production in and around urban spaces. This demonstrates an intrinsic link between cities and agriculture, which has been neglected due to accelerated urbanization processes and the prioritization of other development models.

The sample of 387 respondents reveals a predominantly young population with a reasonable gender balance (54% female and 46% male). This profile suggests a significant opportunity to implement educational and training programs that promote urban agriculture, especially among young people, who might be more receptive to adopting innovative practices.

A notable finding is that 95% of participants express interest in harvesting their own food, indicating a growing awareness of food security and a desire for food autonomy. This interest is complemented by the 98% who expressed a desire to learn how to grow vegetables and fruits, highlighting an opportunity to develop training programs that address both the theory and practice of urban agriculture.

Despite high interest, significant barriers have been identified that could limit active participation in urban agriculture. Lack of space and time are crucial challenges. This suggests the need to promote alternative growing methods, such as hydroponics, which require less space and may be more accessible to people with busy schedules.

The survey revealed that 75% of participants lack knowledge about seeds and 66% are unaware of which plants can be grown in their region. This highlights the urgent need for educational programs that not only inform about growing techniques but also help participants understand which plant species are suitable for their environment, thus maximizing the success of their agricultural efforts.

The majority of respondents (60%) believe that the primary purpose of a home garden would be for personal consumption. This not only improves family food security but can also reduce economic costs, given that 36% of participants spend more than $30

per month on plant products. Therefore, promoting urban gardens could be an effective strategy for improving the quality of life in urban environments, especially in a context of growing food insecurity.

The survey results indicate a strong desire to engage in urban agriculture, but also highlight the need to overcome significant barriers through education and technical support. Integrating agriculture into urban spaces not only has the potential to improve food security and environmental sustainability, but can also foster social cohesion and environmental awareness in urban communities. Therefore, it is imperative to develop policies and programs that facilitate access to agricultural education, encourage the use of sustainable farming methods, and promote active community participation in food production.

CONCLUSION

Small-scale production models can significantly contribute to improving food security and the sustainability of local food systems; therefore, it is important to consider and apply them in urban communities.

Conclusions for builders:

• Incorporate spatial design for urban agriculture from the planning stage of construction projects, designating strategic areas such as rooftops, patios, or facades.

• Harmoniously integrate the infrastructure necessary for urban gardens, such as irrigation systems, compost bins, and growing structures, with the resource flows and overall functionality of the building.

Conclusions for homeowners

• Take advantage of available spaces in your home, such as rooftops, patios, or balconies, to implement small urban gardens and contribute to local food production.

• Adopt cultivation techniques adapted to the urban context, selecting appropriate plant species and developing efficient irrigation and composting systems.

Conclusions for Public Officials

• Implement policies and programs that promote and facilitate the adoption of small-scale food production models in urban and peri-urban contexts.

• Develop regulatory frameworks that provide incentives and appropriate regulations for the integration of urban agriculture into urban development and land use planning.

• Allocate financial and technical resources to support communities and entrepreneurs interested in implementing urban and peri-urban agriculture projects.

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