

# **URBAN AGRICULTURE**

**A PATHWAY TO FIGHT POVERTY IN COMAS, LIMA**

**Communal gardens as a tool to improve the quality of life for a community**

By: Gabriela Chumpitaz

Instructor: Joey Iuliano and Kenny Wong

SBE 498

FALL 2021

UNIVERSITY OF ARIZONA

**TABLE OF CONTENTS:**

ABSTRACT.....	3
INTRODUCTION.....	4
RESEARCH QUESTIONS.....	6
LITERATURE REVIEW.....	6
METHODOLOGY.....	8
PRELIMINARY RESEARCH RESULTS.....	10
PROJECT DESIGN.....	20
DISCUSSION.....	23
CONCLUSION.....	23
LIMITATIONS.....	23
RECOMMENDATIONS.....	24
REFERENCES.....	25
APPENDIX.....	27

**ABSTRACT**

Comas, a district in Lima, Peru, does not have many green spaces and has some of the highest poverty rates in the region. This research explored ways the community can use vacant parcels that are not correctly used and create a communal garden for the benefit of the community. Other districts provided case studies, such as Villa Maria del Triunfo, where communal gardens have been a success and have created work, generated additional income, and reduced social exclusion by creating a community. This study found that communal gardens are beneficial and can help Comas become a producer of products to benefit the health and wealth of the community by utilizing green spaces effectively.

## INTRODUCTION

For thousands of decades, agriculture has been a primary activity in human life. There is a close relationship between agriculture and survival. People have always lived near places with fertile soil and areas remarkably close to water resources, eventually leading to urbanization. Currently, the city of Lima occupies an area of 505 km<sup>2</sup> in an 80 km long strip of the Peruvian coast that includes the lower area of the basins of the Chillón, Rímac, and Lurín Rivers. The city's expansion was carried out mainly in agricultural areas, from 1940 to the present has been reduced from 570 km<sup>2</sup> to 105 km<sup>2</sup> (Arce, 2006). The changing situation caused by the continuous urban expansion makes the statistical data unreliable, since they quickly become out of date. However, it has been possible to determine that at present, there are still more than 13,000 hectares of cultivation and almost 19,000 nominal users in all three basins (Arce, 2006). The extensive cultivation areas are concentrated in the Chillón and Lurín valleys, with just over 11,000 hectares, while in the lower Rímac basin, only about 2,000 hectares persist. The Rímac river has an average flow of 29 m<sup>3</sup>/s compared to 5 m<sup>3</sup>/s from Chillón and 0.41 m<sup>3</sup>/s from Lurín (Arce, 2006). For instance, the main source of water supply for the city is Rimac River; however, the levels of bacterial contamination are higher than those allowed for the irrigation of vegetables. (Arce, 2006)

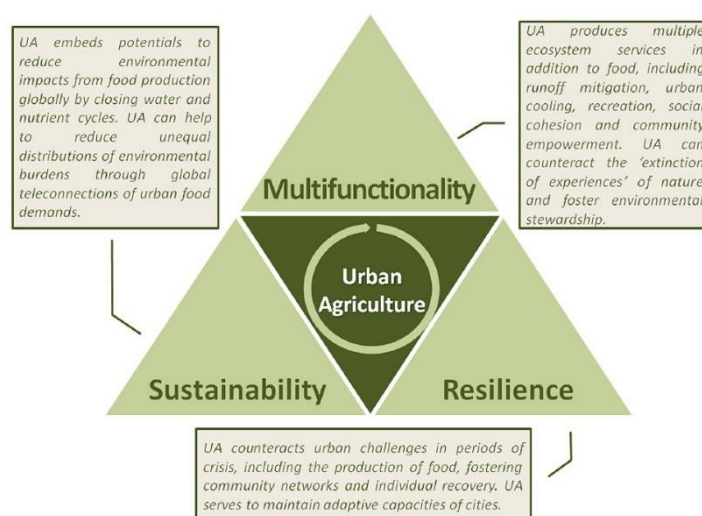
In Lima, there are adequate conditions to promote urban agriculture as a means of producing positive effects for the local population: improvement in nutrition, access to food, fight against poverty and hunger, and economic development. It can also create green areas, reuse abandoned spaces, and promote productive areas.

One of the main challenges encountered in Lima is that in the northern districts (Puente Piedra, Santa Rosa, Ancón, Carabayllo, Comas, Independencia, SMP, and Los Olivos), migration of people from the countryside has led to uncontrolled growth of the city. These areas are not well-planned, and there are not enough green spaces within these districts. According to the 2013 District Poverty Map, published by the National Institute of Statistics and Information (INEI), people with few economic resources live in these districts. Many children and families suffer from malnutrition or lack enough resources to eat well.

The idea of food justice helps us begin to understand the importance of this research. It is important to encourage the understanding of food justice so these food-growing initiatives can merge environmental ethics, land stewardship, and socio-economic benefits to ensure a viable fight against hunger. Additionally, engagement with food production can bring empowerment to individuals and the community (Tornaghi, 2016). The involvement of individuals and the community in the participation and protection of the urban agricultural heritage brings great opportunities for the urban context. Urban agriculture has ecological and social value, but it is also essential to highlight the cultural link to the process. The community is interested in protecting their land, bringing cultural identity and community empowerment (Banduini, 2020).

While urban agriculture and its benefits can be planned to suit each local community differently, the lack of agricultural areas is a prevalent local issue. This is especially true in Comas, a district that lacks green areas. According to MINSA, it is one of the districts that presents 16% of people with poverty, a figure above the 11% average poverty level of districts in Metropolitan Lima.

Having urban agriculture in a district like Comas is important to improve and promote food consumption at low cost, the urban environment, economy, and community development of a society. It is not only the residents who practice it that benefit but also the place where it is developed. Its practice can generate new ways of understanding the city with the help of the population, employ the most disadvantaged groups, and reduce the index of extreme poverty.



**Figure 1.** Urban agriculture triad: Resilience, sustainability and multifunctionality. Retrieved from: <https://doi.org/10.1016/j.landurbplan.2021.104055>

## RESEARCH QUESTIONS

That information leads us to the research question: Would it be beneficial to have communal gardens in the district of Comas, and what benefits would it bring to the community? The focus is on communal gardens in abandoned spaces with no green areas to reduce food scarcity and environmental problems (e.g., pollution, temperature).

It is oriented towards local consumption and can promote sustainability from the economic and ecological aspects. They also create sources of work, generate additional income, create cooperatives that help the community work and reduce social exclusion. And finally, urban agriculture can reclaim empty land and contribute to urban metabolism through the insertion of nature in the form of communal gardens. This can generate spaces for participation and promote community work.



**Figure 2.** Urban agriculture. Retrieved from: *Agricultura en Lima* ([www.agriculturaenlima.org](http://www.agriculturaenlima.org)).  
By Anna Zucchetti.

## LITERATURE REVIEW

Urban agriculture is defined by Mougeot (2000) as an industry located in a city, which grows and raises, processes, and distributes a diversity of food and non-food products, reusing human and material resources, products, and services, which in turn provide human resources, materials, and services, mainly to that urban area.

Contesse et al. (2017) also add: “Urban green spaces deliver a wide range of ecosystem services in all Millennium Ecosystem Assessment categories: provisioning, regulating, supporting and cultural services. Green spaces remove pollution, attenuate noise and cool temperatures.” These are some of the benefits of having urban agriculture as a green space, which is good for the resident’s well-being.

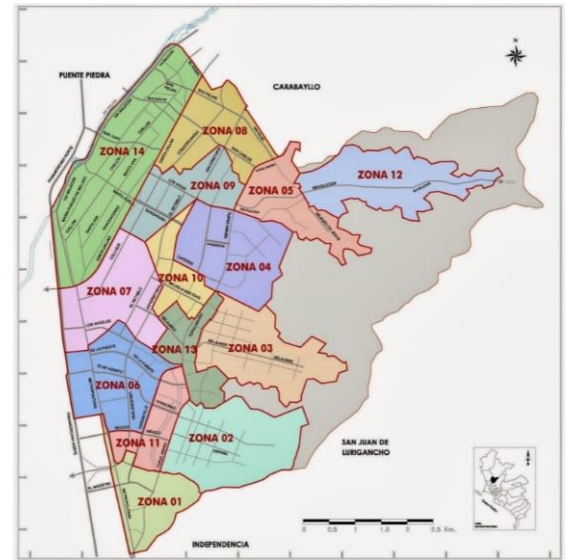
Often the urban planners and part of the scientific community do not consider spaces for Urban Agriculture. Langemeyer et al. (2020) stated that urban agriculture land-use is not prioritized in urban areas. There should be greater motivation of citizens and larger urban movements to counteract global dependencies, gain control of food production capacities, and foster local networks toward social change and resilience.

Alarcón et al. (2019) mention that Lima has a few urban and peri-urban communal gardens. However, there is no published research on the number and profile of these initiatives. Some local and international NGOs have worked on urban agriculture in different communities in Lima, but their experiences are rarely published in academic journals. There are five cases of communal gardens in Lima Este and Lima Sur. Alarcón et al. (2019) find that in 2012, the Metropolitan Municipality of Lima (MML) approved Ordinance No. 1629 that legalizes the use of public spaces for agriculture and implements the Mi Huerta program.

Funes-Monzote et al. (2019) affirm that about 800 million people migrate internally within countries, a figure three times higher than international migration. There is still a wide disparity between rural and urban living conditions in most countries. Social infrastructures and basic services are primarily located in cities, as are centers of energy, resources, and a population that generates heavy imbalances and fragilities in the economic, ecological and social aspects. Beyond what we can do in technological or organizational terms, it is important to emphasize the structural issues that allow a lasting development of strategies for the ruralization of cities and urbanization of the countryside. It is necessary to establish mechanisms to stimulate initiatives that strengthen the mentality of the producer, of environmental preservation and health care. Educational processes that involve all sectors of the population—from children to the most advanced ages—in movements focused on achieving these objectives are essential for changing awareness.

## METHODOLOGY

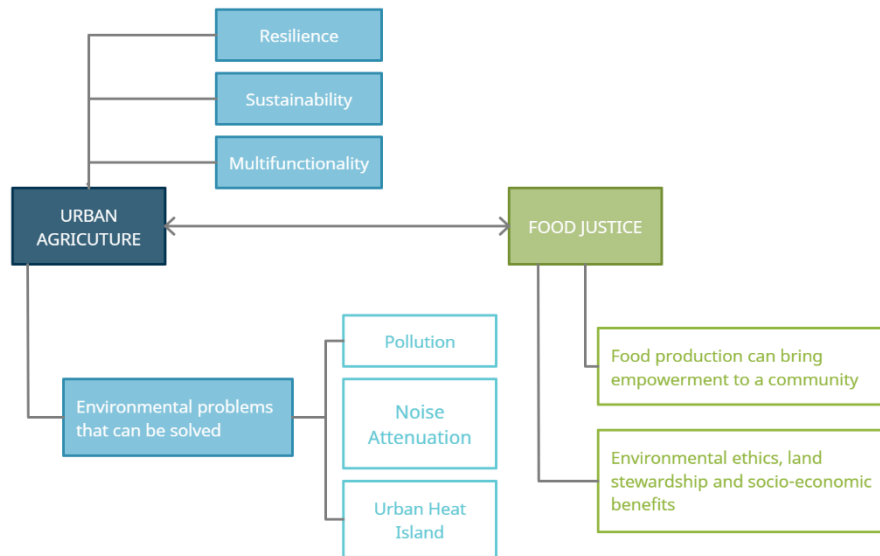
**I. Study/Site Area:** The analyzed area is Comas, in Lima, Peru. According to the Municipality of Comas, this is the fourth largest district in Lima, with over 500,000 people. The district is divided into 14 zones, and its total area is 48.75 km<sup>2</sup> (5% of the territory of the Metropolitan Lima area). Rio Chillón is the only water resource that passes through that territory. The study will be focusing on the high density of housing and few green spaces that the district presents. The best area to implement the community gardens would be Zone 14 because of its proximity to the river, a vital water resource for soil irrigation. Figure 3 shows a plan of the study area.



**Figure 3.** Plan of Comas district. Retrieved from: <https://www.municomas.gob.pe/distrito/geografia>

**II. Research Design:** The purpose of this study is to show that urban agriculture can be greatly beneficial to a community or an individual in Peru, specifically in the district of Comas. As shown in the image of the urban agriculture triad (2021), urban agriculture advances resilience, sustainability, and multifunctionality. It promotes resilience because urban agriculture counteracts urban challenges in periods of crisis (e.g., food production, fostering community networks, and individual recovery). It promotes sustainability because urban agriculture reduces environmental impacts such as pollution, attenuate noise, and cool temperature. It promotes multifunctionality because urban agriculture produces multiple ecosystem services besides food, like mitigation, recreation, social cohesion, and community empowerment. Finally, it is crucial to encourage the understanding of food justice where these food-growing initiatives can merge environmental ethics, land stewardship, and socio-economic benefits to ensure access to good food (Tornaghi, 2016).

**III. Data and Measures:** Growing sustainable food largely depends on what kinds of meals we want to consume, where they will be produced, and how easily we can produce them. The investigative research was roughly two-thirds qualitative data and one-third quantitative data.



*Figure 4. Conceptual framework of variables included in this study. Self-made.*

Measure	Data type	Data Source	Purpose
Urban Agriculture background information	Secondary	Academic Journals via UA Library Databases and Google Scholar	Identify the objectives of a positive intervention with urban agriculture in Comas, Lima, Peru.
Sowing and harvesting in the communal gardens	Primary	Questionnaire	Identify the crops/plants citizens would prefer to produce in Comas, Lima, Peru.
Neighborhood and soil features	Primary	Questionnaire	Identify where the citizens would prefer to grow food in Comas, Lima, Peru.

**IV. Methods:** The research is structured with a cross-sectional design. The literature was collected to determine factors and solutions for the lack of green spaces in the district of Comas in Lima, Peru. Participants from Comas also completed a

Qualtrics questionnaire. The questions focused on food accessibility, proximity to food sources, and interests in growing food. These questions helped determine if the residents from Comas are open to growing food on their own and consider it an important issue. Additionally, the case study of a successful community garden in Comas called “Maná mi Hermosa Huerta” is used as a basis for the creation of a new community garden in another area, improving the case study as much as possible.

## PRELIMINARY RESEARCH RESULTS

### CASES OF URBAN AGRICULTURE:

#### 1. CASE 1: Huertos en Línea, Lima, Peru.



**Figure 5.** Huertos en Línea. Retrieved from: <https://www.radionacional.com.pe/audios/que-hacer/huertos-en-linea>

In 2000, the new mayor of Villa María del Triunfo, in Lima, Peru, started to promote Urban Agriculture in the district. The local government developed the “Comprehensive Development Plan for Villa María del Triunfo (2001-2010).” This Plan is part of the new Organic Law of Cities of 2003/2004, promoting government decentralization, greater management control by local governments, and a greater need for economic independence.

Huertos en Línea is a set of 12 communal gardens, distributed in plots that are worked individually or as a family. All the communal gardens are located on lands under electrical lines belonging to the Peruvian Energy Network (REP). The project is financed mainly by this private company, and the Municipality of Villa Maria del Triunfo subsidizes the irrigation water. The REP currently finances the gardens as part of its corporate social responsibility program. They also provide the tools and materials necessary to clear the

land, install the posts and fences, and cultivate good-quality seeds. They also provide cisterns for water since not all communal gardens have access to a water point.

Figure 6 presents the areas of land that men (blue color) and women (green color) cultivate. When taken into account that more than half of the farmers are women, the distribution of these areas does not seem fair.



**Figure 6.** Map of areas by gender. Retrieved from: *Agricultura Urbana en Peru*, 2009.

The project, conceived as a municipal initiative, was administered and maintained locally, requiring coordination with neighborhood organizations and state programs already operating. Various NGOs, churches, and private companies join the project. Huertos en Línea also has a Board of Directors consisting of at least one representative from each of the 12 orchards. The Board is elected every three years and is responsible for making decisions on behalf of the whole orchards.

## 2. CASE 2: Red Promotora de Agricultura Urbana y Seguridad Alimentaria (REDPRAUSA), Lima, Peru.

In the early 2000s, the Pachacamac district had a high poverty rate. The levels of malnutrition and anemia were very high at that time, and the vast majority of the population lacked public services: 70.6% of homes lacked drinking water; 83.3% lacked drainage; 52.1% lived in substandard housing (FONCODES 2000). The illiteracy rate

was 6.4%, and the level of overcrowding was 35.5% (FONCODES, 2000). The labor activity rate was higher among men who sought employment in larger farms and in the more urbanized area of Lima, while women were left in charge of their homes.

REDPRAUSA is a network of twelve farmers who work individual gardens in Pachacamac, intending to access markets more easily and obtain greater benefits thanks to a reduction in the production costs from an economy of scale. REDPRAUSA members are residents of the district and are distributed in three different locations: Quebrada Verde, Picapiedra, and Alto Manchay. These communal gardens are, in some cases, close to the houses where the farmers live. These farmers are women. In the past, the women farmers were economically dependent on their husbands, who frequently made decisions without consulting them, including those about the sale of land.

This case created many achievements for the women farmers, like the satisfaction of producing and selling their products. Also, they transmit their knowledge and skills about agriculture to sons and daughters and grandsons and granddaughters. They also see the communal gardens as a source of pride, joy, and self-confidence.

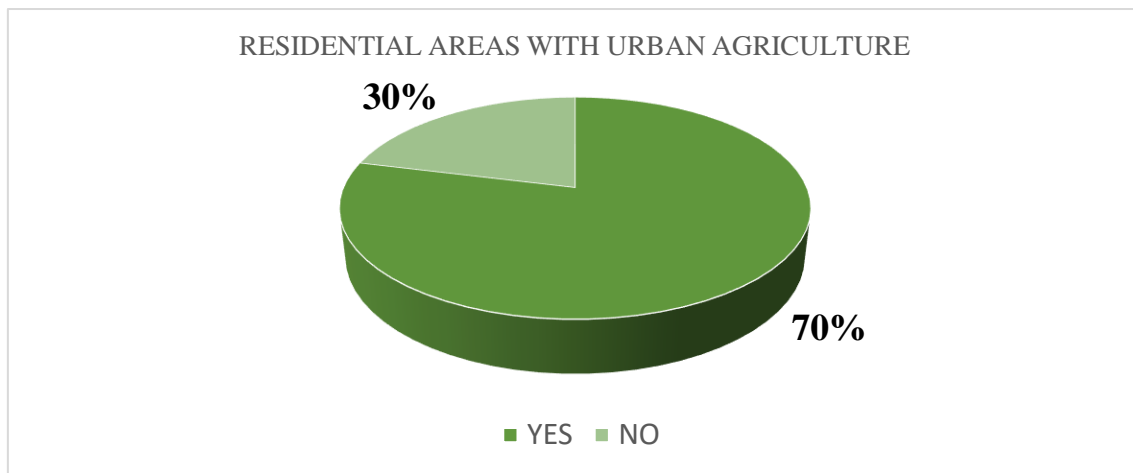
## DATA COLLECTION FROM COMAS:

As mentioned before, Comas is one of the poorest districts in Metropolitan Lima. In the poverty data below (Table 1), the people whose households cannot acquire a basic food and non-food basket (e.g., housing, education, health, transport, etc.) and the extreme poor that cannot afford the cost of a basic basket are considered poor. The table shows that some of the districts with the highest incidence of poverty are in North Lima, including Puente Piedra which exceeds a 30% poverty rate and has a larger population in extreme poverty, 2.7%.

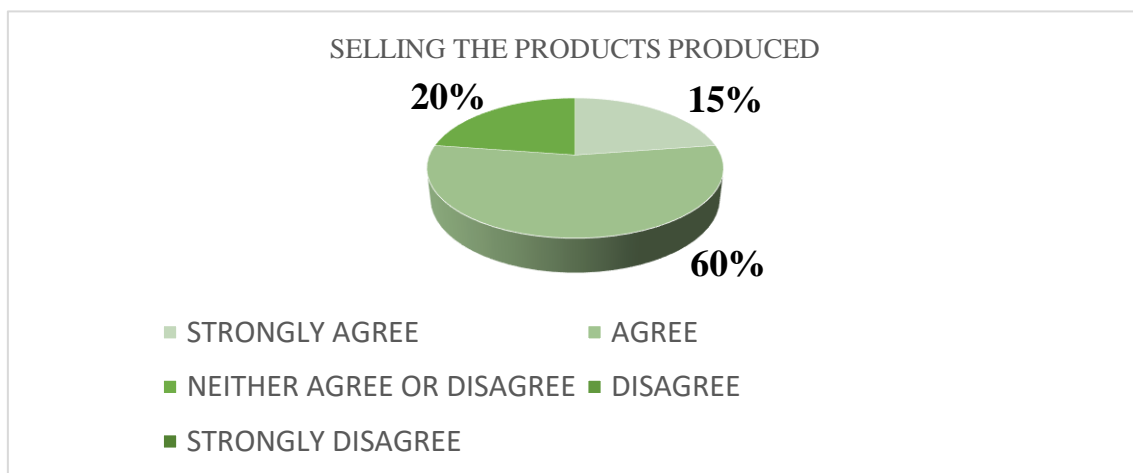
Áreas Interdistritales	Provincia / Distrito	Población 1/	Pobre (%)				Coef. Var. De la Pobreza Total
			Total de Pobres	Extremo	No Extremo	No Pobre	
	<b>Provincia de Lima</b>	<b>8,095,747</b>	<b>17.50</b>	<b>0.8</b>	<b>16.70</b>	<b>82.50</b>	<b>4.60</b>
Lima Norte	Ancon	36,401	19.60	0.8	18.80	80.40	8.90
	Carabaylo	237,269	26.30	1.5	24.80	73.70	4.90
	Comas	509,976	22.30	1.1	21.20	77.70	7.10
	Independencia	215,941	21.30	0.8	20.40	78.70	8.10
	Los Olivos	339,028	13.40	0.6	12.80	86.60	9.00
	Puente Piedra	263,594	35.60	2.7	32.90	64.40	5.80
	San Martín de Porres	620,193	10.90	0.3	10.60	89.10	7.00
	Santa Rosa	12,641	12.00	0.4	11.60	88.00	16.80
Lima Este	Ate	521,692	18.90	0.7	18.20	81.10	6.20
	El Agustino	188,138	22.10	1.0	21.10	77.90	7.60
	San Juan de Lurigancho	962,554	27.00	1.5	25.40	73.00	7.30
	Santa Anita	199,282	12.00	0.3	11.70	88.00	10.80
	Chaclacayo	42,884	10.10	0.3	9.80	89.90	10.10
	La Molina	144,491	0.70	0.0	0.70	99.30	31.20
	Lurigancho	184,593	24.40	1.3	23.00	75.60	4.70
	Cieneguilla	31,160	24.80	1.2	23.60	75.20	9.30
Lima Centro	Barranco	33,996	5.30	(0,2)	5.10	94.70	18.60
	Breña	82,987	8.50	0,3	8.30	91.50	13.10
	Lima	302,056	12.30	0,5	11.80	87.70	6.70
	Chorrillos	303,913	17.20	0,9	16.30	82.80	8.60
	Jesús María	71,139	1.70	0,0	1.70	98.30	22.90
	La Victoria	193,592	14.90	0,6	14.30	85.10	7.30
	Lince	55,733	4.00	(0,1)	3.80	96.00	16.60
	Magdalena del Mar	54,116	2.30	0,0	2.30	97.70	17.90
	Pueblo Libre	77,892	2.00	(0,1)	2.00	98.00	19.00
	Miraflores	86,920	0.80	(0,0)	0.70	99.20	35.10
	San Luis	57,080	7.10	(0,2)	6.80	92.90	11.30
	San Miguel	134,666	2.30	0,1	2.30	97.70	14.10
	Santiago de Surco	309,889	3.30	0,2	3.10	96.70	17.20
	Surquillo	93,271	5.20	(0,2)	5.00	94.80	12.70
	Rimac	178,869	16.50	0,7	15.80	83.50	7.30
San Borja	111,208	0.80	0,0	0.80	99.20	27.30	
San Isidro	58,920	0.60	(0,0)	0.60	99.40	47.30	
Lima Sur	San Juan de Miraflores	382,531	19.70	(0,7)	18.90	80.30	7.10
	Villa El Salvador	410,313	25.90	1,3	24.60	74.10	7.20
	Villa María del Triunfo	404,692	21.10	0,8	20.30	78.90	7.20
	Pachacamac	81,145	32.90	2,4	30.60	67.10	7.10
	Pucusana	12,148	26.70	1,6	25.20	73.30	12.50
	Lurín	69,282	30.20	2,5	27.80	69.80	6.60
	Punta Hermosa	6,309	7.40	0,3	7.10	92.60	22.00
	Punta Negra	5,951	9.50	0,3	9.20	90.50	20.40
	Santa María del Mar	924	4.00	0,0	4.00	96.00	50.60
	San Bartolo	6,368	9.70	0,3	9.40	90.30	19.70

**Table 1.** Monetary poverty chart. Retrieved from: <https://repositorio.urp.edu.pe/bitstream/handle/URP/1545/3%20%20MARCO%20DEMOGR%C3%81FICO%20SOCIO%20ECONOMICO.pdf?sequence=3&isAllowed>

My research is based on a survey from the residents of Comas about their perceptions of urban agriculture. Twenty-four residents completed the survey, and while this is not a representative sample, some interesting conclusions can be drawn. With the results, I determined what the community thinks about urban agriculture and if they are willing to apply it in their life. This activity promotes community work, making the residents feel their environment is theirs and that they can take care of it and maintain it. It not only favors the inhabitants of the place but also improves the urban environment since Lima has many degraded public spaces which can be recovered with this activity.

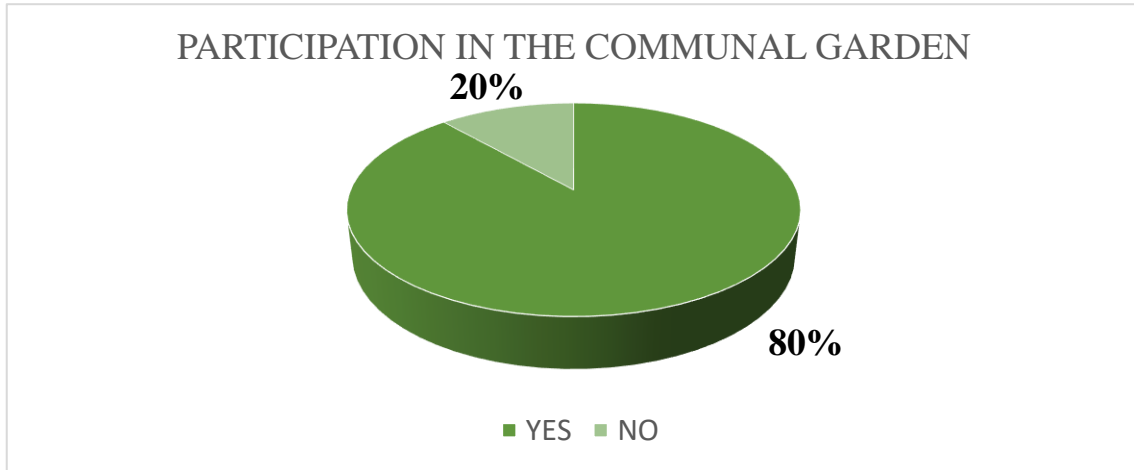


More than 70% of the 24 residents agreed with implementing urban agriculture in the residential area.



In addition, almost 60% of the residents are willing to sell the products on-site that they can produce in their communal gardens. This is a great incentive to plan a better space for the community to produce and sell different types of vegetables and fruits.

Most respondents prefer to produce the products in a communal garden or a rooftop. More than 80% of residents considered that having a communal garden is beneficial for the environment, and that is why they would have communal gardens in their residential areas.



More than 70% of the residents would participate in the planning and making of the communal garden, and with a high rate of participation, this can mean that the project can be a success.

However, the participation of the community is not the only thing that is important for the success of this project. Without proper management and planning, the results could be unfavorable. The insertion of urban agriculture does not depend only on the inhabitant's work, but also on the local government. Guidelines and regulations are needed to regulate, encourage, and improve the development of this activity.

The administrative structure of urban agriculture in Villa Maria del Triunfo is a good example that can be duplicated in Comas.

Another important part of the research is what kinds of vegetables and fruits could be grown inside the communal garden. The sowing calendar of the Ministry of Agriculture and Irrigation was taken as a reference. This indicates which vegetables to grow according to the seasons of the year, and it also indicates the appropriate conditions for the development of vegetables. It is important to mention that there are vegetables brought from other countries, which is why the climatic conditions most similar to those of their place of origin are taken into account. Lima has a varied climate, which lends itself to growing various vegetables, as shown in the sowing calendar below.

Product / Month	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Set	Oct	Nov	Dic	
Cotton		0,6	5,6	26,4	35,5	20,5	9,6	1,8					100,0
Sweet potato	7,2	7,7	8,1	8,1	8,3	9,6	9,7	7,9	8,2	8,7	7,4	9,1	100,0
Sugar cane	8,3	8,0	7,9	6,6	7,1	7,3	8,3	9,1	9,1	9,6	9,5	9,2	100,0
Asparagus	7,8	7,9	7,1	6,6	4,8	5,9	6,8	9,2	6,5	7,3	11,8	18,3	100,0
Dry grain beans	6,9	8,5	9,6	13,3	9,2	8,3	7,3	6,5	6,0	7,6	8,6	8,2	100,0
Hard yellow corn	6,9	8,5	7,8	8,7	8,7	8,4	7,2	8,1	8,0	9,3	8,9	9,5	100,0
Starchy corn	0,5	0,8	1,2	2,9	6,7	15,3	24,7	23,6	20,1	2,6	0,9	0,7	100,0
Tangerine	0,6	1,4	3,7	8,7	13,4	14,5	16,0	16,5	12,8	7,0	3,8	1,6	100,0
Apple	8,0	10,2	13,6	9,8	9,3	8,7	6,2	6,7	6,0	6,0	7,1	8,4	100,0
Orange	0,4	0,1	0,1	0,6	2,8	11,5	19,7	33,4	13,8	9,3	6,7	1,6	100,0
Avocado	1,7	3,6	6,3	11,1	12,5	17,1	14,0	13,1	7,1	4,6	6,1	2,8	100,0
Potato	8,6	4,4	6,1	8,8	10,0	6,8	3,0	5,7	7,8	10,5	13,9	14,4	100,0

**Table 2.** Calendar of harvest. Retrieved from: <https://www.midagri.gob.pe/portal/21-sector-agrario/agricola/181-calendario-agricola>

Product / Month	Ago	Set	Oct	Nov	Dic	Ene	Feb	Mar	Abr	May	Jun	Jul	
Cotton	11,3	32,2	30,8	13,7	2,9	5,5					0,6	3,0	100,0
Sweet potato	7,8	6,8	7,4	7,1	8,8	7,8	8,0	9,0	10,1	10,5	9,2	7,5	100,0
Dry grain beans	7,7	7,1	8,6	8,3	7,5	8,3	6,4	8,4	8,2	9,8	12,2	7,5	100,0
Hard yellow corn	7,1	5,8	7,5	7,5	8,0	7,8	11,3	9,3	9,5	8,7	9,3	8,2	100,0
Starchy corn	3,0	3,2	2,4	5,1	4,6	9,8	13,2	16,2	9,9	12,1	10,0	10,5	100,0
Potato	18,7	9,5	11,8	11,2	5,8	2,0	0,8	0,9	4,6	7,8	13,2	13,7	100,0
Tomato	7,9	7,5	8,7	8,3	6,8	7,9	8,4	7,6	9,3	9,6	9,0	9,0	100,0
Yucca	15,8	19,9	14,4	12,0	14,5	3,2	2,7	2,3	3,3	3,8	3,5	4,6	100,0

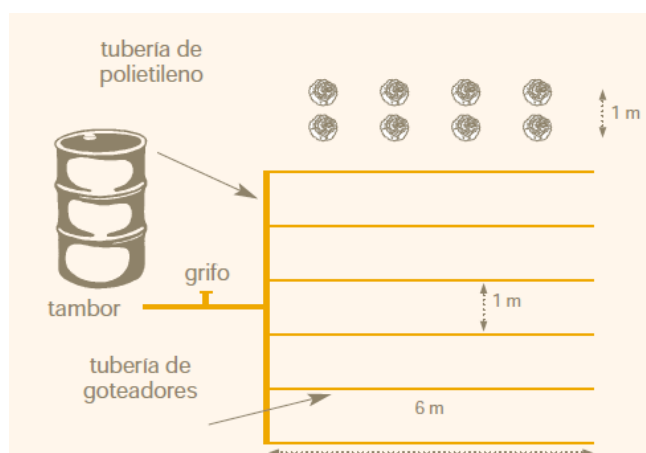
**Table 3.** Calendar of sowing. Retrieved from: <https://www.midagri.gob.pe/portal/21-sector-agrario/agricola/181-calendario-agricola>

## MICRO TECHNOLOGIES FOR URBAN AGRICULTURE

The following technologies presented can be used in Lima, specifically for this case, since these microtechnologies are designed for urban environments and are not expensive, which is beneficial for the community since they will not need much to implement them.

### The drum and drip micro-irrigation system:

Gerrie Albertse of Farming Systems Consulting Services in Stellenbosch adapted a low-cost drip irrigation system developed by International Development Enterprises to meet the conditions of small South African farmers. This adaptation, called a drip and drum micro-irrigation system, consists of a 210-liter drum connected through a tap to a set of five polyethylene drip lines, each with a length of 6 m. (Van Averbeke, 2013)



**Figure 8.** Micro-irrigation system by drum and drip. Retrieved from: *REVISTA Agricultura Urbana*. 2013.

Drippers are made by piercing polyethylene tubing with a heated nail. A length of rope is passed through these perforations with the help of a thick sewing needle. The knots made at both ends of the rope prevent it from coming out of the tube. When the holes become clogged, the rope is pulled from one side

to the other, usually enough to unblock the openings. Dripper clogging can be decreased by placing a stone and a sand filter in the bottom of the drum. This prevents finer particles, which may be present in the irrigation water, from penetrating the pipes and blocking the pipe's holes.

The drum and drip system can irrigate an area of  $6\text{m} \times 6\text{m} = 36\text{m}^2$ . According to its designer, the system allows around 60 kg of fresh vegetables every four months. This requires the application of 600 liters of water per week, which is equivalent to three full drums. In 2003, the components needed to build the drip and drum micro-irrigation system were about US \$20.

People were unable to purchase fruits and vegetables due to widespread poverty, and they were unable to cultivate their crops due to severe water shortages. The drip and drum micro-irrigation system was developed to enable vegetables to be grown with gray water.

### **Hydroponic Technology:**

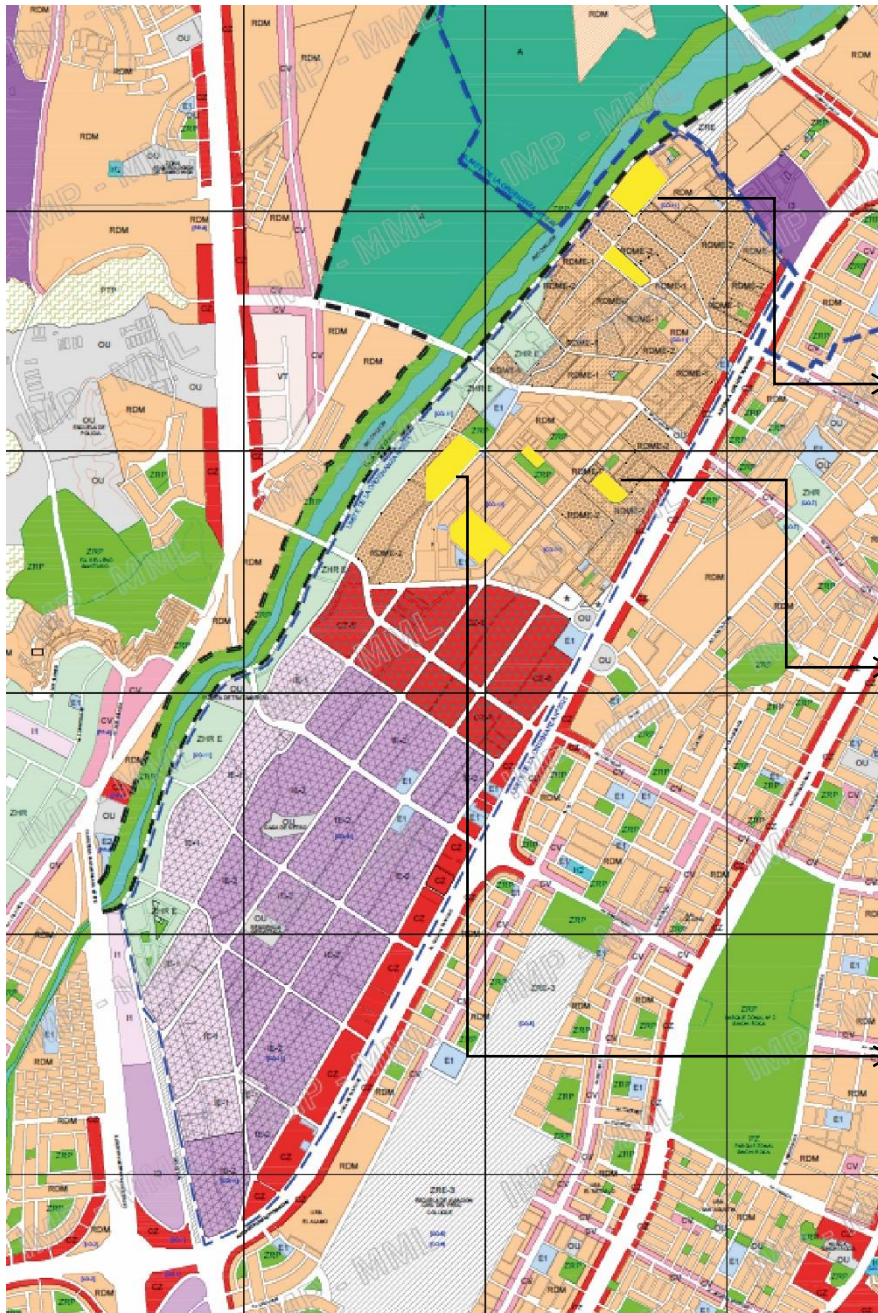
Hydroponics is a technology that does not require the use of land, allowing for the use of small urban spaces, saving time, labor, and supplies. It uses containers, in some cases under direct irrigation with water enriched with nutritious solutions, and in others, with the same irrigation, but through substrates that, besides serving to fix the roots provide the required specific moisture and oxygenation for certain plants. The results are amazing, as are the cheap costs of its inputs (Rios, 2013).

Initially, the project's goal was to teach poor settlers how to grow, cook, and consume vegetables in limited places to improve their diet. Later, it was discovered that high production allowed surpluses to be obtained for marketing within the same sectors where they were produced and in select markets, provided additional income for the families that had a fragile or non-existent income. However, as the project has progressed, it has become clear that, in addition to the previously mentioned benefits, the project's main value is the generation of a new human attitude among the poor toward socio-productive activities that can be developed within the home or in the neighborhood with the participation of family members. This adds to the family's and community's development in a cost-effective, timely, and efficient manner.



*Figure 9. Hydroponic technology. Retrieved from: <https://diariohoy.net/interes-general/hidroponia-un-sistema-de-cultivo-a-favor-de-la-salud-y-el-medioambiente-143688>*

**PROJECT DESIGN**



**KEY**

**Residential Areas**

- RDM Medium Density Residential
- RDA High Density Residential
- VT Workshop Housing

**Comercial Areas**

- CV Neighborhood Commerce
- CZ Zonal Commerce
- CM Metropolitan Commerce

**Industrial Areas**

- RDM Elementary and Complementary Industry
- RDA Light Industry
- VI Big industry

**Equipment Areas**

- E1 Basic education
- E2 Technological Higher Education
- E3 University Higher Education
- E4 Post Graduate Higher Education
- H Clinic
- Hospital
- ZRP Public Recreation Zone
- ZHR Recreational Habilitation Zone
- OU Other Uses
- ZRE Special Regulation Zone

**Urban Agriculture**

- VI Vacant Land for UA

Figure 10. Zoning Plan of Comas. Retrieved from: Municipality of Comas.



Figure 11. Image from Google Maps. 2013



Figure 12. Image from Google Maps. 2013



Figure 13. Image from Google Maps. 2013

After reviewing the land that has no use or has a bad use in Comas, it was concluded that 6 spaces are feasible for the placement of a communal garden due to their dimensions.

In order to develop a prototype of what the communal garden would look like, the land closest to the Chillón river was chosen because it is the ideal example.

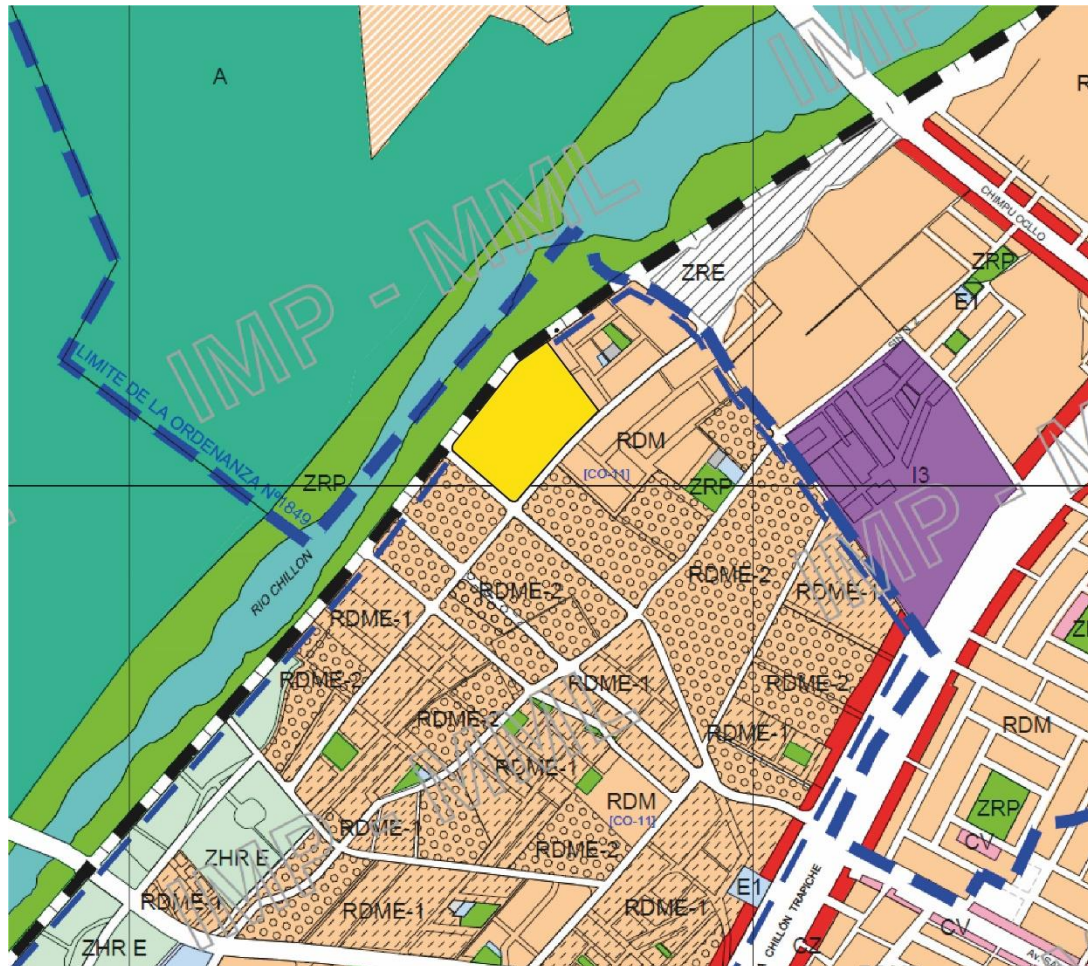


Figure 14. Zoning Plan of Comas. Vacant land selected in yellow.

The final prototype of the communal garden project consists of three important parts: a land area for planting and harvesting; a gathering area for the community, where it can be used as a space to train and teach the community the best management of the land for crops; and finally a space where community members can sell their produce to generate greater economic income.



Figure 15. Prototype in the vacant land in Comas. Self-made.



Figure 16. Render of Urban Agriculture. Retrieved from: <https://www.arquine.com/escuela-rural-productiva/>

## **DISCUSSION**

Urban agriculture is an alternative that supports economic growth and provides food security to low-income people, allowing extra income and high-quality food, which can help against malnutrition. It favors the inhabitants of the place and improves the urban environment since there are many degraded public spaces in Lima, which can be recovered thanks to this activity.

Urban agriculture within urban planning has a positive impact since it helps to improve the city and the habits of a population. It can provide food security, and this can be inserted in the city, as in the case of communal gardens and public spaces, creating a productive character and not only ornamental. In the context of Comas, urban growth has occurred in an unplanned way, areas that were not suitable for construction have been invaded, and only the construction of houses was considered but not the construction of public spaces. Thus, incorporating urban agriculture in public spaces or outside of them in a planned way contributes to the structure of a city.

The implementations of microtechnologies can obtain the highest production levels per unit area, which is essential for agriculture in confined spaces. The production from the microtechnologies requires precise handling but not necessarily a substantial investment since sufficiently efficient rustic installations can be used.

## **CONCLUSION**

This capstone explored ways to improve access to green spaces for the residents of Comas through community gardens. Through a survey, it became clear that residents are interested in utilizing community gardens. In-depth case studies helped identify successful gardens to draw upon and new technologies to improve efficiency.

## **LIMITATIONS**

There may be some limitations to this study. The first one is that although the questionnaire was sent to a group of residents from Comas district, it may not be a representative sample. Future studies would benefit from a wider sample and in-person interviews. The pandemic made this difficult to achieve, so future work would benefit from in-person conversations.

## **RECOMMENDATIONS**

Even though residents from the district of Comas are willing to participate in making a communal garden, it is important to have support from the local government to provide guidelines for the project and help the residents to maintain the communal gardens optimally. Nowadays, it is hard to imagine that a district like Comas can provide food security, economic growth, and good public spaces. However, Comas can become a sustainable district if the local government and the residents support the project. It is impressive how the community is willing to implement communal gardens all over the study area, not only because it is good for the environment but also because it can improve their lives for the better.

## REFERENCES

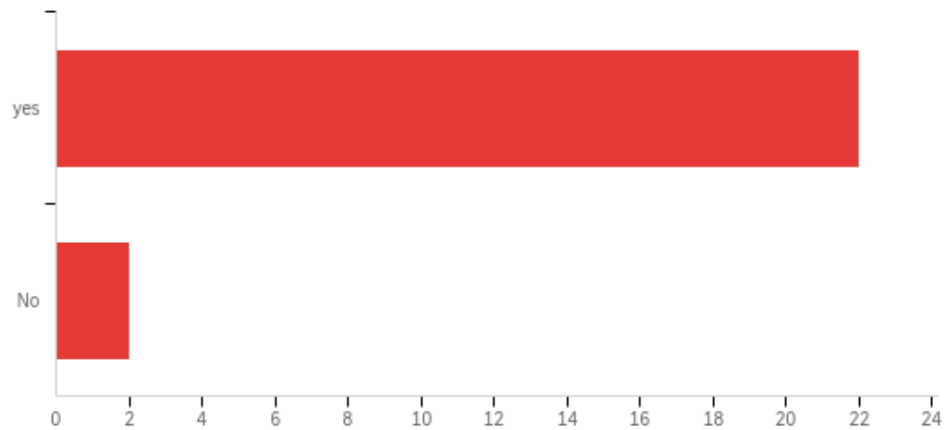
- Alarcón, D.; Schvimer, J.; Kohn, A. (2019) AGRICULTURA URBANA EN PERÚ. Estudio de cinco casos en Lima Metropolitana. Retrieved from: <http://www.agriculturaenlima.org/wp-content/uploads/2019/05/Estudio-5-Casos-en-Lima.pdf>
- Beltran, A.; Castro, JF.; Vazqués, E. (2017) Hambre cero al año 2030 en el Perú. ¿Como lograr el segundo Objetivo del Desarrollo Sostenible? Retrieved from: <https://docs.wfp.org/api/documents/WFP-0000063889/download/>
- Contesse, Maria, Van Vliet, Bas J.M, and Lenhart, Jennifer. “Is Urban Agriculture Urban Green Space? A Comparison of Policy Arrangements for Urban Green Space and Urban Agriculture in Santiago De Chile.” *Land Use Policy* 71 (2018): 566-77. Web.
- Hernández, L. (2006). LA AGRICULTURA URBANA Y CARACTERIZACIÓN DE SUS SISTEMAS PRODUCTIVOS Y SOCIALES, COMO VÍA PARA LA SEGURIDAD ALIMENTARIA EN NUESTRAS CIUDADES. *Cultivos Tropicales*, 27(2),13-25. Retrieved from: <https://www.redalyc.org/articulo.oa?id=1932/193215872002>
- Instituto Nacional de Estadística e Informática (INEI), "Mapa de la Pobreza Distrital 2013".
- Instituto Nacional de Estadística e Informática (INEI), “Planos Estratificados de Lima Metropolitana a Nivel de Manzanas 2020”.
- Langemeyer, Johannes, Madrid-Lopez, Cristina, Mendoza Beltran, Angelica, and Villalba Mendez, Gara. “Urban Agriculture — A Necessary Pathway towards Urban Resilience and Global Sustainability?” *Landscape and Urban Planning* 210 (2021): 104055. Web.
- Mougeot, Luc J.A. (2000). Urban Agriculture: Definition, Presence, Potentials and Risks, and Policy Challenges. 31. International Development Research Centre. Ottawa, Canadá.
- Ministerio de Salud (MINSA). Análisis de la situación local de salud. Distrito de Comas. Provincia de Lima. 2019. Retrieved from: [https://www.dge.gob.pe/portal/docs/asis-lima-2019/CD\\_MINSA/DOCUMENTOS\\_ASIS\\_ASIS\\_DISTRITO%20COMAS%202019.pdf](https://www.dge.gob.pe/portal/docs/asis-lima-2019/CD_MINSA/DOCUMENTOS_ASIS_ASIS_DISTRITO%20COMAS%202019.pdf)
- Municipality of Comas. <https://www.municomas.gob.pe/distrito/geografia>.
- Scazzosi, Lionella., and Paola. Branduini. *AgriCultura Urban Agriculture and the Heritage Potential of Agrarian Landscape*. 1st Ed. 2020. ed. 2020. Urban Agriculture. Web.
- Tornaghi, Chiara. “Urban Agriculture in the Food-Disabling City: (Re)defining Urban Food Justice, Reimagining a Politics of Empowerment.” *Antipode* 49.3 (2017): 781-801. Web.

- Urban Harvest (2007). Memoria y Declaración: “Agricultura Urbana y Periurbana en Lima Metropolitana: una estrategia de lucha contra la pobreza y la inseguridad alimentaria”. Centro Internacional de la Papa-Urban Harvest, Lima-Perú. Retrieved from: <http://cipotato.org/wp-content/uploads/2014/09/004205.pdf>
- Van Veenhuizen, R. (2003, December) Micro-technologies for urban agricultura. No. 10. ISSN No. 13 902 334
- Zasada, Ingo. “Multifunctional Peri-urban Agriculture—A Review of Societal Demands and the Provision of Goods and Services by Farming.” *Land Use Policy* 28.4 (2011): 639-48. Web.

## APPENDIX

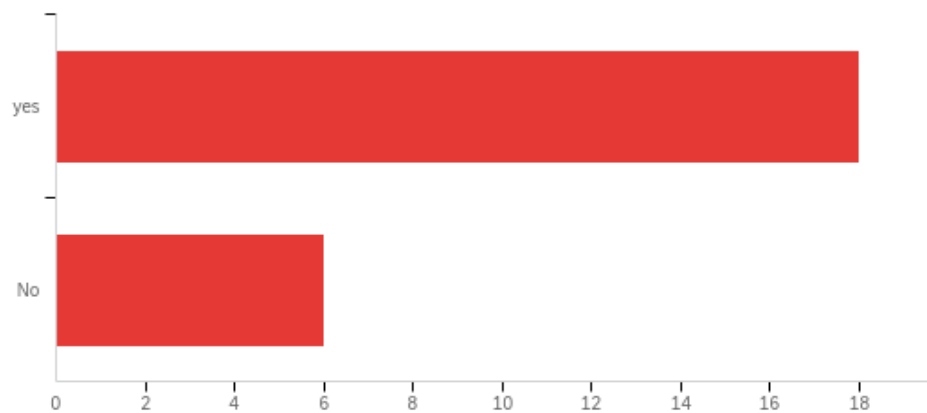
*TOPIC: URBAN AGRICULTURE SURVEY TOOL TO IMPROVE THE LIFE OF A COMMUNITY*

**Q1 - Do you currently reside in any of these districts: Puente Piedra, Santa Rosa, Ancón, Carabaylo, Comas, Independencia, SMP and Los Olivos?**



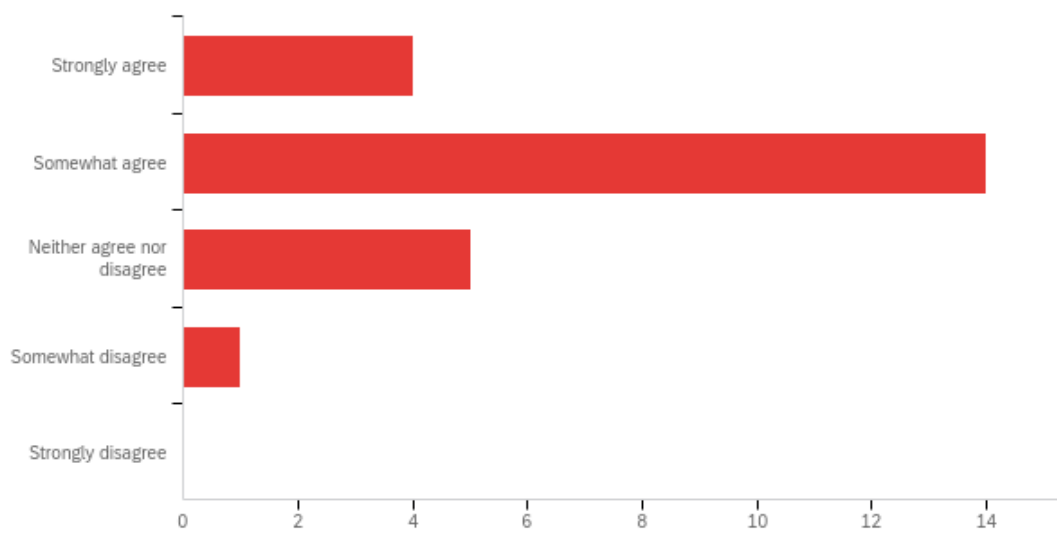
#	Answer	%	Count
1	yes	91.67%	22
2	No	8.33%	2
	Total	100%	24

**Q2 - In the residential areas, do you think spaces should be allocated to have urban agriculture?**



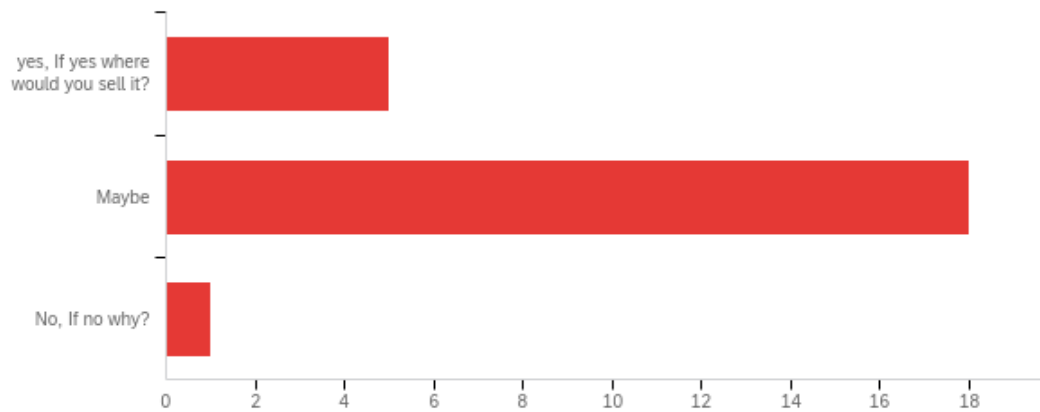
#	Answer	%	Count
1	yes	75.00%	18
2	No	25.00%	6
	Total	100%	24

**Q3 - In the residential area, do you think selling garden products on site could be appropriate?**



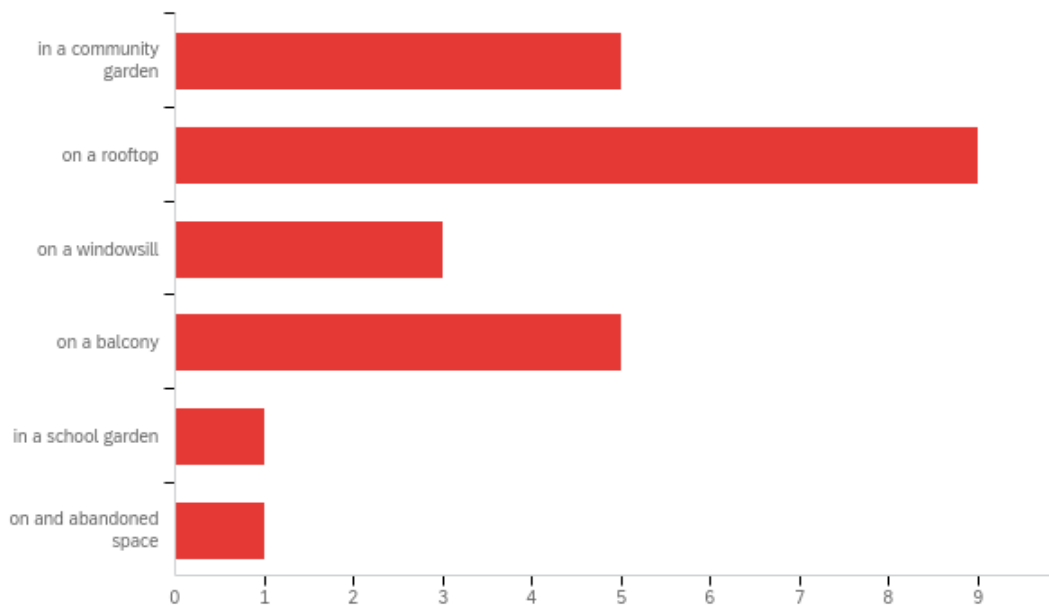
#	Answer	%	Count
1	Strongly agree	16.67%	4
2	Somewhat agree	58.33%	14
3	Neither agree nor disagree	20.83%	5
4	Somewhat disagree	4.17%	1
5	Strongly disagree	0.00%	0
	Total	100%	24

#### Q4 - Would you sell the food that you produce?



#	Answer	%	Count
1	yes, If yes where would you sell it?	20.83%	5
2	Maybe	75.00%	18
3	No, If no why?	4.17%	1
	Total	100%	24

#### Q5 - Where would you prefer to grow the food?



#	Answer	%	Count
1	in a community garden	20.83%	5
2	on a rooftop	37.50%	9
3	on a windowsill	12.50%	3
4	on a balcony	20.83%	5
5	in a school garden	4.17%	1
6	on and abandoned space	4.17%	1
	Total	100%	24

### Q6 - What type of crop/plants would you prefer to produce?

passion fruit

figus

eucaliptus

fruits

vegetables

letucce

letucce

carrot

figus

lettuce, carrot

Legumbres u hortalizas

Tomatoes

Lettuce, potato, carrot, strawberry

plants that grow in all seasons of the year

I would like to produce potato

lettuce

aubergine or aji amarillo

corn

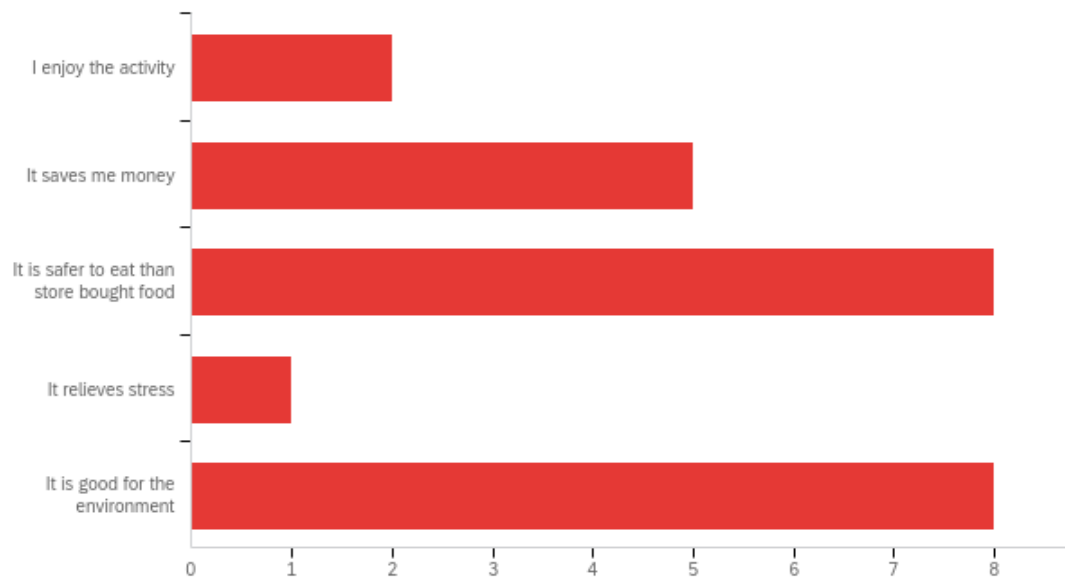
Rosemary, carrot, lettuce

Sorry, I don't know

I would like to produce mostly what I consume: tomato, lettuce, avocado, beet, broccoli, artichoke

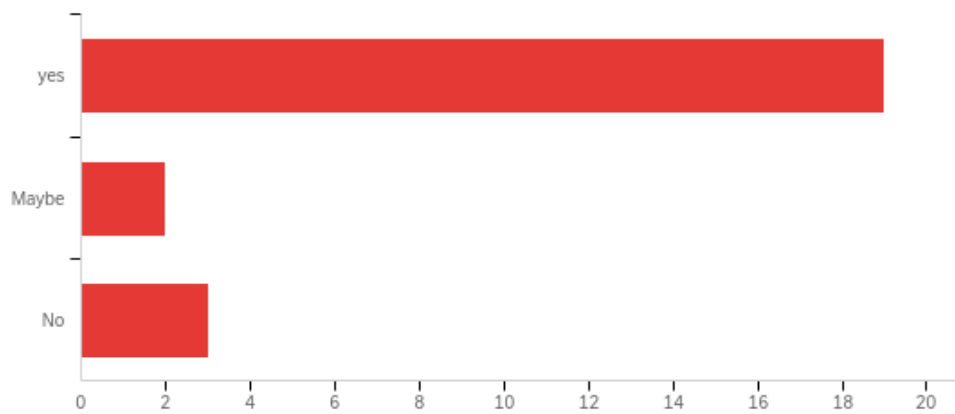
vegetable and plants that not require much attention

### Q7 - Why would you grow the food in a communal garden?



#	Answer	%	Count
1	I enjoy the activity	8.33%	2
2	It saves me money	20.83%	5
3	It is safer to eat than store bought food	33.33%	8
4	It relieves stress	4.17%	1
5	It is good for the environment	33.33%	8
	Total	100%	24

**Q8 - Do you think that the involvement of the community in the participation of producing in a communal garden can be beneficial for the area?**



#	Answer	%	Count
1	yes	79.17%	19
2	Maybe	8.33%	2
3	No	12.50%	3
	Total	100%	24