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Urban Agriculture in the Framework of Sustainable Urbanism

Agriculture represents a crucial phase in the development of mankind. Although cities initially had close ties with agriculture, which was a key element in ancient civilisations, in modern twentieth-century urban plans, such as Le Corbusier’s Chandigarh or Lucio Costa’s Brazilia, agriculture was banished from large cities. The demographic growth of urban areas today and its predictions for the short and long term have increased the value of urban agriculture.

Introduction

As a result of the fast and constant increase in population in many parts of the world, especially in Africa, the Middle East and areas of Latin America, and the decrease in agricultural productivity per capita, some studies suggest that we may in future enter a global food crisis.¹ According to figures provided by the Food and Agriculture Organization of the United Nations (FAO), almost a billion people suffer from malnutrition and four hundred million are chronically undernourished.

Furthermore, in order to optimise large-scale production and commercialisation of food products, new and increasingly advanced farming technologies are

developed. And yet, the expansion of cities resulting from the ever-growing numbers of people moving from rural to urban areas is seriously compromising food production. In the European Union, for instance, approximately 75% of the population lives in cities, a percentage that is expected to rise to 80% by 2020.² In their turn, Latin America and the Caribbean is currently the most densely developed region of the world, where 79% of the population is concentrated in urban areas, and one out of every three people lives in a city of at least one million inhabitants.³ 70% of the population in Oceania today is concentrated in cities, whereas by 2050 the urban population⁴ of Africa and Asia is expected to reach 61.6% and 64.7% respec-

1 *Food, Nutrition and Agriculture... Alimentación, nutrición y agricultura [online]*, Food and Agriculture Organization of the United Nations. [Accessed: 12 November 2014]. Available at: <<http://www.fao.org/docrep/u3550t/u3550t00.htm#Contents>>.

2 'Making our cities attractive and sustainable. How the EU contributes to improving the urban environment,' Publications Office of the European Union, Luxemburg, 2010.

3 'ONU anticipa mayor crecimiento urbano en América Latina,' 2010 [online]. [Accessed: 5 November 2014].

Available at: <<http://www.un.org/spanish/News/story.asp?NewsID=17969#U2FpUVck61J>>. José Marcos Pinto da Cunha, Jorge Rodríguez Vignoli, 'Crecimiento urbano y movilidad en América Latina,' *Revista Latinoamericana de Población* [online]. Asociación Latinoamericana de Población, Year 2, Vol. 3, No. 4-5 (January-December 2009), pp. 27-64. [Accessed: 5 November 2014]. Available at: <http://www.alapop.org/2009/Revista/Articulos/Relap4-5_art2.pdf>.

4 Zulma Recchini de Lattes, 'Demografía y política en el siglo XXI,' in *V Jornadas Argentinas de Estudios de Población*, AEPa, Buenos Aires, 2001, pp. 795-803.

tively,⁵ which will necessarily increase the complexity and diversification of urban connections.

This is how demographic growth, development, unequal distribution of land, the decrease in size of exploitations and the continuous impoverishment of farmers have helped reduce the traditional production of food,⁶ leading to an excessive exploitation of natural resources and an increase in pollution and in food demands. Due to the distance between the rural areas where food is farmed and produced and the urban areas where it is distributed and consumed, the latter are subject to greater economic, environmental and social costs that, in turn, restrict and complicate access to food for vulnerable families threatened by food insecurity and social exclusion. We should mention that the food security of these families doesn't only depend on their income but also on the stability of food costs and on the variety and quality of food available.

In this case we have to turn to other forms of agriculture that guarantee food security for the population at a lower cost and according to sustainable development. In this sense, agriculture assumes a new meaning, encompassed by the concept of urban agriculture introduced by the Food and Agriculture Organization of the United Nations in 1999. The term 'refers to small areas within cities, such as vacant lots, gardens, verges, balconies and containers, that are used for growing crops ... and raising small livestock or milk cows for own-consumption or sale in neighbourhood markets.'⁷

Urban and peri-urban agriculture gives cities the possibility of producing food and attaining maximum efficiency, minimising costs and optimising spaces in built environments. This would replace the present linear production of foodstuffs with a circular system that would make the most of urban cycles,⁸ ensuring food security in low-resource, vulnerable homes and helping to solve the problem through a permanent supply of fresh food, generating jobs and additional income from the sale of farming surpluses.

“During World War I, several countries turned to strategies related to allotments and gardens to complement the limited amount of food available after rationing”

History of Urban Agriculture

Urban agriculture has existed for hundreds of years, as exemplified by the glorious ages of the Egyptian, Greek, Roman and Byzantine cultures, when leaf vegetables, medicinal herbs, palm trees and fruit trees were cultivated within the urban areas of the most important cities.⁹

The monasteries and convents, palaces and private Italian houses of the Middle Ages had orchards

and gardens that grew medicinal herbs and leaf vegetables for feeding the inhabitants of cities.¹⁰

The first garden cities appeared in England in the late nineteenth century: Bedford Park (1877-1897) by Norman Shaw, Letchworth Garden City (1903) and Hampstead Garden Suburb (1907), by Raymond Unwin and Barry Parker. Allotment gardens for workers were created in France and Belgium, with the intention of defending social order. The economic depressions of 1893 and 1929 witnessed the birth of potato patches and relief gardens emerged in the United States as urban spaces for growing potatoes, beans and turnips.¹¹

During World War I, several countries turned to strategies related to allotments and gardens to complement the limited amount of food available after rationing, as exemplified by the United States School Garden Army, the Woman's Land Army of America and Liberty Gardens.¹²

Campaigns designed to support urban agriculture continued during World War II and included Dig for Victory, promoted in Great Britain in 1940 by the Agricultural Plans Branch of the Ministry of Food, and Victory Gardens, endorsed in the United States by the War Food Administration.¹³

Urban agriculture would be revived in the seventies, particularly in the form of allotments, which were used as a tool for community support and the promotion of social cohesion. The Green Guerrilla movement in New York, inspired by community

groups, bombards abandoned urban spaces with balls of clay and seeds. In Europe, the City Farms and Community Gardens campaign emerged in the Netherlands and then spread to the United Kingdom, where the growth of crops and the breeding of farm animals are integrated in urban environments.¹⁴ In the case of Spain, Miraflores Park opened in Seville in 1990 and the Network of Urban Allotments was created in Barcelona in 1997.¹⁵

As from the nineties, the following initiatives are worth mentioning: London 2012 Capital Growth and Abbey Gardens in Britain, South Central Farm in the United States, 56 St Blaise in Paris, Prinzessinnengärten and Garten Rosa Rose in Berlin, Forat de la Vergonya (The Hole of Shame) in Barcelona, Huerto del Rey Moro (Garden of the Moorish King) in Seville, Romita Urban Garden in México, the Urban Agriculture Programme in Cuba, and Guerrilla Gardening (directly influenced by the Green Guerrilla movement) in a number of different countries. We should stress that in the twenty-first century the paradigm seems to be moving towards eco-monumentality, giving rise to zero-emission,¹⁶ energy generating and plant-design projects: vertical farms, a system of gardens and allotments throughout the motorway network of Tokyo and the high-tension network of Toronto, roof gardens on New York's huge factory buildings, etc.

We could say that the objectives, users, forms and organisation of urban agriculture have gradu-

5 Andrés Arroyo Pérez (coor.), 'El futuro de la población' [online]. *Información Estadística y Cartográfica de Andalucía*, No. 1 (2011), pp. 81-96. [Accessed: 5 November 2014]. Available at: <<http://www.juntadeandalucia.es/institutodeestadisticaycartografia/InformacionEstadisticayCartografica/RevistaFuturoPoblacion.pdf>>

6 Ileana Ceron-Palma, Esther Sanyé-Mengual, Jordi Oliver-Solà, Juan Ignacio Montero and Joan Rieradevall, 'Barriers and Opportunities Regarding the Implementation of Rooftop Eco-Greenhouses (RTEG) in Mediterranean cities of Europe,' *Journal of Urban Technology*, Vol. 19, No. 4 (2012), pp. 87-103.

7 'Issues in urban agriculture,' *Spotlight / 1999* [online]. Food and Agriculture Organization of the United Nations,

Agriculture and Consumer Protection Department, January 1999 [Accessed: 6 November 2014]. Available at: <<http://www.fao.org/ag/.../9901sp2.htm>>.

8 Ileana Ceron-Palma, Esther Sanyé-Mengual, Jordi Oliver-Solà, Juan Ignacio Montero and Joan Rieradevall, 'LCM of green food production in Mediterranean cities: environmental benefits associated to the energy savings in the use stage of Roof Top Greenhouse (RTG) systems. A case study in the city of Barcelona,' Life Cycle Management Conference, 2011, Berlin.

9 Jules Janick, 'Ancient Egyptian Agriculture and the Origins of Horticulture,' [online], *Acta Hort*, Department of Horticulture and Landscape Architecture, 582, pp. 23-39, 2002. [Accessed: 6 November 2014]. Available at: <<https://www.hort.purdue.edu/newcrop/pdfs/actahort582-2002.pdf>>.

10 Miriam-Hermi Zaar, 'Agricultura urbana: algunas reflexiones sobre su origen e importancia actual' [online]. *Revista Bibliográfica de Geografía y Ciencias Sociales*, Vol. 944, No. 16 (15 October 2011). [Accessed: 5 November 2014]. Available at: <<http://www.ub.edu/geocrit/b3w-944.htm>>.

11 Nerea Morán Alonso and Agustín Hernández Aja, 'Historia de los huertos urbanos. De los huertos para pobres a los programas de agricultura urbana ecológica' [online]. *Actas del I Congreso Estatal de Agricultura Ecológica Urbana y Periurbana*, Elche, 2011. [Accessed: 13 November 2014]. Available at: <<http://oa.upm.es/12201/>>.

12 Spudic, S. «The New Victory Garden. Royal Horticultural Society Dissertation». Wisley Diploma in Practical Horticulture. Londres, 2007.

13 Morán; Hernández, *op. cit.*

14 George McKay, *Radical Gardening: Politics, Idealism and Rebellion in the Garden*, Frances Lincoln Ltd., London, 2011. [Accessed: 14 November 2014]. Available at: <http://scholar.google.es/citations?view_op=view_citation&hl=es&user=BBJbyXYAAAAAJ&citation_for_view=BBJbyXYAAAAAJ:ufrVoPGSRksC>.

15 Nerea Morán Alonso, 'Huertos y jardines comunitarios,' *Boletín CF+S* (2008), No. 40, pp. 75-124. [Accessed: 13 November 2014]. Available at: <<http://habitat.aq.upm.es/boletin/n40/anmor.html>>.

16 David Arredondo Garrido, 'Agricultura en la ciudad: de la utopía a la conciencia de lugar,' in Juan Calatrava (Ed.), *La arquitectura y el tiempo. Patrimonio, memoria y contemporaneidad*, Abada, Madrid, 2013. An online version, published by Universidad de Granada, Granada, 2014. [accessed: 13 November 2014]. is available at: <http://www.ugr.es/~compoarq/compoarq_archivos/profesores/darredondo_archivos/Obras/6_valoracion_paisajes_2011.pdf>.

ally evolved, and yet it continues to play a key role in urban resilience strategies.¹⁷ In its early days it was an instrument for social control, used to change habits and lifestyles. In the period between the two world wars it acquired political overtones as a vehicle for subsistence. In the seventies it was linked to self-management, community strengthening and environmental education. Today, urban agriculture is an element that supports the sustainability of cities and the incorporation of nature in the urban landscape.

Contemporary Urban Agriculture Systems

Broadly speaking, we may define three chief components in the urban agriculture cycle. One is related to its production, i.e. the end result, be it plant or animal, of the productive activity, such as carrots, lettuces, chickens, honey, etc. Another is connected to the processing and transport of products. The third is the commercialisation and consumption of the products obtained, which may be destined for self-consumption, wholesale or retail sale, or other activities.

Types of urban agriculture according to location, land ownership and use

Urban agriculture is practiced in numerous cities and varies according to different factors including location, scale of action and use. It therefore encompasses community allotments for social purposes, private gardens for self-sufficiency, and publicly owned spaces for small individual allotments.¹⁸ Tables 1 to 5 describe the five main types with current examples. The following section contains a key to their analysis.

Table 1. ALLOTMENTS OF URBAN LAND AUL

Agricultural spaces on land designated as green belt for use as urban allotments. The farming is traditional and production is varied, and includes leaf vegetables, aromatic plants and fruit trees. These areas usually have small farm animals and may be privately or municipally owned. The most common are allotments on communally owned urban land (ACoUL), exploited by schools and non-profit organisations in order to fulfil environmental and social functions.

ALLOTMENTS ON COLLECTIVELY OWNED URBAN LAND ACoUL



Added Value
New York, EUA
Objective: To improve access to food that is local, healthy and affordable for residents. **Description:** It transforms uncultivated

plots of land into urban gardens and promotes environmental training programmes for young people.



Masia Can Mestres
Barcelona, Spain
Objective: To accommodate educational programmes within the network of municipal allotments. **Description:** It

has an extension of 11,000 m² in which different leaf vegetables are grown and farm animals are bred.

ALLOTMENTS ON PRIVATELY OWNED URBAN LAND APoUL



Tomba L'Olla
Valencia, Spain
Objective: To provide plots of land to let. **Description:** Each rented plot occupies 40 m² in which

users can grow crops with the help of a professional adviser. Poultry are also bred, and agriculture is exclusively organic.

Source: Our own research material

17 Nerea Morán and Agustín Hernández, 'Historia de los huertos urbanos,' *op. cit.*

18 Esther Sanyé-Mengual, Jordi Oliver-Solà, Assumpció Antón, Juan Ignacio Montero and Joan Rieradevall, 'Environmental assessment of urban horticulture structures: Implementing Rooftop Greenhouses in Mediterranean cities,' *Journal of the Science of Food and Agriculture*, Vol. 93 (2013), pp. 100-109.

Table 2. AGRICULTURAL GARDEN OR URBAN PARK AGU

These are municipally owned urban gardens and parks promoted for use among the population as urban allotments. They provide educational, environmental and social integration functions. Their traditional and varied crops may coexist with the breeding of farm animals.



Lincoln Park Chicago
Chicago, EUA
Objective: To offer gardening courses for children and families. **Description:** Located within Lincoln Park Zoo, it occupies 5,000 m² with

organic crops of leaf vegetables, fruit, herbs, grain and flowers. It is also dedicated to breeding small farm animals.

Source: Our own research material

Table 3. GREEN ROOFS GR

Privately or publicly owned agricultural spaces on rooftops. Crops are varied, and include aromatic plants, leaf vegetables and fruit trees that can be destined to research, self-consumption or trade. Farming can be traditional or high-tech, and focuses on environmental, nutritional, recreational and educational aspects.

DOMESTIC GREEN ROOFS DGR



Garden on a balcony in Barcelona
Barcelona, España
Objective: Self-production and self-consumption, chiefly of leaf vegetables, aromatic

plants and edible flowers. **Description:** Of varying sizes, they can be located in any domestic space (balconies, patios, interiors).

GREEN ROOFS FOR RESEARCH GRR



ICTA-ICP Building. Autonomous University of Barcelona
Barcelona, Spain
Objective: To research urban agricultural systems.

Description: Headquarters of the Environmental Science and Technology Institute (ICTA) at the Autonomous University of Barcelona (UAB) and the Catalan Institute of Paleontology (ICP). It occupies 9,400 m² and accommodates a high-tech greenhouse on the sixth floor. Gardening is hydroponic.

Source: Our own research material

COMMERCIAL GREEN ROOFS CGR



Lufa Farms
Montreal, Canada
Objective: To market leaf vegetables. **Description:** A company specialised in

farming technologies in urban areas. It occupies 31,000 m² and produces forty varieties of vegetables all year round. Organic gardening and rainwater harvesting, hydroponic technology and composting.



Gotham Greens
New York, EUA
Objective: To market leaf vegetables. **Description:** It occupies

over 15,000 m² of crops and produces over one hundred tons of vegetables per year, using modern technological systems.

Source: Our own research material

Table 4. VERTICAL AGRICULTURE VA

Vertical agriculture is based on the idea of cultivating plants (chiefly leaf vegetables) inside buildings and on their vertical surfaces at different levels. It uses technologies such as hydroponics, aeroponics and aquaponics. The ownership of the buildings varies, as do their functions, which may be commercial, educational, environmental, nutritional or recreational.



Pasona Inc
Tokio, Japan
Objective: To engage the public in improving working environments. **Description:** Approximately

4,000 m² with two hundred species of fruit, vegetables and rice used for self-consumption in the building's cafeterias.



Drassanes School
Barcelona, Spain
Objective: To connect the quality of life to the quality of the environment in cities. **Description:** The project

includes different crops such as leaf vegetables, aromatic plants for cooking and plants that attract animal species to promote biodiversity.

Source: Our own research material

Table 5. INTERIOR GARDENS IG

The idea is to cultivate on horizontal surfaces inside buildings, generally in basements, using modern lighting systems. Crops are varied and include green leaf vegetables, flowers and fruit. Growth systems may be hydroponic aquaponic or aeroponic.



The Plant
Chicago, EUA
Objective: To market leaf vegetables.
Description: A project based on an aquaponic growth system, where tilapia residues

(with high ammonia) are used by the plants grown in the basements of buildings, with modern lighting systems.

Source: Our own research material

Analysis of Contemporary Urban Agriculture Systems

As proved by the examples in the previous section, the five main types of urban agriculture today are quite varied, and their specific functions and approaches reveal the versatile nature of the field. We shall now analyse these types from different angles in comparative charts:

Table 6. Benefits of urban agriculture since sustainable development.

Benefits	AUL			GR				
	ACoUL	APoUL	AGU	DGR	GRR	CGR	VA	IG
ENVIRONMENTAL								
Favours sustainability in cities	•	•	•	•	•	•	•	•
Contributes to an efficient use of resources	•	•	•	•	•	•	•	•
Increases biodiversity	•	•	•	•	•	•	•	•
Improves and enlivens urban landscapes	•	•	•	•	•	•	•	•
ECONOMIC								
Saves money on food	•	•	•	•	•	•	•	•
Supports local economy	•	•	•	•	•	•	•	•
Backs job creation	•	•	•	•	•	•	•	•
Guarantees affordability of food	•	•	•	•	•	•	•	•
SOCIAL								
Supports health safety	•	•	•	•	•	•	•	•
Promotes environmental and nutritional education and sensitisation	•	•	•	•	•	•	•	•
Improves health and quality of life	•	•	•	•	•	•	•	•
Upgrades deteriorated and abandoned urban spaces	•	•	•					

Source: Our own research material

Urban agriculture and sustainable development

Broadly speaking, we may begin by classifying the benefits of urban agriculture from the point of view of sustainable development. Table 6 compares different environmental, economic and social indicators.

Table 6 shows the numerous benefits of urban agriculture, regardless of the form it takes. These include favouring the sustainability of cities, guaranteeing affordability of foodstuffs and improving the quality of life, and cover all aspects of sustainable development. Interior gardens (IG), however, being as they are usually located in the basements of buildings, do not increase biodiversity, improve the urban landscape or upgrade deteriorated areas of the city as the access of fauna is restricted and the gardens cannot be seen from communal areas. On the other hand, they have high levels of security and production.

As regards the social aspect of sustainable development, the recovery of deteriorated and vacant urban spaces isn't favoured by rooftop gardens, whether they be designed for domestic use, research or commercial purposes (DGR, GRR and CGR), as it isn't by vertical agriculture (VA) or interior gardens (IG), for all these are established in private areas in buildings.

Table 7. Scales on which urban agriculture is applied or developed.

Scale	Description	Location	AUL			GR				
			ACoUL	APoUL	AGU	DGR	GRR	CGR	VA	IG
METROPOLITANA	In the city environment. Spaces destined to cultivation, administered by the state or the town hall.	Parks	•	•	•					
		Gardens	•	•	•					
		Plots	•	•	•					
		Empty sites	•	•	•					
DISTRICT	They appeal to residents' ability to cooperate.	Parks	•	•	•					
		Gardens	•	•	•					
		Domestic courtyards	•	•	•					
		Empty sites	•	•	•					
BUILDING	Actions in convenient domestic spaces or other areas available in buildings that favour the creation of micro-companies and companies commercialising vegetables and leaf vegetables.	Façades and walls							•	
		Rooftops				•	•	•		
		Balconies				•				•
		Interior				•				•
		Exterior								•
		Basements								

Source: Our own research material

Urban agriculture on a territorial scale

The application of urban agriculture will change according to the different scales of territories, to the distinctive features of their objectives and to their ways of acting. The three main scales of application—metropolitan, district and building—are detailed in Table 7.

On the metropolitan and district scales, only allotments on collectively and privately owned urban land (ACoUL and APoUL) are developed. The characteristics and objective of the cultivation, the technologies they use and the spaces available necessarily limit green roofs, whether they be for domestic, research or commercial purposes (DGR, RRG or CGR), vertical agriculture (AV) and interior gardens (IG) to the scale of buildings.

Urban agriculture on the architectural scale is reflected in different forms and spaces that are adapted according to the characteristics of the constructions. Horticulture is the main activity, more

often than not found on balconies and terraces. There is, however, a growing tendency to design buildings bearing in mind the possibilities of urban agriculture, and in this sense we come across gardens and vegetable patches on rooftops, underground floors, façades and interiors (image 1).

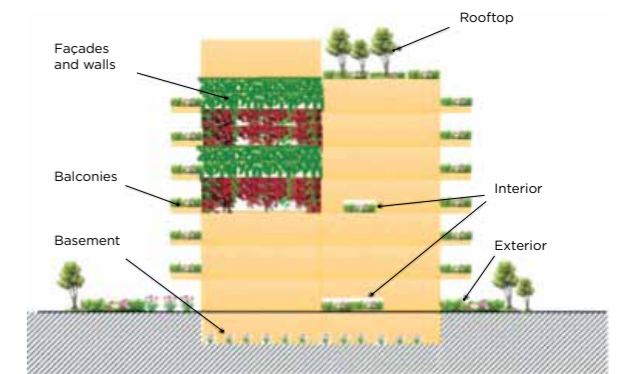


Image 1. Urban agriculture at building scale.

Source: Our own research material

▼ **Table 8.** Classification of urban agriculture in connection with land use.

Kitchen gardens	Description	AUL			GR				
		ACoUL	APoUL	AGU	DGR	GRR	CGR	VA	IG
DOMESTIC	Private gardens on balconies, terraces, terrariums and gardens. Self-consumption by families (surplus produce can be sold). The main crops are leaf vegetables, cultivated by traditional and organic methods.		•		•				
EDUCATIONAL	Located in and promoted by public and private schools, for self-consumption. The main crops are leaf vegetables, cultivated by traditional and organic methods.	•	•			•	•	•	
SOCIAL AND COMMUNITY GARDENS	Managed by groups, neighbours and associations, these gardens may be public or private. Varied crops for self-consumption or marketing, grown by different systems, organic and otherwise.	•		•					
RESEARCH GARDENS	Promoted by research and educational centres for investigation purposes and self-consumption. The technology employed varies according to scientific interests.	•	•	•		•	•	•	•
INTEGRAL GARDENS	Promoted by groups and organisations on public and private land. Varied produce for self-consumption and marketing, sometimes accompanied by the breeding of farm animals. Crops are grown by traditional methods and hydroponic and aquaponic systems. The produce may or may not be organically certified.	•	•	•					
CORPORATIVE GARDENS	Private gardens in companies or organisations. Produce is for self-consumption and marketing. The technology and crops vary according to needs. The produce may or may not be organically certified.		•			•	•	•	•

Source: Our own research material

Urban agriculture: land use and objectives

Table 8 shows the categories into which land use and its objectives are divided in the field of urban agriculture.

As mentioned, table 8 shows the heterogeneity of land uses in urban agriculture and its objectives. With the exception of institutional and industrial gardens, practically all others have a strong social component.

Urban agriculture: types of produce and uses

Urban agriculture is a dynamic concept that encompasses a variety of farming systems, ranging from production for subsistence and home processing to totally commercialised agriculture. In other words, its potential future direction is manifold. As to the products obtained from the present systems of urban agriculture and to the potential future of the crops, table 9 reveals which are most common today.

Table 9 shows that horticulture and aromatic plants are the main products obtained from urban agriculture. Stockbreeding and farming are only developed in allotments on communally and privately owned urban land (ACoUL, APoUL and AGU) due to the need for large extensions of land for rearing the animals. Aquaculture, on the other hand, is restricted to green roofs for research (GRR) and to commercial green roofs (CGR), vertical agriculture (VA) and interior gardens (IG).

Flows of materials and energy related to urban agriculture

As regards crops, in order to choose the method that is most suited to their needs we have to familiarise ourselves with the characteristics of the space available, its location, the objective of the cultivation and the type of growth. These variables will determine whether the production system will be traditional or

technological. Several technologies contribute to the present boom of urban agriculture, some of which are mentioned in table 10.

Table 10 reveals the existence of two general trends in the field of technological processes. The first is the choice of traditional water and energy systems in all those types of urban agriculture with a social component. The second is the presence of high-tech water, energy and material systems in green roofs for research (GRR) and commercial green roofs (CGR), vertical agriculture (VA) and interior gardens (IG).

▼ **Table 9.** Classification of urban agriculture in terms of types of products and uses.

Type	AUL			GR				
	ACoUL	APoUL	AGU	DGR	GRR	CGR	VA	IG
PRODUCT								
Horticulture	•	•	•	•	•	•	•	•
Forestry	•	•	•		•	•	•	•
Aquaculture					•	•	•	•
Aromatic plants	•	•	•	•	•	•	•	•
Stockbreeding	•	•	•					
Farming and stockbreeding	•	•	•					
USE								
Self-consumption	•	•	•	•	•			•
Local trade	•*	•*	•*	•*				
Regional trade							•	•
Recreation and leisure	•	•	•	•				
Social objectives	•	•	•	•				•
Education and research	•	•	•		•			•
Occupation	•	•	•	•				

Source: Our own research material. * Self-consumption is the main objective, and only surplus production is sold locally.

▼ **Table 10.** Some of the flows of materials and energy employed in urban agriculture.

Flow	Technologies	AUL			GR				
		ACoUL	APoUL	AGU	DGR	GRR	CGR	VA	IG
WATER									
Hydroponics (water + nutrients)			•			•	•	•	•
Aeroponics (water + nutrients)						•	•	•	•
Aquaponics (water + nutrients)						•	•	•	•
Recirculating irrigation system			•			•	•	•	•
Traditional irrigation system		•	•	•	•				
ENERGY									
LED lamps (light-emitting diodes)						•	•	•	•
Sodium vapour lamps						•	•	•	•
Solar panels						•	•	•	•
Solar radiation		•	•	•	•	•	•	•	•
MATERIALS									
Thermal curtains						•	•	•	•
Advanced glazing						•	•	•	•

Source: Our own research material. *Self-consumption is the main objective, and only surplus production is sold locally.

Influence of Urban Agriculture on Cities

The agricultural production of food in urban areas is becoming increasingly popular around the world as a result of the benefits it provides for city dwellers and for the balance of the urban environment, reducing its impact on the natural environment.¹⁹ Agriculture reduces the need for transporting food in and around cities, diminishing their dependence on fossil fuel, carbon dioxide emissions and other pollutants.²⁰ In this sense, urban planning can incorporate environmental aspects and the use of resources, such as food, drawing up conditions that will provide access to the land for this activity.²¹

So, the presence of urban agricultural systems such as those studied in this article are changing our cities holistically, as proved by the examples we have mentioned. At the metropolitan and district levels they transform public space, giving it new uses, facilitating training activities and favouring social reintegration, the creation of a special identity in each district, etc. At the building level, they influence cities by making them environmentally and visually greener, changing their aerial and street appearances. In both cases they enable the urban production of natural and local food, adding botanical and landscape richness to cities and improving the conditions of temperature and humidity by controlling the presence of water and agricultural plant species, reducing their environmental impact.

It is difficult to foresee the influence that urban agriculture will have on the planning and development of cities of the future. Yet, as mentioned, urban agriculture is spreading and begins to diversify

according to scale, technicity, uses, products, etc. In short, this form of agriculture has huge growth possibilities, and its expansion and diversity will enhance the cities and developments of tomorrow, making them unquestionably greener, more agricultural and self-sufficient. This is the new form of green urban growth exemplified by recent projects such as Garden Bridge in London, designed by Thomas Heatherwick.²²

Urban planning, however, decidedly needs a coherent unifying strategy that will enable urban agriculture to be considered an element of symbiosis with cities, regardless of their geographic location, and therefore become complementary activities to the rural agro-industry and generate a comprehensive, non-linear food system, reducing the environmental impact of cities and producing benefits for the population and the local economy.

“Agriculture reduces the need for transporting food in and around cities, diminishing their dependence on fossil fuel, carbon dioxide emissions and other pollutants”

19 Camilo Villagrán Oyarzún and Ken Yan Qiu Sun, 'Agricultura urbana y el rol de la planificación de las ciudades' [online]. *Revista de urbanismo*, No. 29 (December 2013), Universidad de Chile, Facultad de Arquitectura y Urbanismo. [Accessed: 13 November 2014]. Available at: <<http://www.captura.uchile.cl/handle/2250/134444>>.

20 Graciela Arosemena and Francesc Navés, 'Cultivar la Ciudad,' *Idea sostenible* [online]. Universitat Politècnica de Barcelona, Year 2, No. 11 (July 2015), pp. 1-5. [Accessed: 14 November 2014] Available at: <http://upcommons.upc.edu/revistes/bitstream/2099/231/1/11_cultivarciutat_Arosemena_CAST.pdf>.

21 Camilo Villagrán Oyarzún and Ken Yan Qiu Sun, 'Agricultura urbana y el rol de la planificación de las ciudades,' op. cit.

22 Anna Winston, 'Thomas Heatherwick's Garden Bridge given green light,' *De Zeen Magazine* (December 2014). [Accessed: 15 November 2014]. Available at: <<http://www.dezeen.com/2014/12/02/thomas-heatherwick-garden-bridge-thames-london-green-light-planning-permission/>>.

Conclusions

Present systems of urban agriculture are diverse and allow for a wide range of approaches, models, scales, directions and objectives, which do not curtail their advantages for the urban environment. Most land uses are connected to social issues such as self-consumption, and only a minority of it is destined to regional trade. The main crops are leaf vegetables, combined with small livestock exploitations in social allotments that have greater extensions of land. Contemporary urban agriculture employs different high-tech growth systems to guarantee the quality and continuous production of crops, improve the use of resources and support sustainable development. In spite of today's growing technological offer, traditional cultivation systems are still employed, especially in community allotments, kitchen and school gardens, i.e. all those of a social nature. Furthermore, research centres and large-scale commercial industries also turn to high technology.

Urban agriculture promotes sustainable development. Its benefits include favouring an efficient use of resources, increasing biodiversity, backing job creation and boosting local economies, promoting environmental and nutritional education and improving health and quality of life.

Given that urban agriculture is a growing phenomenon, ideally it should be introduced in urban planning and management to ensure safe and adequate food provisions for cities. This practice, which in some cities is in its early stages (as described in the third section of this article), is very important in towns where food safety is not guaranteed for significant chunks of the population, particularly in regions where resources are scant.

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