Chapter 56
Soilless Urban Temporary Agriculture as a Strategy for Brownfield Site Renewal

Leonardo Boganini and Chiara Casazza

Abstract The last few years have witnessed the development of a large number of projects, in the fields of planning and architecture, that aim to integrate food production in urban spaces. This practice goes under the name of Urban Agriculture and it is spreading ito many cities because it carries benefits and implications toward urban sustainability (environmental, economic, social and institutional). The paper aims to describe an ongoing research project, Ur.C.A. is an in progress research project, financed by Regione Toscana, and develop by the Interuniversity Centre and the DISPAA Department of the University of Florence, in partnership with two local enterprises: Azienda Agricola Cammelli and Azienda Agricola Artemisia.

Ur.C.A. aims to identify the possibilities and the potential of integrating agriculture in urban settlements, especially in brownfield sites and marginal areas, taking advantage of hydroponic technologies. The integration of agricultural activities in urban areas meets the requirements of consciousness toward food, reducing the gap between production and consumptions, and of alternative sustainable km0 alimentary production chains. Furthermore urban agriculture improves shared public spaces and social and recreational activities.

Brownfield sites and temporary unused areas can be, through urban agriculture, regenerated in terms of space quality, also providing them of new functions and a new role.

The project general objective is to analyze the possibilities of the requalification of the above mentioned urban contexts, through urban agriculture, focusing on legislative and technological feasibility. Ur.C.A. aims to develop an innovative use for brownfield sites that, through the integration of food production, can enhance social innovation, citizens awareness toward environment, health, and diet, social participation, and furthermore can stimulate an urban km0 production and consequentially new small scale local economies and green jobs.

Ur.C.A specific objective is to **identify an innovative hydroponic growth cell system**, suitable for urban contexts in terms of design, technology and sustainability, which would integrate renewable energy resources and rain water collection.

L. Boganini • C. Casazza (✉)
Dipartimento di Architettura DIDA, Centro ABITA, Università degli Studi di Firenze, Florence, Italy
e-mail: l.boganini@gmail.com; Casazzakia.casazza@gmail.com

A. Sayigh (ed.), *Mediterranean Green Buildings & Renewable Energy*,
DOI 10.1007/978-3-319-30746-6_56

The new concepts of growth cell will be especially suitable for urban unused areas: indeed in our towns can be found several spaces that remain temporary, but generally for a long period, unused as "frozen" waiting for new projects to be approved and completed. The Ur.C.A. growth cell, conceived as light, transportable, modular, nearly zero environmentally impacting, and energy efficient, can become a device useful to quickly, but also temporary, requalifying the mentioned areas.

Keywords Urban agriculture • Urban regeneration • Integration • Soilless technologies • Brownfield sites

1 Introduction

The last few years have witnessed the development of a large number of projects in the fields of planning and architecture that aim to integrate food production in urban spaces. This practice goes under the name of urban agriculture[1] [8] and it is spreading to many cities because it carries benefits and implications with respect to urban sustainability (environmental, economic, social, and institutional).

Food production in urban settlements is definitely not a new issue: indeed we can find it in several different periods of history: it is sufficient to mention *les jardins potagérs* in France, the Rinascimental Orangeries, the medieval *hortus conclusus*, Howard's Garden City, Frank Lloyd Wright's Broadacre City, and the Victory Gardens in the USA during the two world wars (the equivalent of the Italian *orti di guerra*). In recent years the phenomenon has acquired renewed strength and with different characteristics, approaches, forms, expressions, and technologies, showing different spatial and architectonic solutions. Nowadays food production faces different needs than in the past: if previously it almost aimed to satisfy food needs, nowadays it needs to meet the requirements of food security, halthy food access and, in the case of developing countries, it faces the challanges of food deserts, food miles (and consequentially emissions from transport but also preservation and packaging) overcome, sustainability, and alternative food models.

In this last context, which is the one this chapter is concerned with, urban agriculture stands out and is distinguished by its multifunctional features and by the awareness of its role in ecosystem service creation. Indeed it responds to certain shared exigencies and is characterized by specific functions and benefits it brings to urban environments. In particular urban agriculture serves the following functions [6]:

– Creates a short food chain;
– Reduces the distance (physical and psychological) separating consumers and producers;

[1] With the term Urban Agriculture (UA) we can define an "industry" (Luc J.A Mougeot) located within of a town which grows or raises, processes and distributes a diversity of food and non-food products, using mainly human and material resources, inputs and services found in the urban area, and sharing outputs and ecosystem services to the city itself.

– Supports environmental and nutrition education;
– Promotes citizens' participation and inclusion in the food system, city greening and shared green spaces, urban renewal, well-being, health, and job creation through a new urban local food market.

This chapter **will stress the possibilities and the potential of integrating agriculture into the social fabric, especially in transitional areas like brownfield sites and marginal areas**, **taking advantage of hydroponic technologies** in order to pursue an environmental, architectural, and social renewal and refunctionalization of these urban spaces. The research will focus on the Italian local context, where the research project Urban Con(t)emporary Agriculture (known by its italian acronym Ur.C.A.) financed by Regione Toscana and developed by the ABITA Interuniversity Centre with the DISPAA Department of the University of Florence, in partnership with local enterprises (Azienda Agricola Cammelli and Campioni Serre) and supported by the Florence municipality public administration interest, is actualizing a pilot project.

2 State of the Art

Urban agriculture is attracting the interest of the scientific community and is becoming a concrete strategy for the city of the future, on two fronts:

- Food: food security, education, health, diet, awareness, sustainable production
- City: urban renewal, sustainability, urban greening, citizen participation, social inclusion

From an overview of the state of the art and from an analysis of national and international case studies we can identify three distinct elements in urban agriculture experiences [2]:

- The kind of spaces that have the potential to host urban agriculture
- Performance and effects on the urban environment
- Growing technologies and devices suitable for urban agriculture integration on different scales depending on available space and performance requirements

Those spaces that have the potential to host urban agriculture projects can be summarized as follows [12]:

- Urban scale: green areas, parks, gardens, pocket spaces, brownfield sites, vacant lots
- Building scale [also called building-integrated agriculture (BIA[2])]: terraces, flat roofs, *façades*, backyard gardens

[2] Astee, L.Y., Kishnani N.T. (2010) "Building Integrated Agriculture: Utilising Rooftops for Sustainable Food Crop Cultivation in Singapore" Journal of Green Building: Spring 2010, Vol. 5, No. 2, pp. 105–113.

Urban agriculture activities can include hobby farming, self-sufficiency, education, therapy, sales of products, community service, urban renewal, nonfood production (e.g., biomass or textiles). Impacts on the urban environment can be illustrated whether from a social, environmental, or economic point of view: it allows urban areas to progress toward being greener with its benefits such as space quality, well-being, urban heat island effect reduction, pollution absorption, good air quality, social inclusion, and safety. Furthermore, urban agriculture, which allows for local short chain production, minimizes agriculture's environmental footprint (in terms of transport and soil consumption), creates jobs, enhances local retail markets, fosters well-being [11], promotes education and health owing to the conscious consumption of food and farming activities, enhances citizen participation in the local governance, and guarantees food self-sufficiency [9].

In terms of growing technologies and devices, it is interesting to note how different technologies have been investigated or adapted (and transferred) from agriculture to architecture [4] in order to make the aforementioned spaces suitable for crop production and to fulfill space and user requirements. Growing technologies and devices can be summarized in the following ways:

- Traditional growing (plants rooting in a soil substrate): in the ground, in vases, raised beds, greenhouses, green roofs, vertical gardens;
- Hydroponics with hydroponic irrigation (plants rooting in a soilless or soil-simulant substrate): greenhouses, growth cells, hydroponic vases, hydroponic towers, vertical farms, vertical gardens, and living walls. These latter are especially suitable in the case of artificial surfaces and when light weight, productivity, and crop protection are required.

Brownfield sites and unused areas can be, through urban agriculture, regenerated in terms of space quality and serve new functions and play new roles. The integration of agricultural activities in these areas meets, on the one hand, the requirements of urban regeneration, by improving shared public spaces and social and recreational activities, and, on the other hand, those of consciousness toward food systems, reducing the gap between production and consumption, and alternative sustainable short chain food production chains [14].

The potential of brownfield site use and renewal for urban agricultural purposes has been developed by some recent projects such as the GrowUp Urban Farms in London, Prinzessinnengarten Community Garden in Berlin, the Jardin Partagés in Paris, the Plant vertical farm in Chicago [3], OrtiDiPinti in Florence, Hayes Valley Farm in San Francisco, and several community gardens in New York City and Detroit.

3 Method

The cities we live in are facing several challenges in their struggle for sustainability. Globalization and industrialization together with the large organized distribution of food products have caused on the one hand a generalized loss of awareness by consumers of food (its quality and its provenance), and the loss of social, cultural,

and educational values connected to it, which have brought other problems such as health and gastrointestinal diseases. On the other hand industrialized agriculture has affected our environment through the exploitation of vast tracts of land, environmental footprint due to transport, food preservation, and the burning of fossil fuels, energy consumption (food preservation), CO_2 emissions (for transport), and chemical pesticides and fertilizers [1].

Recently initiatives aiming to recover awareness of food production and a sustainable food chain, food quality, education, and local products have been spreading, and consumers have become aware of industrial agriculture and food chain unsustainability, demaning consciousness, impact reduction, and traceability. Some government administrations[3] [5] are indeed developing the concept of a sustainable urban food system[4] and enhancing urban food planning strategies.

Furthermore, analyzing the issue from an urban and architectural point of view [13], we can show how our cities are characterized both by a lack of green and shared spaces and by unused or marginal areas and brownfield sites due to bad urban planning or abandoned spaces that remain frozen at the current level of evolution. These blank spaces have become an element of degradation in terms of space quality but also safety and need to be renewed. Usually government administrations consider these spaces for new public projects, but in the meantime, they remain temporarily, but generally for long periods, unused or "frozen" waiting for the projects to be approved and completed.

For example, the city of Florence in its new urban regulations has identified such mentioned spaces as follows:

- ATA: empty lots that will host residential buildings construction
- ATS: empty lots that will host non-residential buildings construction or other urban facilities (parkings, sport fields)

Both these kinds of areas are, as already stated, unused and degraded but might be a resource if they were properly restored and given a new role.

The aforementioned unused or abandoned areas can find new life through **innovative, temporary** urban agricultural use. Indeed, the integration of food production in empty spaces can create a new area of attraction, giving them new functions, and it can enhance social innovation, citizen awareness of the environment, health, and diet, and social participation; furthermore, it can stimulate urban km0 production and consequentially new small-scale local economies and green jobs.

[3] Toronto Food Charter or the Portland Food System Strategy.

[4] The term *urban food system* includes all the activities of the food chain (production, transport, processing, selling, consumption, and waste) and the goal of a sustainable urban food system is to understand and plan their connection with other urban features: transport of food for retail sales, preparation and serving, nutrition education, recreational activities, therapeutic activities, and urban waste management. Therefore, restaurants, retail stores, supermarkets, hospitals, canteens, and schools could talk about the different activities related to food production or be linked in an urban local food system.

Unused areas will therefore host small-scale crop production for local distribution (also involving local cooperatives and enterprises) through high-tech hydroponic greenhouses and shared community vegetable gardens, aiming at self-sufficiency and social inclusion through low-tech (also soilless) raised beds.

A **temporary** use of the aforementioned spaces is a necessary feature: indeed, such areas must not be modified, as they are provisionally unused but waiting for new projects to be developed, and furthermore they are not able to host new construction if not included in a city's regulations. Incidentally, temporary and removable constructions are permitted, especially for public utilities.

The technological feasibility of urban agriculture in the aforementioned contexts relies on the use of innovative off-the-grid greenhouses. These meet the requirements of high productivity, low water consumption, and crop protection. Indeed, they were conceived as being light, transportable, and modular, having near zero environmental impact, and being energy efficient; they can be used to quickly, but also temporarily, restore the kinds of areas mentioned earlier.

The goal of unused areas renovations can be achieved by taking advantage of hydroponic growing methods because they permit a reversible but also sustainable and off-the-grid approach. Furthermore, using hydroponic soilless or soil-simulant growing methods makes it possible to overcome a shortage or lack of cultivable soil, often one of the results of pollution in urban contexts.

The term *hydroponic* describes those cultivation systems that do not use soil as a substratum and that use water as a vehicle to grow nutritive substances. Their management relies on automatic systems, controlling the microclimate, transpiration, irrigation, and the plant nutrition supply.

Cultivation without soil can be classified into two main categories, depending on the substratum:

Fluid Substratum

- Nutrient film technique: film of food plant that flows in intervals
- Aeroponic: plants are cultivated in perforated panels; roots hang under the panel and are sprayed with solutions of food plant.
- Floating: plants are cultivated on floating supports.

Solid Substratum

- Light and static materials like vegetable fiber, mineral wool, and expanded clay are used as support for roots. In both these systems, water is the element that constantly brings nutrients to the plants, making up for the lack of soil that in traditional cultivation stores nutritive elements and serves as a physical support for the plant itself.

The main advantages of the techniques of cultivation without soil are as follows: high productivity in small spaces (the system is 3–10 times more productive than traditional methods in 10–20 times less space and time), product quality improvement thanks to the management system, and water savings (up to 90 % in closed-cycle systems).

4 Results

The previously defined analysis and method are applied to the city of Florence. In this case study we have defined a simple tool that can be useful in identifying the elements, in terms of performance, function, and distribution, needed to realize a temporary urban farming intervention in transitional areas. The tool consists of a series of points and a specific graphic system useful for simplifying the approach to urban farm planning and design.

The main focus is indeed on the design approach, which aims to define the principal criteria useful for both government administrators and designers to improve urban agriculture with a temporary perspective. We can divide the approach to designing new urban agricultural spaces into three areas:

1. Relationship with urban regulations (planning and functional)
2. Analysis of social patterns already present in the area and of its critical points
3. Analysis of technical aspects necessary for crop production and the functional design of the area

Relationship with urban regulations: *the regulatory framework*
The first analysis, useful for defining a new urban agricultural area, concerns local laws: it is necessary to define the operative framework to understand the possibilities of every specific city. The main categories to check are as follows:

– Urban regulations and specific land-use compatibility with agricultural use, food production, and local selling
– The presence of brownfield sites or unregulated areas
– The presence of transitional areas susceptible to future changes or projects

In the first case it is theoretically possible to create an urban farm that could be used as a food production, distribution, and training center: this is the best possibility, but, unlike some North American cities that adopted specific urban agriculture laws (e.g., San Francisco, Detroit), in the city of Florence no areas have been designated for that. Indeed, inside the urban planning system of the city of Florence, the areas designated for agricultural uses are few and marginal, outside the city limits, and far from the main social scenes.

For the two other cases a temporary design approach and a specific agreement between urban farmers and the municipality are viable and necessary in order to attempt local urban regulations. Indeed the *temporary* feature makes it possible to practice urban agriculture even in areas using land for different (not agricultural) purposes; for example, urban farms will be removed once any expected project is carried out, with the condition of a complete restoration of the space at the end of the agreement.

In the case study (transitional areas) it is possible to distinguish between privately owned and publicly owned lands: in the case of public spaces, the municipality is allowed to temporarily make use of such spaces, while in the case of privately owned spaces, a previous agreement between owners and government

officials is mandatory. In both cases it is necessary to obtain public authorization for temporary buildings and for specific activities (e.g., selling, services). In our case there is a need to use a simple, totally off-the-grid (for example, public water and energy supply networks cannot be used), and very easy-to-assemble system to prepare and design the area.

Analysis of social patterns: *new use of public and private space*.
The second step is the analysis of the social context: as we have seen, urban agriculture aims to produce food (in particular vegetables) inside the city, with the ultimate goal fo developing a new Km0 market. Furthermore, inside this new agricultural system it is possible to identify social values, typical of rural areas, that are helpful in improving social conditions and quality of life.

Through temporary agriculture it is possible to modify the users' spatial perceptions for the purpose of defining a new method to reuse (and revitalize) marginal spaces or, in the case of transitional areas, to speed up the acceptance of new uses. Furthermore, with the involvement of the people, it is possible to use these spaces for temporary educational venues for the purpose of diffusing good practices in terms of sustainable crop production (also using new technologies) and reusing space.

This analysis must concentrate on the following tasks:

- Defining areas inside the city, suitable for urban agriculture, that should be near social points of interest, for example, parks, public squares, hospitals, senior centers, and schools
- Defining the connections between urban agriculture and the other uses or activities already taking place at (or in an area of influence) points of interest/areas: the scope of the analysis is to define the critical issues
- Comparing this analysis with the regulatory framework

At the end of is analysis (urban regulation and social network) it is necessary to create a city plan where it might be possible to identify those areas that can be used for urban farming and a new services net connecting the main points. Furthermore, it is necessary to identify areas where urban agriculture can help to improve social conditions because it can work as a social buffer while revitalizing marginal areas.

The study must so define the main spaces for urban agriculture, the areas of influence with the main social points, and the transitional spaces already present. This zoning of the city serves to define the main features for the specific context and the benefits it and urban farming projects will be able to bring (Fig. 56.1).

Analysis of technical aspect: *function*, *space, and technology*
To optimize the production and connected social value created by temporary urban farming, it is necessary to identify specific activities and their connected spaces.

It is possible to divide spatial typologies into three main and interconnected categories:

- Production space, which is useful for hosting production, improving the creation of new local enterprises focused on vegetable production, and hosing Km0 selling points.

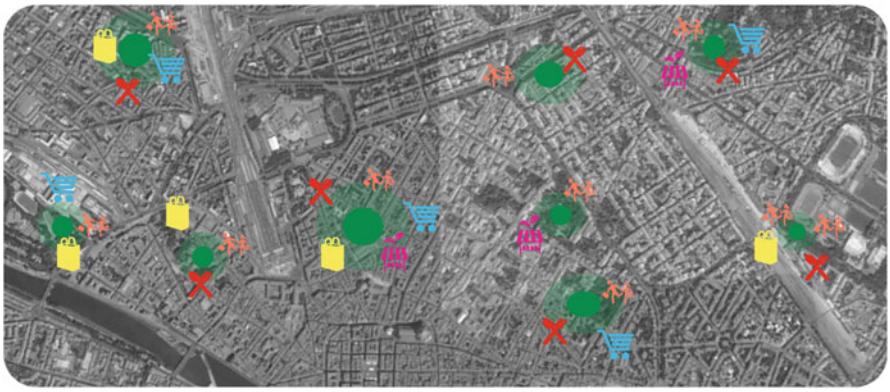

Fig. 56.1 Analysis of social patterns and existing connections in the downtown area of Florence

- Educational spaces and common vegetable gardens, which are useful for improving and divulgating the cultivation of vegetable gardens using specific technologies (like hydroponics) and of sustainable food production.
- Common spaces, useful for improving social connections with the rural world within the city and improving social inclusion and recreation.

This subdivision is helpful in the decision-making phase and in urban farming design, as a function of the main purpose that the area must fulfill: production, social recreation, or education.

The production area is subdivided into several simple spaces: main area, used especially for production; management space, a service zone necessary for the functioning of the production space; core system, which contains the fertigation management system (distribution of water and nutrients) and the climatic condition management system, together with the heating and cooling generator; nursery, where vegetables are kept before the planting phase; entrance and the sale point; packaging area (which connects to the common space) where the products are cleaned and prepared for sale or serving.

The social area aims to improve the connections and interactions among people and rural values: in this case, the simple space serves as a destination point. It is possible to distinguish private vegetable gardens from common vegetable gardens, where users can make use of soilless systems, the compost area, a garden therapy or garden learning area dedicated to the diffusion and application of knowledge, and a didactic area that is open to schools and private gatherings.

The common space is the most flexible one: it can be transformed by designers according to the external context and in concert with the main internal functions. This part of urban farms has the task of creating new connections between the existing social net and the area. In this part one finds the Gruppi d'Acquisto Solidali, or Solidal Buyers Group (GAS) point and all other facilities typically found at main entrances. In the case of GAS, the opportunity a temporary and agricultural use of urban areas it is important in order to allow the diffusion

of those social values related to the practices of Alternative Food Networks, Community Supported Agriculture and Social Buyers Group [10]. All spaces must be dimensioned according to the functions required by every particular place and context.

The building technology used in this type of project is divided into two different groups: the main structure and the production structure. The main structure is composed of all the buildings and all the paths inside the area. The necessity of moving the main structure (assembling and disassembling) requires a light and dry structure, often prefabricated to optimize construction time and costs. In particular, the most delicate parts are the connection with the ground and with the water and electricity networks: in this case, it is necessary to identify systems and strategies to make a zero impact [7]: the use of a photovoltaic system and rainwater reuse are the bases for creating an off-the-grid system. The production technologies are based on hydroponic and soilless systems: the first can be used inside the growth cells and greenhouse; the second, through the use of raised beds, are suitable for social and private areas (Fig. 56.2).

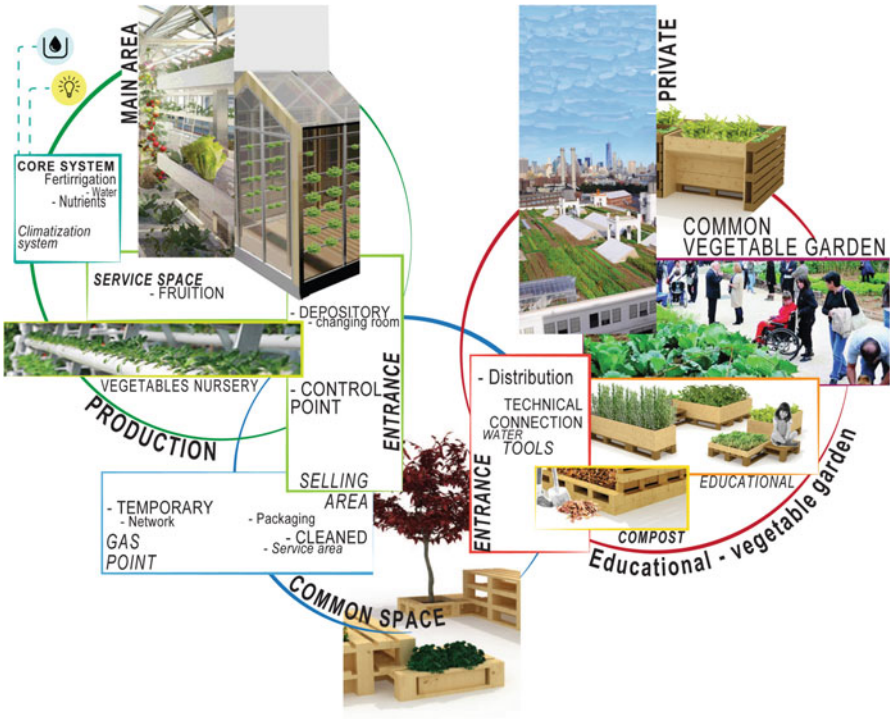

Fig. 56.2 Analysis of technical aspects: connection between space and function

5 Conclusion

Temporary urban agriculture can encourage the reuse and transformation of marginal areas: through their new function it is possible to social cohesion values and to create new enterprises within a city.

The tool that we propose is useful for defining the main areas and criteria (in terms of space and function) to apply urban farming within city limits, with the aim of facilitating, for a given amount of time while these areas await approval for projects, the transition from one land use to another and revitalizing the place and increasing its social value. This new use of urban agriculture requires zero impact and a reversible approach, defining an off-the-grid system useful for producing food and vegetables directly within the city: this can bring a new vision of food distribution and production, in favor of security, health, and new social activities and values.

6 Future Development

The next phase in the development of this research will aim to create the first prototype of a temporary urban farm inside the city of Florence, Italy. With the Ur.C.A. project and the involvement of the city government, we have identified three different areas in which to propose this type of experiment. The research aims to use the same prototype in these zones focusing each time on a different characteristic of urban farming:

- When the focus is on creating new social enterprises in food production and selling, with the involvement of local cooperatives, emphasis will be placed especially on the production area.
- When the focus is on enhancing social participation and inclusion, special attention will be paid to common vegetable garden spaces and the dissemination of rural culture.

Temporary urban farming will be used to redefine a new role for the three aforementioned areas to reduce their local decay and increase their value.

The expected results are manifold: the creation of new a Km0 production and selling point that will include new GAS points, increased use of marginal spaces to reduce social decay, and the diffusion and dissemination of knowledge on hydroponic harvesting systems. This prototype will be carried out also through the development of an off-the-grid system capable of fulfilling all its functions, in terms of energy production and water. The final purpose is to develop a tool dedicated to public administrators and designers that can be useful in decision making on how to integrate urban farming into local regulations.

References

1. Despommier DI (2013) Farming up the city: the rise of urban vertical farm. Trends Biotechnol 31(7):388–389
2. Gorgolewski MA, Komisar JU, Narsr JO (2011) Carrot city: creating places for urban agriculture. Monacelli Press, New York, p 240
3. Kaufman JE. Bailkey MA (2000) Farming inside cities: entrepreneurial urban agriculture in the United States, Lincoln Institute of Land Policy Working Paper
4. Palazzo VA (2003) Tecnologie ambientali per l'integrazione di verde agricolo in aree urbane. Tesi di Dottorato, Università degli Studi di Napoli Federico II
5. Pothukuchi KA, Kauffman JE (1999) Placing the food system on the urban agenda: the role of municipal institutions in food systems planning. Agric Hum Values 16:212–224
6. Viljoen AN (2005) Continuous productive urban landscapes: designing urban agriculture for sustainable cities. Elesevier Architectural Press, Oxford, p 304
7. Smit J, Nasr J (1992) Urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources. Environ Urban 4(2):141–152
8. Mougeot LJA (2000) Urban agriculture: definition, presence, potentials and risks. Thematic paper 1 international conference on growing cities growing food: Urban Agriculture on the Policy Agenda La Habana Cuba, Oct 1999
9. Philips A (2013) Designing urban agriculture: a complete guide to the planning, design, construction, maintenance and management of edible landscapes. Wiley, Hoboken, p 288
10. Butler L, Monorek DM (2002) Urban agriculture and agricultural communities opportunities for common ground. Ames Council on Agriculture Science and Technology
11. Astee LY, Kishnani NT (2010) Building integrated agriculture: utilising rooftops for sustainable food crop cultivation in Singapore. J Green Build 5(2):105–113
12. Boganini L, Carta A, Casazza C, Sala MG (2013) The urban agriculture: a classification of possibilities. ICFEEB conference, China
13. Tjeerd Deelstra Herbert Girardet Urban Agriculture and Sustainable cities. In Aesop 2nd European Sustainable Food Planning Conference, Urban Performance Group, University of Brighton
14. Lee-Smith D (2009) Integrating urban agriculture in the urban landscape. In RUAF Urban Agriculture Magazine 25
15. Lee-Smith D (2009) Carrot city: design for urban agriculture. In RUAF Urban Agriculture Magazine 22
16. Sommariva E (2012) Agricoltura Urbana strategie per la città dopo la crisi. Atti XV conferenza Nazionale Società Italiana Urbanisti-L'urbanistica che cambia rischi e valori Pescara 10–11 maggio 2012