



Challenges in Sustainability

Special Issue
Urban Agriculture:
Fostering the Urban-Rural Continuum

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Cover image

Urban garden at Bercy, Paris (Source: Wikipedia).



Special Issue:

Urban Agriculture: Fostering the Urban-Rural Continuum Proceedings of the *5th Rencontres Internationales de Reims on Sustainability Studies*

Invited Editors:

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Scope:

There is an urban arrangement that can address this urban-rural continuum while deeply transforming urban systems conditions to foster a more sustainable future: Urban agriculture. Urban agriculture postulates that some type of agriculture may flourish within the city. It considers that urban multifunctionality should also include farming. As a matter of fact, urban agriculture is not such a fresh idea. It existed for centuries in very different places around the world, such as the chinampas in Tenochtitlan—the actual Mexico city—since the 15th century or sooner, the hortillonnages in Amiens—a French city north of Paris—for more than twenty centuries, or the interstitial gardens (agriculture d'interstice) of Yaoundé—Cameroon's capital—which accompanied the foundation of the city in the 19th century.

But what should be the objectives of urban agriculture in planning? Community gardens, kitchen gardens, food farming, for example, are three different things, completely. The types of urban agriculture that exist in a city vary a lot according to the climate, the cultural background, the economic and social situation of the city, etc. In many urban areas of Central America or India, urban agriculture is essentially a food security issue, related to fight against poverty and malnutrition. The situation is quite different in European or North American cities. There, urban agriculture is mainly seen as a social innovation that contributes to improving the quality of life, fostering social links among neighbors, and enhancing urban landscapes. It is not so much about food, really. The main expressions of this approach are community gardens and kitchen gardens. These last years in developed countries, there has been a growing proliferation of projects promoting urban farming architectures, such as Agritecture, or Tree-Like Skyscrapers and Vertical Farming—cultivating plants or breeding animals within tall greenhouse buildings or vertically inclined surfaces. At the same time, urban rooftop farms are epitomized by the mainstream medias as the paragon of urban agriculture. Is it still urban agriculture, or is it something else? Besides, may urban agriculture be the cornerstone that helps reconfigure urban areas, and the backbone of a new and more sustainable urban arrangement to foster urban transition to sustainability in the urban-rural continuum, or not? Here are some of the issues that will be tackled at the 5th Rencontres Internationales de Reims on Sustainability Studies.

About *Challenges in Sustainability*

Focus & Scope

Challenges in Sustainability (CiS) is an international, open access, academic, interdisciplinary journal dedicated to the publication of high-quality research articles and review papers on all aspects of global environmental and transformational change toward sustainability. Research articles, reviews, communications or short notes and films are welcomed. Manuscripts must be prepared in English; they will undergo a rigorous peer review process, and they will appear online immediately after final acceptance. We especially encourage submissions from early stage researchers.

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The objective of the journal is to be a front-runner for original science that stimulates the development of sustainability solutions in an era of global environmental change. CiS defines its place at the interface between natural, socio-economic, and the humanistic sciences, creating a unique platform to disseminate analyses on challenges related to global environmental change, associated solutions, and trade-offs. The journal helps to further the field of sustainability science by bridging gaps between disciplines, science and societal stakeholders while not neglecting scientific rigor and excellence. The journal promotes science-based insights of societal dynamics, and is open for innovative and critical approaches that stimulate scientific and societal debates.

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Editorial

Urban Agriculture: Fostering the Urban-Rural Continuum

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Urban agricultural projects have been mushrooming since the end of the twentieth century, reshaping urban landscapes and even the whole urban fabric, experimenting with alternatives to the traditional urban life, sometimes creating new commons, and bringing people together. Within a city, farmers, gardeners, and their neighbors share more than just fence lines. Cities already have a huge potential for farming. Three examples can be observed in very different cities around the World: Singapore, is fully self-reliant in meat, Bamako is self-sufficient in vegetables, and in Berlin there are 80,000 community gardens on communal land and 16,000 more people are on a waiting-list [1]. And this is just the beginning; in many cities new unbuilt areas emerge in the wake of deindustrialization (derelict lands, wastelands, brownfields, etc.), or as a consequence of urban shrinking due to aging populations (as in Japan or Germany), or of emigration (as in some African mid-sized cities). These new areas are a wonderful opportunity for urban agriculture. In Detroit, thousands hectares of urban land have been given over to unemployed workers for food growing. In Britain, urban agriculture has been promoted on wastelands of 20 cities by their various councils [2]. Urban agriculture is gradually becoming a planning policy option. In Delft, the planners of the city already combine urban agriculture with several other land uses in their planning documents; in Paris, an inclusive local land development plan protects agricultural landscapes [3,4]. Urban agriculture is neither—or no more—the short-lived remnant of a rural culture nor the hipsters' latest futile craze.

Yet, on the face of it, tying together these two words—urban and agriculture—is not self-evident, even if city and agriculture have gone hand in hand for a long time: in fact,

since Neolithic times and the first human settlements, as pointed by Paul Bairoch [5]. Jane Jacobs even promotes the idea that agriculture is of urban origin, and it was only later that agriculture migrates to the countryside—this was a very slow process [6]. It was only in the middle of the Twentieth Century, in the aftermath of the WW2, that cities and agriculture—which had always been inseparable—divorced. Increased mobility and progressive globalization made apparently pointless proximity between farmers and urban consumers. Farming was banned from the city by planning regulation. Urban agriculture suffered then from many political restraints: restrictive urban policy, laws giving an illegal status to urban agriculture, lack of supportive services, etc. Hopefully things are changing, and urban agriculture is being welcomed again in the city after an unfortunate interlude of some fifty years. Still in the Ninetieth Century the close interaction between city and farming could be read in the landscape and in the planning instruments and procedures. In 1826, Von Thunen's theory explained agricultural patterns near urban areas—in the form of concentric circles, with crop type being determined by transport cost-distance modeling. It was maybe a rough and restrictive draft of what we coin today as the importance of addressing the rural-urban continuum to deal with urban sustainability. Indeed, talking about urban sustainability is meaningless if we stop at the city limits. Everyone agrees today to consider that sustainable urban policies should take into account an urban-rural continuum that goes far beyond the dense mineral town within its administrative limits.

Urban agriculture may help designing truly sustainable policies for such complex settings. We need to question and discuss ways to include, in a perennial manner, agri-

culture in urban policies. Urban agriculture can be seen as a process of hybridization between city and agriculture, which offers many advantages over other expressions of nature in the city. In addition to allowing the development of agricultural production, being consistent with the aspirations of urban populations wishing to reconnect with nature, and providing many ecosystem services, urban agriculture also provides new opportunities for developers to rethink the organization of the urban fabric. To facilitate this, there is a need for knowledge building (sharing examples, procedures, comparing different places), which should take the form of a co-production of knowledge by all the actors involved in urban agriculture actions through the world. Confronting and integrating values and knowledge from different stakeholders is crucial to help decision-making. This task was initiated by the international conference *5èmes Rencontres*

Internationales de Reims on Sustainability Science whose theme was precisely “Urban Agriculture: Fostering The Urban-Rural Continuum”. Most of the articles in this special issue of *Challenges in Sustainability* were presented on the occasion of this conference.

To capsulize into a few words what was the guiding thread throughout the conference, and therefore the unifying idea of this special issue beyond the diversity of the papers, the following can be said: When trying to determine if urban agriculture may contribute to a sustainable future, the primary question to ask is: Will this agriculture be at the service of the inhabitants? Its success depends on its objectives, its form, and its local ownership by the people concerned. It has a lot to do with building resilient communities. By doing so, urban agriculture can be the cornerstone that helps reconfigure more sustainable cities.

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Research Article

Building Urban Agricultural Commons: A Utopia or a Reality?

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Abstract: There are several categories of urban agriculture which need to be distinguished if we want to efficiently feed urban inhabitants with local agricultural produce while benefiting from other functions filled by urban agricultural landscapes: namely, eco-systemic functions or ecological and social functions. The second function will focus on methods to regulate unbuilt land in urban areas which have virtually no regulations and others which have strict controls preventing construction. The last will consist of possibilities to build, what I would refer to as, urban agricultural commons: in other words, tangible and intangible resources produced with farmers and gardeners for the inhabitants; for their local consumption and for the quality of the living environment, based on a political principle for common action. The concept of common is derived from the works of socioeconomist E. Ostrom (1990; [1]) and French philosophers P. Dardot et C. Laval (2014; [2]): “What is built in common”. It was applied to urban agriculture and landscape (Donadieu, 2012, 2014; [3,4]). The concept of urban agriculture has been used worldwide in the last twenty years by researchers, especially in France by A. Fleury (2005; [5]) and P. Donadieu(1998; [6]), in Mediterranean regions (Nasr and Padilla, 2004; [7]), in Asia, Africa and North and South America—all through the publications of the Resource Centres Urban Agriculture & Food Security (RUAF; [8]).

Keywords: multifunctional agriculture; urban agricultural commons; urban agriculture

1. Agrobusiness, Fun and Subsistence

1.1. Agrobusiness and Amateur Gardening

There are two ways of producing food products around cities and for cities. The first, which is prevalent in terms of the number of producers, its economic weight and the surface area involved, concerns farmers and agricultural entrepreneurs. They produce for local markets (urban markets and shopping centres) or for more distant markets in the same country or abroad. They are market gardeners, wine growers, cereal growers, livestock farmers, nurserymen, etc. Some cultivate in fields and others cultivate in greenhouses. Their activity is a business, an agrobusiness. Some farmers receive support within the framework of the

European Common Agricultural Policy and others, such as the livestock farmers, market gardeners and wine growers, receive little or none at all.

The second way of producing food products concerns amateur gardeners who represent a small proportion in terms of numbers and the surface area cultivated. They cultivate family allotments and community gardens and are to be found in much greater numbers in northern and central Europe than in the Mediterranean region. Their objective is not business but subsistence and/or leisure; the benefits of cultivating; of mutual support and the possibility of offering solidarity to those in need of help, such as the unemployed.

These agrobusinesses and amateur gardens occupy so-called open spaces: unbuilt spaces in urban areas, especially on the roofs of buildings, which provide the kinds

of landscapes most appreciated by inhabitants. These agricultural and horticultural practices are often associated with woodlands, gardens, public and private parks and produce two types of urban agricultural landscapes. Subsistence landscapes are often regulated in the same way as in the north of Lisbon during the economic crisis (Figure 1).

As regards leisure, enjoyment and pedagogical purposes, this is the case of Paris with its collective gardens (in French: *jardins partagés*; [9]). There are more than one hundred collective gardens in Paris, situated next to residential buildings and in public parks and schools, all of which are encouraged by town authorities. These are places which foster social interaction, but which also help people to re-establish a relationship with cultivated and natural environments. They can also provide opportunities to develop professional skills and often represent a lifeline for marginalised populations.



Figure 1. Community gardens in the north of Lisbon (Portugal).

1.2. An Urban Agricultural Order: A Paradigm Shift?

Public authority interventions vary depending on political situations. In Switzerland, city authorities sometimes cover the costs of production sites, as in the case of the vineyard of the Lausanne City Farm, or of urban farmland in Geneva which has been protected from urban development since the 1960s (Figure 2).

Urban authorities and many inhabitants dislike anything that evokes disorder, insecurity or poverty, such as improvised gardening sheds built by gardeners. In France, people like orderly family allotment gardens such as those set up in the new town of Saint Quentin-en-Yvelines, near Versailles, in 1985, or in a public garden in Angers in 2002 (Figure 3).

But for the main part, the urban agricultural order is the one produced by private agricultural enterprises on land, generally poorly protected from urbanisation. In France an average of 50,000 hectares of agricultural land disappears every year. Legal protection systems exist in almost all European countries but they insufficiently contain the pressure of urbanisation. In France, building permits given by the public authorities increases the value of land by 10 to

100. Only a strong political will, high environmental risks, extremely strong legal protection or exceptional profits from wine production (as in the region of Bordeaux, France) are able to contain urban sprawl.

In the end, the issue for elected representatives, specialists and the inhabitants of urban areas is quite simple: how to choose beyond the alternative between, the landowners' right of disposing of agricultural land, and the construction of urban public agricultural areas on private or public land?

The urban agricultural commons I am referring to are not public property, they are not community property either since they fall outside the scope of both categories. They are what is built in common for a general interest: the use of fertile agricultural and gardening land to grow food and fulfil sustainable local functions.



Figure 2. Vineyard of the Lausanne City Farm (Switzerland), near the Lemman lake.



Figure 3. Community gardens in a public park, in the center of Angers (Loire Valley, west France).

This is a revolution, a radical paradigm shift because it requires insurance that the cultivated land, the crops and livestock produced, and the farmers provide sustainable urban resources. These resources should not be evicted from the city as that has been the case during more than a century of hygienic modernism, an ethical principle which has undoubtedly become obsolete. That is why a more pragmatic approach, which takes potential impacts into account, is to be recommended: to ensure that everyone benefits from the eco-systemic goods provided by a diversified urban agriculture. To choose and prioritise them, because all eco-systemic supply, regulation and cultivation services cannot be provided equally to all the inhabitants. Because they are not just consumers but also inhabitants who want to enjoy a good quality of life in their own environment.

1.3. *The Urban Region: A New Vision of the City*

The old-fashioned, so-called modern city, invented in the 20th century is no longer viable. There is a need to invent another model based on the simple notion that all urban planners and landscape architects are familiar with: the system of parks developed by Frederick Law Olmsted in the United States and Jean-Claude Nicolas Forestier in France at the end of the 19th century. An urban agricultural system of public parks which includes future agricultural and gardening spaces. They are referred to as ecological networks or, in France, green and aquatic networks (in French: *trame verte et aquatique*). These parks are designed at the city level following the scientific research in landscape ecology conducted by Richard Forman and Michel Godron on the conditions to restore biodiversity. These unbuilt areas provide indispensable eco-systemic functions for the city: agriculture for food and energy, vegetation to regulate urban microclimates, the regulation of environmental risks (floods, fire, erosion of biodiversity, pollution of water tables) and the sequestration in the soil and the vegetation of excess carbon in the air.

The development of urban agriculture should be associated with policies for ecological networks and biodiversity as well as other public policies such as those relating to energy. These practices and policies are being deployed in Europe, but the pace is slowing due to the need for housing which irreversibly occupies too much valuable farmland. Is it possible to resort to other than regulatory means to preserve agricultural land, for instance by revisiting the notion of the common?

2. **The Building of Urban Agricultural Commons**

2.1. *The Destruction of the Commons: An Old Socio-Political Process*

Agricultural activity is not the result of nature but of culture, in the sense of cultivation for food and energy along with the cultural values attributed to such production. That is why the spaces and the tools used in agriculture have never been

res nullius: things belonging to no one, such as the air or the fish in the sea. The use of land for farming automatically engenders its appropriation as well as that of its produce, at least during the cultivation or production cycle [6].

So much so that in the cases of traditional African societies or of the former European commons, the land is jointly owned by the community; the modern legal notion of the individual ownership of land (*usus, fructus et abusus*) does not apply. It is the representatives of the community who decide on the collective rules governing the use of the land for crop or livestock farming. In such a context, which still applies in pastoral societies, the land and its permanent plant cover is *res communis*, public domain, a common resource, accessible to the rights holders of the community (a village, a municipality, an ethnic group). If the rules for the conservation of natural resources (soil, grass, tree, water) are not respected, the resource is put at risk and may even disappear: as a result its shared use is jeopardised (this is the “Tragedy of the Commons” theorised by the American economist Garrett Hardin in the 1960s [10]).

In such conditions two solutions are adopted: the land is privatised (*res privata*) by the sharing of the land between the right holders with or without the enclosure of the plots (as in the case of the enclosures in England in the 18th century), or it is made a public property: *res publica* (by allocating it as a part of the public domain of local authorities).

In the urban environment, collective property may persist as in the case of the commons in English cities (green, non-agricultural public spaces open to the public). Generally, unbuilt, wooded, agricultural land or aquatic spaces are either privately owned or the property of the State. Common lands have practically disappeared from the two categories defined by economists: public properties (in principle outside the realm of the market), and properties accessible via the market: property belonging to clubs (payment of a fee without exclusion) and exclusive private property.

2.2. *The Construction of Agricultural Urban Commons: A Socio-Political Form of Governance*

As demonstrated by the economist Elinor Ostrom (1933–2012), it is possible to create and preserve common resources (the water from water tables—in Los Angeles especially—an irrigation system, the fish in the sea) and to transmit them in good conditions. Such rational governance of a resource also applies to unbuilt lands in urban areas. It mobilises land owners, the users of “natural” soils (farmers, foresters, naturalists) or artificial soils (hydroponic farms), public authorities, experts, and generally “the public”, as defined by the American pragmatist philosopher John Dewey (1859–1962). The governance stakeholders, the “appropriators” and the public authorities, define the rules for the use of productive public or private agricultural and urban land. In post-industrial dross and brownfields sites, soils are often polluted. In France, the creation of community gardens requires a joint project between public authorities and gardeners [11].

A common is therefore a political principle of deliberation, of co-decision and action. The things built in common become common to the actor and co-deciders, “that which is covered by the activity of putting something in common, that which is produced in common by this activity” [2]. This common practice designates things, objects, private or public (the soil and the plants, farm produce and forestry products), and an awareness of moral values (justice, solidarity, freedom, dignity, etc.) which are at the basis of collective deliberation (co-decision). We shall call them agricultural urban commons.

They adopt different forms according to local histories. On the Saclay plateau to the West of Paris, near Versailles, 2,000 hectares of private agricultural land farmed by 12 farmers have been protected from urbanisation (listed under a law for the protection of sites) in 2000 (Figure 4).



Figure 4. “The Plateau de Saclay”, near Versailles (France), rapeseed crops and orchards.

This land and its cereal farming landscapes have become the commons of the inhabitants of the plateau; students and teachers from the Paris Saclay University campus; a branch of the French national agency of research in agronomy (INRA, or National Institute of Agricultural Research); the grouping of municipalities of Saint-Quentin-en-Yvelines; local public; private real estate organisations and the State (Paris-Saclay Public Land Agency since 2010). The agricultural urban commons of the Saclay Plateau were established by a system of territorial governance which emerged in the 1970s as a result of environmental demands expressed by the inhabitants.

The same thing occurred in the case of the Plaine de Versailles where a surface area of 2,000 hectares was protected by a territorial governance body composed of the grouping of municipalities of Versailles Grand Parc, and the association of farmers, elected representatives, inhabitants and public agencies of the Chateau de Versailles area (Figure 5).

When public or private institutions are confronted with the democratic expression of territorial stakeholders and with the tensions and conflicts caused by competition between building (housing, commercial zones, leisure areas) and food production, the ensuing discussions result in the creation of a common. In certain cases, such as Saclay, associations of consumers take ownership of land with the aim of producing local organic farm produce. In other areas, such as the Rennes metropolis (West France), the notion of *urban fields* designates land open to an agricultural and urban multi-functionality. Common projects fail, however, if stakeholders do not agree. These agreements often require a lot of time and are not eternal!

These new commons designate agricultural spaces which are usually private and the agricultural use of which is decided by, and for, local stakeholders and inhabitants who support their preservation. These spaces are similar to classic “commons” because they can be exhausted as a result of urban sprawl, but they are different in that they are appropriated. It is therefore common action which produces the common and not the over-abundance or inability to appropriate the resource (such as the air or the sea). Therefore, a soil, the function and agricultural uses of which fulfil eco-systemic functions (production, regulation, transmission) recognised as useful by the inhabitants, becomes a common.



Figure 5. Gally farms, near the Castle of Versailles. Strawberry crops under shelter.

These “edaphic” commons become assets when entitled persons are allowed to defend their transmission. In such a case, the stakeholders of this transformation into an asset are public agencies (such as land and urban planning agencies), private entities (owners and tenants) and the users who have access to the sites (for purposes of leisure or direct supply).

2.3. Organising Urban Growth and the Preservation of Open Spaces

An essential priority for the possible existence of agricultural urban commons is the conservation of cultivable and wooded land according to geographic continuities. It starts with the cartographic indication of the desirable use of the land in urban planning documents. For at least forty years the Ile-de-France region has had an urban planning policy. Initially it did not cover agricultural spaces, but today it includes a regional plan for open (unbuilt) agricultural and forestry spaces, which provides a political framework for the actions of elected representatives in municipalities. In addition, the policy for regional land use management (in French: *Périmètres Régionaux d'Intervention Foncière*, PRIF) make it possible for the agency in charge of green spaces (in French: *Agence des espaces verts*) to buy threatened agricultural land and nature areas. The same applies for all the municipalities which have had a territorial development master plan for the last ten years such as the grouping of agglomerations of Montpellier (since 2004).

Within this legal framework, which is clearly in favour of the general interest (the shared objective of providing healthy local food), it is very difficult for elected representatives to prevent the urbanisation of open spaces and advocate for reasoned agricultural urbanism. What forms of agriculture do urban municipalities need? This is a second essential issue.

2.4. Vertical or Horizontal Urban Farms?

For fifteen years now it has been theoretically possible to build vertical farms or production units. These essentially use the hydroponic farming model which is perfectly mastered by horticultural farmers, especially in green houses. Investors, however, have remained very cautious and so far hardly any vertical constructions have seen the light of day.

That is why the conventional solution of horizontal farms situated in urban green areas is far preferable, as seen in a recent project (2009) in Munich, Germany. These farms already exist, such as the orchards and large dairy farm of Viltain on the Saclay Plateau. With a few conditions: compliance with principles guiding ethical ecological agricultural, and in some cases, local production: animal welfare, limited or proscribed use of pesticides, organic farming, short farm-to-market cycles, organised access for the public, etc.

Another condition is that farmers should find in these continuous agricultural spaces few of the problems that might urge them to move away from cities: problems with

the circulation of farm vehicles and machines on clean roads, problems with sources of organic matter (livestock, compost), the lack of local technical and veterinary assistance or of storage buildings and, above all, the possibility of transforming their crops and produce locally.

A last condition is that in the medium term there should be no uncertainty concerning the continued use of the land for farming. Farmers investing in agriculture cannot buy machines and animals, work on fertilising soils and selecting crops and deciding on which ones to rotate, develop quality produce and gain the confidence of clients if they have no control over the land through ownership or rental. In this area European countries have very different legislation which makes it possible to develop the use of unbuilt lands as commons. For mainly environmental (biodiversity) but also food production reasons there are private and public land agencies which make it possible to build urban agricultural and forestry networks. This is the case in France, for example, with the land development and farming societies (in French: *Société d'aménagement foncier et d'établissement agricole*, SAFER), or the green space agencies (in French: *Agence des espaces verts*) in the Ile-de-France region. But all these tools are unable to prevent the consumption of agricultural land.

The ideal solution would be to ensure that agricultural land and the use of agricultural urban commons should become as “natural” as urban forests and public parks and gardens in the minds of everyone. Since such a utopian point of view is not feasible there is a need for a pragmatic approach: to experiment and evaluate the results with the inhabitants, elected representatives and farmers, and to improve practises and new projects for the benefit of all.

2.5. Which Form of Territorial Agricultural Urban Governance?

So that an agricultural urban environment can actually exist, the political will to develop and share it with the people concerned is a prerequisite. The urban area of Rennes in the west of France (400,000 inhabitants) is a fine example. For almost 20 years, its elected representatives have sought to build with urban planners, farmers and landscape architects an urban agricultural region in the form of an archipelago; in other words, urban islands localised in a woody landscape of Brittany (in French: *bocage*), a network of small towns and a centre linked by road and rail (metro) infrastructures. This vision of a rural city, or urban countryside, was shared by local politicians and inhabitants. And farmers are grouped together to sell their livestock and vegetable produce. The inhabitants of this city live in an urban area in which farming activities are a part of the urban environment, where urban planners have designed green and aquatic networks, pedestrian and cycling lanes, and where chambers of agriculture have supported the development of short cycles to bring produce to market and organised the production and processing sectors. Tensions subsist, namely in the land property market, but the notion of an urban agricultural region has become a reality.

Another significant trend has developed during the last thirty years in Europe by which consumers pick produce directly from the farm, such as in the urban region of Versailles Grand Parc on the Gally Farm (Figure 6).

There is currently a plan for the installation of a similar farm gate direct marketing operation in Monza, North of Milan. It is the shortest channel to market for produce where the producer is directly in contact with the consumer and which also provides a pleasant experience of country life. Initially, crop varieties were limited, but the variety of cultivated species has considerably increased today, some cases including as many as 50 or 60 different species in efforts to address the increase in demand.

I could mention other urban agricultural practices indicating the existence of significant urban agricultural activity: greenhouse farming, riding centers, agritourism and bee-keeping in town. Sometimes inhabitants are invited to farms to participate in wine harvesting, as in the North of Montpellier (South France) in a vineyard belonging to the urban community. Such pleasant activities would be difficult to imagine in sterile vertical farms.

Access to community gardens close to one's urban residence has become a form of luxury that the city of Versailles is promoting in working-class neighbourhoods. The possibility of meeting one's gardening neighbours, of engaging in a social activity which also puts one in contact with nature, with the land, and procures the pleasure of consuming one's own vegetables: these are valuable commons local inhabitants have benefited from since World War Two. These commons also provide wages for 150 people within the framework of a social insertion program. Could vertical farms provide such community services?

To be able to admire the countryside while living and moving about town, these are sensations urban planners have deprived European urban inhabitants of since the end of the 19th century. For instance, in the Netherlands, near Rotterdam, a typical example of an urban country, the population is not deprived of the joys of spring thanks to the presence of vast fields of bluebells.

Another idea related to sustainable development, which is becoming widespread today in metropolitan areas, is the notion of self-sufficiency for the most fragile types of produce such as fresh produce. In order to achieve this in the metropolitan area of Rennes, all green spaces would probably have to be converted to agriculture which would not be desirable except in an exceptional circumstance such as a war. Finally, we must remember that green spaces have often in the past been used to exclude the use of poor or marginalised populations. Today, the challenge of the commons is to build an alternative to the private use of public spaces [12].

3. Conclusion

In this new context, to compose or design the agricultural city and to give it new forms is a challenge for the landscape architects and urban planners of the 21st century. This practice existed in France when Louis XIV asked the architect

Mansart and the gardener Jean-Baptiste de la Quintinie to install a vegetable garden and orchard of 12 hectares next to his palace in the new town of Versailles. Why not mobilise these competences again (Figure 7)?

Why not design an urban agricultural environment with the tools and concepts of landscape architecture? This would involve showcasing agricultural activities ranging from the most high-tech to the most traditional, and highlighting and promoting their social, economic, environmental and cultural benefits. It happens to be the complete opposite of what was done during the 20th century. This would undoubtedly make it possible for such activities to be accessible to a majority of the population!

The sharing of agricultural or garden land and products through a form of territorial governance is not a utopian dream. However, it is idealistic in that it challenges the consumer's model of society and notably, the fact of supplying cities by means of long-distance transport with its repercussions on energy consumption and public health in a context of increasing food insecurity. And yet, such a notion is realistic as the examples cited above demonstrate.

Utopias like vertical farms are probably chimerical—to bring all the food necessary for the city dwellers. "Horizontal" urban farming on natural or artificial soils for, and with consumers, is a better solution. The notion of the common is a political principle and a shared duty for stakeholders such as public authorities and associations as well as private organisations and individuals engaged in the same activity: the creation and conservation of local farming and gardening activities on cultivated lands which can be transformed into urban assets.



Figure 6. Direct picking, Gally farms, Urban region of Versailles (West Paris).



Figure 7. The *Potager du Roi*, Versailles.

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Research Article

Urban Agriculture, Commons and Urban Policies: Scaling up Local Innovation

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Abstract: May urban agriculture be the cornerstone that helps reconfigure more sustainable cities and if so, under which conditions? And if so, what type of urban agriculture? Such are the two issues underlying this article. Why not counteracting urban sprawl by fostering what could be called “rural sprawl”, by introducing nature and rural characteristics such as farming within the city, in its interstitial areas and wastelands? In this perspective, urban agriculture becomes a common good, bringing people together and reshaping the whole urban fabric that would eventually propose a radical remaking of the urban. Urban agriculture lends particularly well to long-lasting urban policies, especially those turning environmental “bads”—such as brownfields and wastelands—into environmental “goods” and urban amenities. Urban agriculture in interstitial abandoned urban areas may be one of cities’ main seedbeds of creative innovation. It is all about the right to decide and the power to create, renewing and deepening what Henri Lefebvre called *The Right to the City*.

Keywords: common goods; inclusiveness; local innovation; sustainable city; sustainable design; urban agriculture; urban planning; urban policies

1. Introduction: Promoting “Rural Sprawl” across the Rural-Urban Continuum

Traditionally, sustainable urbanization is identified with the historical model of European cities, with their dense centers and their suburbs, while low density cities are usually associated with soil squandering and heavy traffic—when taking one’s car is the only solution to move from one place to another [1]. Thus, the compact city is often perceived as a universal model for urban transition to sustainability [2]. Even more so given the fact that urban sustainability is generally discussed in the light of making a better use of what already exists, which is well in line with the spatial dynamics of a compact city: Recycling the urban fabric and the urban functions without going through phases of obsolescence and degraded neighborhoods [3,4]. But this view

is becoming controversial for at least three reasons. First, high densities also generate huge environmental nuisances and constraints [5], and besides climate policies introduce arguments for considering positively lower-density urbanization: For example, green neighborhoods planted with trees presenting a high water loss coefficient can lower the local temperature (10% of vegetation increase lowers the temperature as much as 1° C within a 100 m radius) [6].

Second, establishing a compact city may prove impracticable in the long run because it goes against market preferences and people’s desires for individual housing [7,8]. We must admit that whatever huge efforts were made by public authorities wherever in the world over more than fifty years to limit urban sprawl, they failed [9–11]: Sprawl has become the usual mode of production of the contemporary city, whatever its size, its administrative configuration or its

policies [12,13]. Even “shrinking cities” and those facing decline and abandonment, have to deal with fragmentation and urban sprawl [14].

Third, many aspects of urban sustainability cannot be addressed within the limits of the compact city. For example, any city—be it sustainable or not—has to provide water and energy to its inhabitants, while reducing pollution and processing all the urban waste [15]. Beyond all the well-known technical solutions—smart grids, selective sorting, urban heating, wastewater treatment plants, intelligent buildings, etc.—the energy, the resources, the water and the food still come from outside the city limits. Sewage plants and garbage dumps are also outside. Even a large number of the people that work in the city live outside, when they cannot afford the expensive—and sometimes gentrified—urban centers [16,17]. When a place looks sustainable by giving to other places the burden of its sustainability—exporting pollution and polluting activities, while siphoning resources—this place is not really sustainable. It benefits from what David Pearce calls imported sustainability [18], which is a major bias against the implementation of sustainability policies.

Thus, it is impossible to address urban sustainability by considering only urban centers. It is crucial to design sustainability across areas large enough to include most of the fluxes of the urban metabolism, which means areas encompassing suburban, periurban, and dependent rural or natural places [19]. As a matter of fact, the social, economic, scientific, technical and cultural transformations of the last few decades have produced deep changes in how society relates to space. Today, urban areas have either no boundaries or very fuzzy ones, as showed by Bernardo Secchi [20,21] with the notion of *Citta Diffusa* or by Thomas Sieverts [22] with the notion of *Zwischenstadt*. Why on earth are we supposed to set up a false dichotomy between urban and rural area, given that lifestyle, facilities and amenities are not so different? It is much more consistent to start addressing a whole “urban region” when considering urban transition to sustainability as shown by the European project PLUREL [23,24].

How to address sustainability across the urban-rural continuum—suburban, periurban, and dependent rural or natural areas—, considering (i) that urban sprawl has proven very difficult to stop (if not impossible), and (ii) that distinguishing between rural life and urban life makes no real sense anymore?

Since lower-density urbanization offers some advantages as far as sustainability is concerned and is no more considered an absolute evil, why not counteract urban sprawl by fostering what could be called “rural sprawl”, by introducing nature and rural characteristics such as farming within the city—within its interstitial areas and wastelands? After all, low-density urbanization was once the rule than the exception for centuries all around the world [25]: In villages and hamlets, small communities had a very dynamic social life in a nice environment. Such a position postulates that urban agriculture might be the source of a new

type of urban arrangement, that if generalized would deeply transform urban systems while contributing to a more sustainable future. But what do we really call urban agriculture in this article?

2. What Type of Urban Agriculture Are We Speaking About?

Basically, urban agriculture is the practice of cultivating, processing, and distributing food in or around a village, town, or city [26]. This notwithstanding, there are very different types of urban agriculture that don't have much in common except that they consist of growing edible plants in the city: Intensive vertical farming, micro-farming, kitchen and community gardens, etc.

Thus, are we speaking of the new farming architectures that have been proliferating since the nineties in the wake of the Smart Cities movement, such as Vertical Farming—cultivating plants or breeding animals within tall greenhouse buildings or vertically inclined surfaces [27]—epitomized by the mainstream medias as the paragon of urban agriculture? Vertical farming takes form in several ways [28]: Crops being grown in the interior floors of midrise buildings with apparatuses that rotate crops on belts (<http://www.verticalfarm.com/>), rooftop farming, tree-like skyscrapers (<http://agritecture.com/>). The point of this farming laden with eco-technologies is exploiting synergies between the built environment and intensive—if not industrial—agriculture [29]: Recirculating hydroponics and aeroponics that significantly reduce the amount of water needed, collecting rain and treating wastewater, producing photovoltaic green energy, etc. [30].

It was Dickson Despommier who started using the term “vertical farming” in 1999, first to qualify the cultivation of plants on flat roofs, and then inside retrofitted empty mid-rise buildings [31]. But his vision of a vertical farm was that of “a neighborhood concept couched in futuristic terms, but with a homespun intent” [32]. This is quite different from the brand-new smart buildings—tree-like skyscrapers and high-rise agritectures—proposed today as the be-all-and-end-all of urban agriculture, which eventually are projects that remain projects: None have ever been built, which says a lot about their feasibility. There are many huge problems inherent to this vertical farming:

- Even if a building is largely fenestrated, plants still need soil and additional sunlight to survive. When Sunlight is replaced by LEDs, it has a huge energy cost.
- Controlling humidity and air circulation, and evacuating the heat released by the LEDs also has a huge energy cost.
- Fertilizers would always be necessary, as would pesticides due the mildew and other pests found in greenhouses today.

As such, realizing such vertical farms would require significant technological breakthroughs [33].

In real life, vertical farmers are far more modest, and

much closer to Despommier's intuition: A three-story building with solar panels on its roof in the South Korean city of Suwon; a three floors underground farm in the city of Den Bosch in the Netherlands, with plants cultivated without sunlight by a private company—PlantLab. And it is logical, since vertical farming is an old idea finally, that is not necessarily linked with Smart Cities, ecotechnology and big data. Indigenous people in South America have long used vertically layered growing techniques, and the rice terraces of East Asia follow the same principle; as did the hanging gardens of Babylon, thousands of years ago. And, by the way, it was Gilbert Ellis Bailey who first coined the term “vertical farming” in 1915, long before anybody heard about any smart-*whatsit* [34].

As beautifully put by Stan Cox and David Van Tassel, recent vertical farming looks like a dreamy idea with a solid financial and political hidden agendas, which would ultimately become even more industrialized than modern rural agriculture [35]. Indeed, to defend this type of urban farming many authors argue that fossil fuels, fertilizers, and government subsidies to industrial farming are also expensive [36]. Doing so, they consider implicitly that vertical farming and industrial farming should be of the same nature and have the same standards. It says a lot about the financial interests and real objectives. Such a type of urban agriculture is all but sustainable, and can certainly not foster urban sustainability.

Besides, there are many good reasons why high-rise buildings do not already have trees: It is hot or cold or windy or both, up there. Nearly every climate variable is more extreme than at street level. As mentioned by Tim De Chant: “If—and it's a big if—any of these buildings ever get built, odds are they'll be stripped of their foliage quicker than a developer can say 'return on investment'” [37]. Besides, what would be the economic and social cost to water and fertilize these trees? Concerning cattle, what would be the real productivity of such farms, when a single cow needs more than 1.5 ha of grassland in his life. And even vegetable crops grow better on natural soil than indoors or on roofs [38]. There is obviously a huge discrepancy between the dream—or the nightmare—and the reality.

The final point, which for me constitutes the first on the sustainability planning level, is: How the urban fabric may be inclusive of this type of farming? As highlighted by Saskia Sassen, in the broader perspective of the Smart Cities movement: “These technologies have not been sufficiently ‘urbanized’. That is, they have not been made to work within a particular urban context. It is not feasible simply to plop down a new technology in an urban space” [39]. Focusing on these agritectures may lead to ignoring promising alternatives of urban development [40].

Eco-technologies are not an end in themselves, and may certainly not be considered sustainable by nature: A hammer can be used indifferently to knock in nails or to shatter skulls, but the hammer is neither bad nor good. It is the person that uses it who decides. The same goes for eco-technologies. Never underestimate the negative effects of the new technological and networked infrastructures

needed for a city to be smart [41]. Thus, the success of sustainability policies depends on their objectives and their local ownership by the people concerned [42]: An issue too often dodged by the designers of smart-agritectures. When trying to determine if urban agriculture may contribute to a sustainable future, the primary question to ask is: Will this agriculture be at the service of the inhabitants—and not the other way around. Indeed, it is crucial to keep in mind that the “environment”, far from being pure transcendence, is embedded in societies, as demonstrated by Maarten Hajer [43,44]. In a former article for *Challenges in Sustainability* I explained how the human being builds a representation of the ecosystems he lives in and calls it “environment” out of the usages he makes of its resources: takings (usage of air, water, minerals), inputs (pollution), alterations (housing, transport) [45]. Thus to address urban sustainability, it is crucial to know what a “good environment” is for the people and the communities living there; one in which the enhancement of environmental conditions *stricto sensu* (water quality, air, biodiversity, prudent use of resources, land and energy, etc.) improves living conditions and facilitates new lifestyles. A polluted environment can be a place where life is good. Just think about the price of a square meter in the very center of the very noisy and very polluted Manhattan, Paris or London. Conversely, an environment with clean air and clean water can be quite intolerable as evidenced by windswept, segregated social-housing blocks settled in the middle of nowhere.

3. A Common Good

All of the above leads us to consider that to design a more sustainable future in the rural-urban continuum we should rather focus on a more traditional type of urban agriculture that gives consistency to the whole urban fabric. That is to say an urban agriculture made of community gardens, kitchen gardens, crofting and micro-farming, land sharing, low-rise rooftop gardens or schoolyard greenhouses—which are different things but strongly linked to each other because they develop the potential for people to exercise significant influence over the place where they live [46,47]. The point is longer-lasting change, in the spirit of Rob Hopkins' *Transition Towns* [48,49]. Tim Beatley's *Green Urbanism* also resonates with the type of urban agriculture we contemplate in this paper. *Green Urbanism* identifies six issues by which a city complies with urban sustainability all of which may apply to community and kitchen gardens, as well as crofting: The city should be (i) living within its ecological limits, (ii) functioning in ways analogous to nature, (iii) striving to achieve a circular rather than a linear metabolism, (iv) striving toward local self-sufficiency, (v) facilitating more sustainable lifestyles, and (vi) last but not least emphasizing neighborhood and community life [50,51].

This urban agriculture varies a lot according to the climate, and the economic and social situation of the city. In many urban areas of Central and South America, Africa or South East Asia, urban agriculture is essentially a food

security issue, related to the fight against poverty and malnutrition [52?, 53]. The situation is quite different in European cities [54], North American cities [55], or Japanese cities [56]. In these regions, many official urban agricultural projects result from “greening” agendas created under the umbrella of the *Green New Deal*, which aims to address global warming and the financial crises rather than food issues as mentioned by Tim Jackson [57]. In most other cities, the landscaping aspect and the recreational dimension are highlighted. In all these cases, urban agriculture is mainly seen as a social innovation that improves the quality of life, fosters social links among neighbors, and enhances urban landscapes. In so-called “Northern” cities urban agriculture is not so much about food, really [58]. In any event, all these urban agricultures—whatever their form, their goal and their means—share significantly common features: The size and shape of the field plots, the informality, the ability to create or foster neighborhoods relations, etc. [59].

Their common features result from the fact that all these agricultures have been in the cities—where they met the same needs and fulfilled the same purposes—since time immemorial. Urban agriculture is not such a fresh idea. Moreover, it is certainly not an offspring of sustainable development. Urban agriculture existed for centuries in very different places around the world, such as the *chinampas* in Tenochtitlan—the actual Mexico city—since the 15th century or sooner [60], the *hortillonnages* in Amiens—a French city north of Paris—for more than twenty centuries [61], or the interstitial gardens (*agriculture d’interstice*) in Yaoundé—Cameroon’s capital—where they accompanied the foundation of the city in the 19th century [62].

Urbanization has gone hand-in-hand with agriculture from the beginning, as matter of fact since the Neolithic period [63]. Agricultural activities have been crucial to the foundation of new colonies since Greek and Roman ages [64]. Even in medieval times when walls and defensive structures left out most of the farmland, agricultural patches were available inside the city and next to the city walls [65,66]. Jane Jacobs even assumes that agriculture was initially within human settlements that could be called primitive urban places, and migrated to the countryside only later [67].

But while cities and agriculture have long been inseparable and mutually reinforcing, everything changed during the twentieth century: Increased mobility and progressive globalization made pointless the previous need for geographical proximity between the farmers and the urban consumers. Farming was then more or less banned from the city under the combined forces of urban densification and planning regulation [68]. This period could be qualified as the great rupture.

The new craze for the form of urban agriculture that we are dealing with in this paper began 20 years ago. It renewed—but also transformed deeply—the old tradition of nineteenth century backyard gardens that existed before the great rupture. Beyond traditional allotment gardening, urban agriculture appeared in front lawns, kitchen gardens, pavement verges, railway embankments and any interstitial spaces, which is more unusual. In many ways, the citizens

involved in this type of urban agriculture claimed ownership over the city, and particularly over the policies and projects developed by the city [69].

It means that the relation between urban agriculture and the sustainable city is not just a matter of food or greening, it is also about inclusiveness and ownership. One among the many challenges of urban sustainability is reestablishing the inclusiveness of the urban fabric instead of just popping-up parks, green spaces or smart-buildings. The current regional master plan of Paris proposes—as an important mean to foster sustainability—a quantitative objective of 10 m² of public green area per inhabitant; as though it were sufficient to display “green” to become suddenly sustainable. Shocking but understandable: mayors, representatives and more generally elected officials adore showcasing actions that are very visible. They are less interested in citizen ownership and holistic approaches, which are more important to make the city sustainable but harder to implement and less profitable as an electoral issue. Besides, French *espaces verts* (green spaces) do not necessarily bring people together. They may also be used to separate, in line with the Parisian history: The introduction of greenery by Haussmann was an attempt to control the use of public space by a technical approach [70]: “. . . by losing its name, the old park is deprived of its positive attributes... the *espace vert* is no longer a place but rather an indistinct area whose boundaries are decided in the abstract world of the master plans. . .” [71].

All things considered, when trying to make a city sustainable, there may be some good sense in promoting urban agriculture instead of manicured sophisticated green areas. In this perspective urban agriculture would propose a radical remaking of the urban [72], which breaks with the urban-rural dichotomy. This option paves the way to a reinvention of the urban form and its management through new lifestyles and through the reconstruction of some kind of urban commons [73,74]. Such an urban agriculture should be considered as a common good, bringing people together and reshaping the whole urban fabric.

Is it really doable? Has it already been done, and if so where and how? In all the historical examples given before—*hortillonnages*, *chinampas*, *agriculture d’interstice*, etc.—as well as in recent cases where urban citizens and gardeners gain ownership of the city, it appears that urban agriculture “works better” when no public or private actor explains to the population what the procedure should be and how people should act. To say it otherwise, it looks like urban agriculture “works better” when nobody looks: That is when the inhabitants first transform their living environment outside of any legal framework or official urban project, and their actions are only integrated afterwards into urban planning or urban policies. In France, the *Trames Vertes et Bleues* (Green and Blue Grids) are a perfect example of what not to do. These Trames are land management tools dedicated to the preservation of biodiversity—especially in urban and periurban areas—created in the aftermath of the *Grenelle de l’Environnement* [75], after 2007 [76]. The

procedure was way too formal and technocratic to succeed in the constitution of a true regional *Trame Verte* [77]. Nobody asked the local communities and the inhabitants for their views. Thus, in many places the implementation of the Trames turned confrontational, and resulted finally in inconsistent and incomplete grids [78].

On the other hand, the remarkable history of La Fournillière shows how a squatted wasteland in a poor place near social housing blocks turned into a very popular park based on urban agriculture. The inhabitants created this place by themselves, seeking their own objectives. In the end, the local authorities had no choice but to enact their initiative and legalize it, re-commoning urban land through agriculture.

4. Inclusiveness, Ownership and Local Innovation: The Case of La Fournillière

To understand what happened at La Fournillière it is necessary first to apprehend the historical context. The place was a village—annexed to the French city of Nantes in 1908—that became an industrial suburb with fruit and vegetable canneries (Figure 1). A rich soil that allows cultivation of field peas, baby carrots, or asparagus, explains why the canneries settled there. These companies provided kitchen gardens to their employees within the policy framework of industrial paternalism. During the post-war boom major changes took place: Social housing complexes were built and successive projects were developed on the site of these kitchen gardens. The first one was an access highway to downtown Nantes. The gardeners were evicted and their gardens ceased to exist. This first project was finally abandoned. Others projects followed but they failed to become

effective due to local political turmoil. Finally, nothing happened and in the seventies the place turned into wasteland of more than 3 hectares [79].

The people living nearby—especially those from the social housing blocks who didn't have access to nature—started eyeing this abandoned land and its rich soil with interest (Figure 2). From the mid-seventies—one after the other—they progressively occupied La Fournillière, first at night and finally in broad daylight. By the end of the nineties, there were more than 70 squatting gardeners there. As mentioned by Elisabeth Pasquier, to get a piece of land there you simply had to start digging the ground somewhere—a corner that looks vacant—and wait. If nobody were coming at you, you could keep digging and start tending your future garden. A few days more, or a week, without any hostility from your neighbors meant that this piece of land was ostensibly yours. You could then start fencing, sowing, and socializing with your neighbors [80]. At the end, two categories of squatting gardeners worked a piece of land at La Fournillière [81].

On the one side, some of the former evicted gardeners—or their children—came back. They were locals, most of them descended from Brittany or Vendée (two French regions). They were few. They stuck together and kept closely connected via common emblematic activities, such as *pétanque* (bocce tournament), *apéritif* (before-dinner drinks) or barbecues. This category of gardeners was made of poor but not marginalized people. They lived in substandard one-family houses. There were usually old people with a small retirement pension or younger poor workers; they knew how to cultivate a small piece of land.

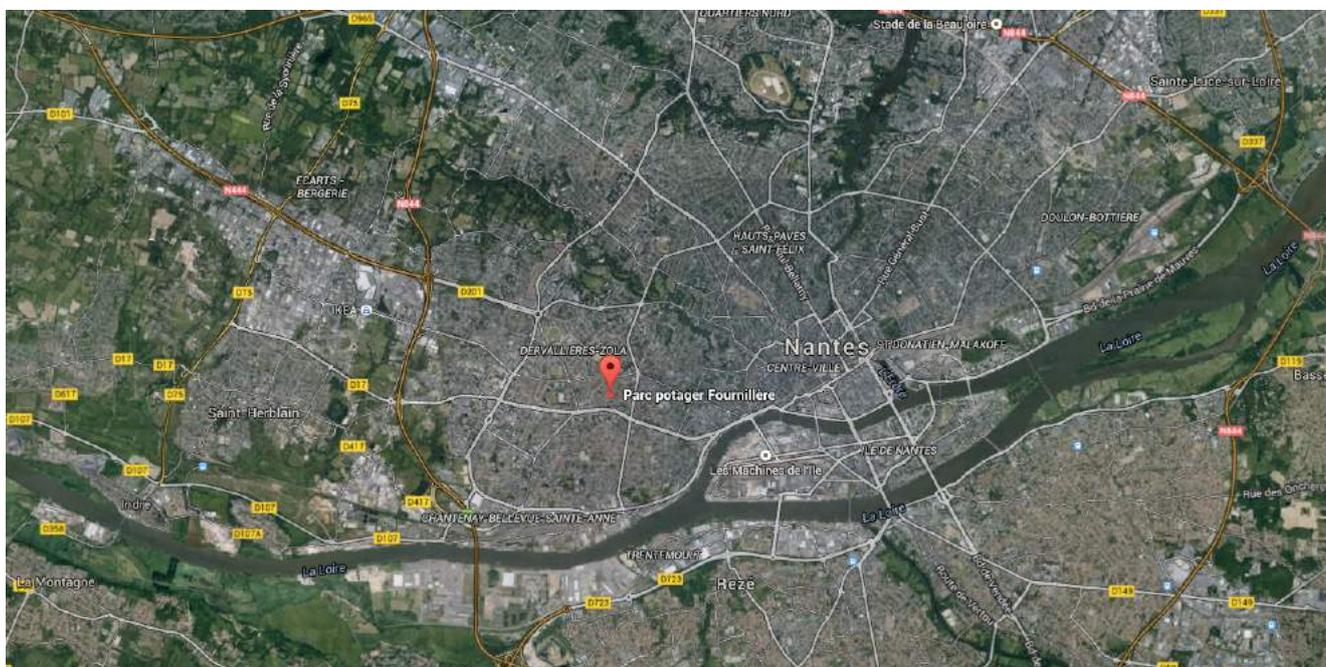


Figure 1. Situation map of La Fournillière downtown Nantes. Source: Google Maps.



Figure 2. La Fournillière in the early seventies. Source: City Archives of Nantes.

On the other side was a completely different category. These gardeners came from the disadvantaged social housing complexes around La Fournillière. They had different origins and ethnic background, being mainly North Africans. Many among them were unemployed and lived on social benefits. For them, "owning" a piece of land at La Fournillière was a way of keeping active, and it was a place where they could settle symbolically—a "circulatory space" (*territoire circulatoire*), within the meaning of Alain Tarrus—, a place where they could grow roots, literally [82]. These gardeners were called "*les autres*" (the others) by the local gardeners from the first category, but they represented an overwhelming majority with nearly 4 gardeners out of 5.

Both groups tended to ignore each other, but an element of solidarity brings them together: They were all fully aware of how precarious and uncertain their future in La Fournillière was. As squatters, they could be expelled at any time. They all knew they had to stand united to respond effectively to any of the many menaces that might threaten their plot—a new urban project, theft and vandalism from the people outside, etc. Such a situation fosters social links.

Nothing changed until the early nineties, when a new elected city council took interest again in La Fournillière. This time the new project was a neighborhood park. Something unusual happened then. The two groups of gardeners started uniting their forces and organizing to impose their views on the project. They also knew that the game of illegally occupying pieces of land couldn't go on forever. It was time for them to make their situation legal, preferably on their own terms. A form of collective intelligence emerged,

and with it the seeds of a collective identity [83].

Rather than making demands and organizing protests, they decided to draw out an in-depth report on the actual situation at La Fournillière, providing an exact overview plus maps of the different pieces of land, including the spatial pattern of the different gardens and their history. The report displayed the long work of clearing and planting that they had done as well as the public goods they had created. It illustrated the social and ecological value of these gardens for the whole city. The gardeners demonstrated that La Fournillière was a well of common good as it was, whereas the project developed by the municipality could very well fail and destroy the whole site unless they took into account their own experiences and the actual organization of La Fournillière. Finally, they claimed that they wanted to be decision-making partners in the project and have a seat at the decision-making table.

The planners of the city of Nantes understood that the opposition of the gardeners was not a negative NIMBY reaction but the expression of collective wills and skills [84]. Once they realized that an alternative proposal with strong local community (and therefore, electors) support was emerging, they agreed to discuss with the gardener's collective. At the end of a long process of negotiations—and against all odds—the city council decided to support the gardeners' alternative project and to abandon its own proposal. The new project envisioned a park organized around the existing gardens, forming islets or patches. Paths for walkers and runners entwined with the islets, connecting them. At the very center of the park a venue was placed

to initiate visitors to the recycling of material and waste in urban gardening, including waste sorting and composting to enhance biomass and biodiversity. The gardeners determined themselves the rules for living together: More frugal and wiser water-management; a ban on cutting any tree in one's own gardens, since trees are considered to be common goods etc. [85]. In some sense, the case of La Fournillière is prototypical of Alberto Magnaghi's idea of combining both bottom up and top down processes of decision-making in the urbanization process [86].

Today, La Fournillière is a particularly charming and unusually large urban farming land that one can only reach by walking. Two narrow lanes lead to a kind of huge clearing covered by gardens, scattered trees, and bushes (Figure 3). Large colored water tanks surround shacks made out of recycled materials gathered in small patches. A maze of service alleys spreads around five key items: three wells, a pond, and an improvised *pétanque* court. La Fournillière is also a social theater. These kitchen gardens give grown-ups a place where they can get away from it all and become kids again: a parenthesis in their ordinary lives since at the end of the day they go back home. They indulge themselves by putting things in the garden that wouldn't be permitted anywhere else in the city: a doll's head impaled on a pole, a teddy bear crucified on a picket fence, etc. Apart from the magic of the place, they are also kitchen gardens and also have, as such, straightforward economic interests: cabbages, potatoes, and other vegetables are planted to feed the family year-round. Two larger paths cross the whole area. They were created by the footsteps of thousands of people. Placed in the middle of the city, traversing La Fournillière is a shortcut for many men and women going to school, to work, or simply to the market in Nantes.

5. Conclusion: The Right to Decide and the Power to Create

As I discussed in a recent paper a city does not arise from the sole will and skill of architects, planners, surveyors, and politicians [78]. It has to be nurtured and molded by its inhabitants to bring it to life. Such a process needs time, quite differently from the frenetic timeline and knee-jerk reactions to any opposition that elected officials and planners, guided by their own short-term interests impose on urban policies (the next election, compliance with construction deadlines etc.).

Urban agriculture lends particularly well to long-lasting urban policies, especially those turning environmental “bads”—such as brownfields and wastelands—into environmental goods and urban amenities. Naturally, it will not be possible everywhere. There are also health issues when redeveloping brownfields for urban agriculture, due to potentially polluted groundwater and soils. Nonetheless, it would make sense to establish productive lands as a key component of urban design when possible, as proposed by Andre Viljoen and Joe Howe [87]. A network of agricultural plots, which would penetrate the smallest nooks and crannies of the urban fabric, should be a wonderful tool to link the different components of the city, while providing other ecosystem services such as walking and leisure activities. Besides, such a network would greatly improve urban resilience, by linking formerly scattered vegetated places within a consistent system. Squares, parks, gardens—community gardens and kitchen gardens, as well as public gardens—and more generally all vegetated urban public spaces will be connected by urban agriculture.



Figure 3. A Shack and a Garden at La Fournillière. Source: Miraorti

In this perspective, urban agriculture embodies the proper use of slowness (*Le bon usage de la lenteur*) in urban planning and design as depicted by Pierre Sansot [88]. And the history of La Fournillière illustrates it perfectly: Had only one of the successive lunatic projects designed in the seventies been built, these gardens would have never existed. It is also a symbol of what can be done when everybody is involved in the planning procedures, which means sitting everyone at the table so that all the inhabitants understand that the urban affairs are also their affairs. This urban agriculture is about the right to decide and the power to create, renewing and deepening what Henri Lefebvre called *Le Droit à la Ville* (The Right to the City) [89].

As a general rule, urban transitions to sustainability—to which these urban agricultures relate—require involving every citizen in the decision that affect them, and especially

in the designing of the urban projects—and not only by “consulting” them. The more top-down repairing planning procedures the less results, if not linked with grassroots collaborative process and with negotiation between local communities and local authorities [90]. Grasping what happened at La Fournillière eventually means deciphering the eternal game between what the authorities—whatever their form—try to impose on the social fabric, and what the social fabric—represented by the gardeners—impose on the authorities, through deception or force, through confrontation or bargaining. It is all about how people take ownership over their own city. In this way, urban agriculture can really be the cornerstone that helps reconfigure urban areas, and the backbone of a new and more sustainable urban arrangement to foster urban transition to sustainability.

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Research Article

Action Research: An Essential Approach for Constructing the Development of Sustainable Urban Agricultural Systems

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Abstract: How can research contribute more directly to promoting and leading to sustainable solutions and projects? This article suggests that one of the most important research approaches capable of achieving this is the Action Research approach. This involves the researcher taking on a number of roles when working with other actors (e.g. citizens, farmers, local elected officials, citizen associations, government representatives... with the specific set of actors depending upon the nature of the subject being investigated and for which solutions are sought). The roles that the researcher can play involve providing appropriate information to the other actors, providing counseling to them, organizing and animating meetings with the actors, and accompanying the whole process involving all the actors. These roles are essentially played out by the researcher when the other actors request the researcher to assume whichever roles they consider to be significant. The fundamental notion is that through this process the actors appropriate the sustainable solutions as their own, and the researcher helps them achieve this. This article is based on: a) a synthesis of pertinent research using the Action Research approach (specifically in relation to sustainable agricultural systems in periurban territories), and b) specific research undertaken by the two co-authors of the article, all in the context of periurban agricultural systems during the last 8 years, as well as on some of their publications. The necessary characteristics of Action Research and the researchers involved are identified, namely: a) patience; b) an emphasis on process; and c) an emphasis on participation on the part of multiple actors.

Keywords: Action Research; periurban agricultural systems; roles of researchers; sustainable development solutions

1. Introduction

Increasingly, the notion of so-called 'sustainable' agricultural systems raises many questions for many actors both in government and in the research community. With increasing urbanization, urban spaces penetrate more and more into what remains of their surrounding rural areas,

and this territorial fringe, which has often been called a hybrid space, has become the focus of much attention in recent years [1]. With the introduction of the concept of sustainable development, a shift has become necessary in the food supply systems for cities and therefore ultimately in the modes of 'production'. Since the end of WW2, state authorities have largely focused on industrial agriculture de-

spite its share of negative externalities for the environment and public health; today more than ever, this agriculture which occupies the smallest spaces within agglomerations and remains the largest land user on the edges of cities, naturally leads us to rethink the agricultural reality. In relation to this, both public and private actors have a duty to be resourceful in order to highlight the fact that agriculture adjacent to and within urban agglomerations remains vital for certain population segments in both developed and developing countries [2]. However, much of the research that has been emerging on this issue does not put enough emphasis on Action Research, an approach that has come directly from North America and in many respects has given rise to very relevant results.

This urban (including periurban) agriculture (UPA) has to face many challenges; the researcher can in many cases contribute to the emergence of solutions, while at the same time remaining open and willing to meet the demands of the actors involved. The researcher's roles remain essential in this Action Research approach—as informant, advisor and in accompanying the actors in their construction of pertinent and, today, sustainable projects.

This article is focused on the importance of Action Research and the challenges presented by urban and periurban agriculture (UPA), particularly in relation to the new production systems introduced by actors practicing this UPA. We argue that Action Research can play an important role in developing more sustainable forms of UPA. Our examples from France, Canada and more recently from the Pays de Herve, Belgium, demonstrate some of the most important aspects of an Action Research approach and especially emphasize the importance of the 'researcher' in this process.

2. What is Action Research?

Action Research is a scientific approach that was not born spontaneously; its beginnings have been attributed to social scientists, from the 19th century and the first quarter of the 20th century [3]. The use of the term by Kurt Lewin in 1933 ultimately defined the fundamental concept [4]. Action Research highlights the importance of a methodological approach in which the "individual" is central to success both in terms of the individual researcher and the dynamics of the relationships in which the individual researcher finds him or herself.

Thus, this creates an interaction between the researcher and the object of the research; namely, the social group at the center of the research. There has since been a proliferation of work using the Action Research approach, especially after the Second World War, and it is occupying an increasingly significant place in the scientific world particularly because of the interest in finding practical solutions to various issues.

What then really is Action Research?

The researcher's attention is focused on the object of the research, involving the systematic collection of observable and verifiable data, in order to describe, explain, anticipate

and plan future events. Research and action are thus intimately connected within the same activity, taking as a reference point the group of actors (individuals and collective actors such as associations, municipalities...) on which the research is focused.

According to Lewin, Action Research is a type of scientific approach that can be adapted to everyday life, and the researcher must therefore be fully involved in the projects aimed at transforming the social reality [5]. The researcher must be particularly careful in relation to how his or her involvement and influence in the phenomena being studied are taken into consideration. Finally, the ethical dimension of the researcher is highlighted in this research approach, and once defined it must be maintained.

Finally, and to summarize, Action Research characteristically involves different actors, which in the context of this article includes farmers, their families and associations but also political actors, professionals and citizens, all of whom end up working together to create agricultures and agricultural territories that are sustainable.

3. What Are The Challenges That Urban And Periurban Agriculture (UPA) Must Face?

Increasingly agriculture is losing ground against the relentless advance of the city, and the issue of the conservation of farmland is one of the first challenges that has to be resolved. In Canada, legislation has been put in place to preserve agricultural land (1973 in British Columbia and 1977 in Quebec as well as strong guidelines for municipalities and regions in Ontario from 1978 onwards); in the United States, in the 1960s, considerable efforts were also put in place to conserve farmland in several States [6,7].

In France, the inclusion of UPA has played an important role in territorial planning and development policies since the mid-1970s, and a more formal approach began to be integrated into these policies after 2000, both at national and regional levels [8]. In Wallonia, it was only in March 2014, that the *Code wallon de l'agriculture* was put in place; the objectives of this Code appear to be very pertinent but for the moment real actions have yet to be undertaken.

Overall, however, the issue of dealing with UPA has become widely recognized and integrated into the thinking of public authorities, largely because of the multitude of functions that these agricultures support for the benefit of society, including food production, leisure, environmental (ecosystem services) and residential functions. These functions can often be in conflict with each other and give rise to conflicts that several governments have attempted to control and reduce. Each function can be associated with different actors each with their own perspectives and interests to defend. Nevertheless, it is the agricultural production function which suffers the brunt of the advancing urban area, and despite attempts to curb these losses, it is clear that losses of farmland continue even where there is strong legislation to conserve farmland resources. And when farmland is lost so are the many other functions that

farmland and farming activities support.

The results remain positive in Canada and France, but in Belgium, especially in Wallonia, where despite the Walloon Code and the Sector Plans which 'determine' land uses on the ground, we have to recognize that losses of farmland are still significant, amounting to up to 80% in some municipalities over a relatively short period of time [9] and are still continuing. The initial results of research on the municipalities in the Pays de Herve follow along these lines and in 30 years (1980 to 2010), this part of the Walloon region has shown a 70.4% drop in farmland area [10,11].

One of the major challenges facing UPA is to be able to ensure its sustainability, and not just through the type of agricultural land conservation legislation that exists in several Canadian provinces and the other efforts made in France more recently.

Some useful results can be identified in certain French regions, just as in Canada, but enormous efforts are still required in Wallonia. Another challenge concerns what has been happening to agricultural activity in France, where over 200 farms disappear each week [12] and overall in Wallonia, where 36% of the farmers do not know whether they will have a successor. In relation to this, Action Research can become part of the solution and contribute to the development of agricultural development plans aimed at the development of sustainable agricultural systems including the creation of improved incomes.

This situation really seems more than worrying and challenging, and it raises the question of the relationship between the city and its agricultures (UPA). This in turn requires a much better understanding of the relationship between citizens and farming (and food production generally including urban gardens of different types) in and around cities, and of the expectations of citizens. Indeed, more and more farmers are questioning the challenges related to this cohabitation between the farming population and non-farm population, such as how to respond to new social expectations, related on the one hand to environmental issues and on the other hand to the mistrust born of the various health crises that have shaken the agricultural world. Developing sustainable agricultural areas and farm activities requires much more than land use planning even though appropriate land use planning structures and regulations are important. The construction of agricultural development plans is what is needed to complement land use planning, as has been happening in Quebec, Canada, since 2008.

Periurban agriculture has had to contend with continued urban expansion, including urban sprawl in many countries despite land use planning. Periurban farms, as elsewhere, also have to cope with difficulties in their functioning, partly related to agricultural machinery becoming larger and larger making it increasingly more difficult to maintain their farm operations (i.e. the globally competitive and capitalist form of agriculture that has become so important in many Western countries) because of traffic circulation problems in these territories. Furthermore, the isolation, splitting up and fragmentation of farms are all challenges that have

to be taken into consideration on behalf of and by these farmers. Furthermore, in some jurisdictions such as Ontario, Canada, agricultural land use planning has favored the large scale productivist and capitalist system of agriculture in areas where the property parcels are very large; land use planning has tended to refuse breaking such property parcels into smaller parcels because of earlier concerns over ex-urbanization processes. However, this approach makes it more difficult for some types of emerging farms (such as small scale organic farms and small farms that use limited agricultural machinery) to become established in such areas despite an increasing market for their produce; and land rental is limited because of the lack of legislation permitting secure farmland tenure in such areas.

Added to this is an important lack of knowledge of the farming profession by citizens who often continue to see agriculture as being made up of the *fermes d'antan*, and who remain very demanding in terms of services provided to them by farmers. Farmers often hope to find solutions to their problems in these periurban areas through infrastructure development, which in reality is more often detrimental to agriculture.

All of this is reinforced by the lack of attractiveness of the farming profession, which creates problems in terms of manpower, as well as has already been mentioned the commonly held negative image of this profession.

In addition to these challenges are added questions related to energy, which will become pressing in the very near future—how to deal with the energy crisis, what are the alternatives to replace fossil fuels, and how can agriculture respond?

Furthermore, farming is also facing the inevitable consequences in the European Union that the Common Agricultural Policy has created over a long period of time of always trying to encourage farmers to produce more involving more input use that is harmful to the environment, all of which has led to a reorganization of agricultural production systems that have generated many negative externalities: various types of pollution, soil erosion and increased water use (agriculture is a major consumer of water). The ecological impacts remain a challenge to be met around the world. Many of these challenges are reflected in the very concepts of sustainable development—what are the appropriate solutions from the social, economic and environmental perspectives?

Finally, one of the major challenges affecting the planet is that of food security: how to feed 9 billion people by 2050 [13] while putting in place a so-called 'sustainable' agriculture or agricultures? UPA has an unquestionably significant role to play in improving food security in major urban and metropolitan areas partly because of the very high quality of farmland resources around many cities.

4. How Can Action Research Help Better Understand this UPA? What Is the Role of the Researcher?

The Action Research approach remains avant-gardist in empirical studies, although in the last ten years more researchers have adopted the approach.

This methodology goes far beyond mere traditional research, because the researcher takes on a very specific set of roles and contributes significantly to the advancement of action in the field. Action Research is NOT about a researcher simply collecting data, analyzing it and presenting reports (and scientific publications). The research becomes part of a process involving many other actors and in no way should the researcher control that process. The researcher essentially assumes the following roles to different degrees depending on the circumstances of the project:

- The researcher becomes a provider of information of the broadest range possible, the content of which must be fully understood and appropriated by all the stakeholders involved (public authorities, private citizens, and especially in our present context, farmers and their families. . .).
- The researcher must also accompany the farmers and other actors in the development, for example, of an agricultural development plan in a municipality in which all actors with legitimate interests who wish to be involved should be involved and participate in meetings that the researcher will organize or help to organize.
- The researcher will also organize meetings such as 'focus groups' with groups of farmers and other stakeholders, with elected officials being particularly important, as we shall see developed in the examples, including that of Christophe Soulard and his team of researchers in the Montpellier Agglomeration.
- The researcher must also really take into account without any prejudice of the legitimate interests of each segment of the populations concerned and involved in and affected by the project. The researcher must also be prepared to ensure that each actor is aware of the importance of his or her involvement over the long term in the proposed solutions.
- The researcher must also be prepared to provide counseling and if necessary advice on bringing in a mediator if no solution appears to be emerging.

The researcher helps participants, in the present domain especially the farmers but also other actors, to better appropriate the multiple functions of agriculture that exist in periurban areas, their importance in the food supply of cities and their role in establishing the territories' long term sustainability in relation to the farmland and agricultural production systems. This means ensuring that the actors involved really understand the importance of maintaining these strategic areas in order to achieve food security.

The role of the researcher and especially his or her personality remains fundamental in Action Research methodology. The researcher must be prepared to listen to all the actors, and to guide them and especially to demonstrate continuously the value of their involvement. The researcher's personal commitment and level of involvement are a 'guarantee' of success in constructing and managing Action Research.

Nevertheless, it is not always easy for the researcher to get the message across; in our case both to farmers, who

often maintain their preconceptions, and to the other actors who also often have their own preconceptions. Above all, it requires that the demands of the other actors are well known. The objectives and solutions that are developed as well as the various actions need to be developed by all actors and the researcher can contribute by clearly helping them be defined and contributing to their modification as the process unfolds. The researcher must carry out his or her roles and meet the demands of the people involved. This is clearly not at all like the traditional research roles involving the analysis of different types of data and the preparation of reports, scientific publications and communications: all of these are possible through Action Research, but generally they take more time and necessitate much patience on the part of the researcher.

Continuous support is essential throughout the process, since solutions are always emerging; but it is also the responsibility of the farmers and other stakeholders to be involved, because the probability of success is quite real as long as the actors give their full support. Besides this support, which is provided continuously in group meetings, the researcher's presence on the ground is also essential, both for the farmers and other stakeholders. Insofar as statistical analyses alone do not necessarily reflect the reality, 'cross-checking' is needed to better "understand" the reality and therefore to move to action accordingly. Finally, some special requirements are needed on the part of the researcher, namely the three 'Ps' of Sustainable Development, i.e. Process, Patience and Participation:

- **Process:** This is extremely important because Action Research involves the researcher taking on the responsibility of involving all stakeholders, both farmers and other actors in the territory (politicians and citizen groups as well as others). The ultimate goal is that each person appropriates the importance of the "multi-functionality" of agricultural land (and farm activities) and their role in environmental issues. To achieve this, initially the researcher can organize discussion groups, which allow the emphasis to be placed on the "knowledge" of each person; note that a whole world often separates farmers from urban citizens, who because they do not know the farmers for the most part, are not able to appreciate how agriculture has become an irreplaceable actor in the renewed city [14]. Moreover, in many cases, in meetings we highlighted the lack of knowledge of the negative externalities of farming by the farmers themselves. Thus, it is up to the researcher to provide them with the appropriate elements so that they can fully appreciate these negative externalities.
- **Patience:** As recently emphasized by Christophe Soulard [15], Action Research necessitates undeniable qualities in the researcher, especially patience; any researcher must be able to carry out his or her research but above all else from a sustainable development perspective must be able to move the whole process towards possible sustainable solutions.

By involving all stakeholders, the researcher through the Action Research approach suggested in this text moves towards a constructive and sustainable output with all the other actors, particularly with the purpose of achieving sustainable farmland and farm activities through UPA. It is the other actors who must play a major role in constructing these solutions and must therefore appropriate the ownership of these solutions. So investment of time, listening and engagement are the key qualities inherent to the researcher in the construction of positive results through Action Research, and this is achieved without imposing his or her own ideas and purposes, which would be counter-productive.

- **Participation:** Without participation, there is no Action Research, of course, and above all, all actors regardless of their socio-economic level are essential for any progress in the process in which the researcher may have had a significant role in starting. All those with an interest in a development plan for agriculture and spatial planning generally need to be invited, if they wish to participate in an 'active' manner. The aim is to bring together stakeholders to develop viable and sustainable solutions for themselves, their families, as well as for future generations (which forms a major objective in the definition of sustainable development).

The co-construction of projects is an efficient approach to establish the parameters to develop sustainable territories. Farming in and adjacent to the city is at the forefront of the construction of territories, as many studies have amply demonstrated.

Nonetheless, each territory has its own specificities and Action Research is not a miracle 'recipe' that can be applied in any territory in the same time frame or in the same way. The specificities of each territory can vary substantially, of course, and this is why the researcher must take account of any given territory's own specificities. Above all else, especially, nothing is set in advance, and profound questioning can take place early on in the process, and therefore the researcher may often find it necessary to contribute to reorienting the Action Research process.

5. Towards Which Forms of More 'Sustainable' Farming Systems Should We Move, and How Can We Help Stakeholders Better Understand this Question?

The hybrid space that constitutes periurban territories is constantly evolving; in addition to the many functions that are developing, the dominant activity from a spatial point of view remains agriculture, except where major industrial parks have been developed. The researcher who decides to implement an Action Research process can contribute significantly to the emergence of agricultural plans and projects in these hybrid spaces.

Urban and periurban agriculture has been quite exten-

sively integrated into public policies in both France and Canada, but is still struggling to break through in Wallonia. The organization of group meetings between different stakeholders, especially farmers, can contribute to the co-construction of projects and plans to create more sustainable agricultures. Some researchers have focused attention on agri-urban projects [16,17] and others on projects in more periurban areas [18]. In all situations, it is only by meeting people that the researcher will be able to better explain the Action Research approach and, more importantly, to understand the expectations of each actor.

The importance of the concept of sustainable development, and all the media coverage of the harmful effects of different types of development on the environment and the urgency of preserving the environment, has helped researchers to give their Action Research projects an environmental orientation very quickly. The information and knowledge that researchers have accumulated provides an excellent gateway to involve both farmers, political actors and citizens. The various health crises associated with the agricultural sector and its impact on the health of all citizens, including the negative effects of pesticides, is no longer a secret! If necessary, the researcher can also obtain support from specialized professionals in these domains.

Our examples have highlighted this situation in France, where some researchers have been attempting more and more to implement an Action Research approach and methodology, e.g. by the team led by Christophe Soulard (INRA UMR Innovation in Montpellier) in collaboration with Isabelle Touzard (Mayor Murviel-les-Montpellier and Vice-President of the Metropolis) [15]. The purpose of the researcher and his team has been to support the Metropolis to 'construct a metropolitan agriculture and food policy'. Numerous meetings were held initially to construct an inventory of the agricultural situation with elected officials and then gradually the meetings were extended to include other actors. The awareness of the importance of UPA really helped the construction and implementation of projects for Montpellier.

In the examples developed further below, the researcher's role remains essential, and in many cases, elected officials themselves do not have all the information at their fingertips and especially do not always have the experience to organize focus groups to discuss the unquestionable benefits that agriculture can provide for a territory.

More and more researchers have been focusing their attention on UPA (e.g. [2,19–22], and the authors of this text). All the empirical studies converge on the importance of sustainable UPA, which can not only provide healthy food products but can also create social ties and above all help manage wastes and effluents that will be multiplied by four in cities by 2030 [23] if nothing is done about it, not to mention its contribution to food security.

Modern productivist agriculture has reached very high levels of pollution (e.g. water, air, various types of erosion); researchers who implement an Action Research process

are naturally often asked at meetings to explain this situation prior to engaging in discussions to reorient these agricultures. Although in the context of periurban agriculture, some authors make no distinction between the different systems of agricultural production, we must recognize that in the structure of the city and its periurban areas not all forms all agricultural production can be considered from a sustainable development perspective. Among the examples encountered in Canada, Bryant and Chahine [18] implemented an Action Research process at the request of a group of farmers in the municipality of Senneville, west of Montreal, who had heard of the Action Research being undertaken at the Université de Montréal; this example gave rise to some very relevant results in terms of establishing long term sustainable agricultures, mostly in terms of organic food production.

In another context—that of Wallonia (16,854 km²) [24], thirty-three times smaller than France – Bousbaine, in the context of preparation of her PhD thesis, has already discussed an outline of Action Research in 2015 in the course of preliminary interviews with 24 farmers and six political actors, by proposing to these respondents the setting up of an Action Research methodology. The importance of these preliminary interviews was undeniable. Indeed, some of the official statistics on agriculture in the territory were in point of fact false, and the results of the meetings were most interesting and led to correcting the erroneous interpretations of the agricultural transformations suggested by official statistics. These preliminary steps were the first steps towards an Action Research process, which is currently being expanded to include the Pays de Herve in 2016. Contacts have already been made at the level of the European Union and with Walloon MPs. The farmers contacted are totally in favor of becoming involved in the discussion groups which will also include citizens. Surveys were also conducted by the NPO (non-profit organization) *Au Pays de Herve Futur* (In the Future Land of Herve) and certain courses of action have already begun to emerge [24].

The first meetings with a restricted circle of actors are being planned, and it is also necessary to expand the study to include another different study area where concrete actions are being put in place gradually, with a view to achieving more sustainable agricultures environmentally. The Walloon Code of Agriculture voted in Parliament in March 2014, is oriented in the same direction, so it should be easier for the researcher to involve political leaders.

6. Conclusion

The agricultural issue has become the centerpiece for the proper functioning of cities at different scales; both farmers and urban citizens must become fully aware of this situation. The latest events at the gateways to Europe suggest the need to be able to feed more people and emphasize the challenges relating to the urbanization of periurban areas. In addition, of course, there are other major challenges facing these agricultures (UPA), including climate change and

the necessary adaptation of agriculture to these changes. All of these other challenges need to be taken into account eventually.

Researchers in Anglo-Saxon countries have been working for some years on the relations between UPA and cities, including more recently through Action Research [18,25], and a number of pertinent results have been observed, especially in terms of increasing the sustainability of the farm systems involved and reinforcing the relationships between farm producers and citizens through different forms of short circuit marketing of food produce.

The meetings and discussions involved in Action Research projects allow the researcher to contribute to the development of a plan that is strategic for the country and the city regions, plans that can be constructed by a wide range of actors, and that can be based on the undeniable interest of UPA and its wide variety of benefits to society. The land issue is an important gateway to discussions, even though some farmers suggest that 'agriculture in the city is not agriculture'. Under these circumstances, it is up to the researcher to remind people that farmers in UPA can contribute substantially to the food supply of cities, while still stressing the need to respect the environment and to develop stronger ties between UPA and the cities. One way this can be achieved is by highlighting for instance the French and Canadian examples, or even the case of the Belgian capital, Brussels, where many community gardens exist and have been encouraged by the Minister of the Environment.

We cannot have researchers in any way deconstruct existing agricultures in a territory, as emphasized by Christophe Soulard [15]; an analysis of the current situation should be undertaken and opportunities discussed that are reconcilable with the agricultures already present even though their farmers may decide to modify their food production systems. In research on the periurban areas around Charleroi [9], few farmers were aware of the opportunities of their spatial proximity to the city, particularly through short food circuits or direct sales. We were then committed to explain to these farmers the interest of maintaining UPA from an environmental perspective and also, of course, the financial benefits generated by their proximity to the city. In addition, the concept of the multi-functionality of agriculture had not been very effectively appropriated by Walloon farmers, and subsequent meetings with officials from the Walloon Federation of Agriculture were very rewarding when this concept was introduced and discussed.

A new process of food governance is looming for both cities and the periurban territories around them, and which is moving towards greater sustainability. Its implementation through Action Research processes focused on a specific territory seems entirely appropriate. Many French examples can support this observation and the researcher can become the link between the various authorities and the other actors (farmers, citizens and various associations and NPOs (not-for-profit organizations)). This governance process must:

- Be articulated to integrate different scales of analysis and action;
- Promote exchanges between the various actors;
- Take into consideration the specificities of the different territories and their inequalities; and
- Support innovative actions that already exist and integrate them with other actions, always keeping in mind the concept of sustainable development.

In this regard, the researcher can contribute to bringing the actors together to transform proposed projects into reality on the ground as in the Pays de Herve where actions are taking place, and as well to support other projects in other territories.

All legitimate interests are thus taken into account by

the researcher who must have a great deal of patience, be prepared to listen attentively to everyone and be prepared to make a real investment in the project when the actors request it. The purpose remains first, the search for permanent solutions and second, to ensure that the different actors are each satisfied with the process and outcomes. The researcher must make a major commitment to the key players, in our case the farmers, but without putting aside local officials. Finally, the researcher assumes the roles of counselor, of providing advice, and of accompanying the actors in the process, without imposing his or her own views and carrying out these roles only when the other actors ask the researcher to carry out these roles [26].

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Research Article

Cultivating the Glocal Garden

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Abstract: This paper addresses the question under which conditions small-scale urban agriculture (UA) initiatives can accelerate a sustainability transition of the global food system. It develops the notion of a glocal garden, a large number of likeminded local initiatives with a global impact and forms of worldwide collaboration. Taking a transition perspective, the glocal garden, producing vegetables and fruits, is a niche that has to overcome barriers to compete with the dominant food regime. Since a sustainability transition restructures (policy) sectors, institutional domains including knowledge systems, the paper explores which innovations are needed for the glocal garden to succeed. It discusses the glocal garden as an environmental, a social, an economic and a global project. As an environmental project, the glocal garden will link sustainable production of food with renewable energy production. As a social project, it will be organized into a consumers' cooperative. As an economic project, it will strive for profit, increasing the yield in a sustainable manner. As a global project, it will enhance collaboration between local cooperatives in the North and the South, as well as with rural agriculture. Under these conditions, the glocal garden can develop into a power, able to resist a possible future food regime that splits societies, in terms of quality standards and food products, into haves and have-nots.

Keywords: cooperative; global food system; sustainability transition; urban agriculture

1. The Question

Small scale sustainability movements, including the widespread initiatives for urban agriculture (UA), are considered part of a sustainability transition. One feature of sustainability transitions is that current large scale activities, i.e. the production facilities, as well as transnational ownership of production and trade, become challenged by activities at a much smaller scale. This raises the question as to whether a sustainability transition of (part of) the global food system can be accelerated by increasing the share of UA. This question does not imply that, eventually, UA would entirely replace (large scale) rural agriculture. It does imply that two main features of UA, i.e. small scale gardening and substantial involvement and ownership by

the (nearby) community who uses the products of the garden, can trigger an acceleration of a sustainability transition of the current food system.

Asking this question is far from self evident, if only because quite some experts would reject the idea as an idealistic fantasy. As former head of FAO Louise Fresco argues, no matter how appealing it might seem to go back to small scale, farmers markets, traditional setting and good food, it is a fallacy that comes from a past that we have forgotten about [1]. Rabbinge [2] claims that, through technical progress over the last millennium, humankind has managed to avoid the Malthusian scenario as it can continue to do in the near future. The increasing world population, from 6.1 billion in 2000 to 8.9 billion in 2050 [3], can, as Rabbinge explains, easily be fed using less land. In his view,

a decrease of agricultural land would mean a decrease of fertilizer and pesticides use, which is a contribution to sustainable agriculture. From his perspective, a sustainable agriculture will only be possible with industry producing machines, fertilizers and pesticides [2,4]. Fresco shares this view: “Even if a decreasing number of people acknowledge it today, the application of agricultural and food system science has been one of the great success stories of mankind, and it has been such a success story because of the collective capacity of humankind to adjust to the lessons learnt [5]”. In all, since the 1960s, world population has doubled while the available calories per head increased by 25% [5,6]. The challenge, however, is to double food production in the decades to come, an increasing part of which for over 3 billion people already living in metropolitan areas. In her view, this is neither going to happen through farmers markets nor by relegating millions of farmers, especially in industrializing countries, into poverty. Instead, Fresco argues, people need affordable and safe food, which requires “smart” mechanization to compensate for the growing migration from rural to urban areas and to improve the labor conditions of those still working in agriculture [1].

Also from the perspective of community gardeners, exploring the potential of UA to challenge the food system is not necessarily relevant. In North-America and Europe, people participating in UA do so with a variety of motives [7–10]. As Veen [10] finds for the Netherlands, many people like to garden because they enjoy the act of gardening and not because they want to change the world or oppose the conventional food system. Findings with respect to actual motives for engaging in a social movement, however, have little bearing on the relevance of the question of the movement’s potential for system change. After all, the system impact of peoples’ actions is not always explained by their motives or intentions.

Overall, the urgency of a sustainability transition of the global food system is broadly recognized. However, different views exist with respect to the main issues the transition needs to address and its desired direction and goals, even including the very meaning of the concept ‘sustainability’ itself. Interestingly, UA has always been a worldwide phenomenon. This paper considers urban agriculture in line with the FAO [11] as the growing of plants and the raising of animals within and around cities. However, to distinguish from private (back)yards, urban agriculture produces some kind of utility or value shared within a community rather than hedonic pleasure for the private garden owner only. The value can relate to (substituted) money value, such as from vegetable crops, food security, seed saving, health, social coherence, the shared pleasure of gardening, the aesthetics of landscape etc. Therefore, it plays a role in addressing a variety of issues related to food system transition and can be part of diverging sustainability scenarios, even if environmental impacts are not under all conditions found to be positive [12]. Many point to the persistent problems in the South, such as local famines, food scarcity and natural disasters,

which are expected to be aggravated by global warming and extreme weather events. Hence, for industrializing countries UA is being discussed as an option satisfying the need for food security [11,13]. Since the 1960s, food security is not the first priority anymore in Europe and North America. Here, community gardening is practiced under conditions of food abundance and relative wealth—with an exception for the so-called ‘food deserts’ in US metropolitan areas [14]. For people in industrialized countries, priority issues addressed by UA relate to the large scale polluting production facilities, the exorbitant power of the retail sector, monopolies in seed breeding and the disconnectedness between producers and users.

This paper takes into consideration the wide variety of UA initiatives, including community gardens, market gardens, (rooftop) greenhouses and other forms, as well as the variety of forms of social organization practiced. Yet, its focus is to identify and explore under which conditions UA can accelerate a sustainability transition of the food system worldwide, thereby overcoming allegedly opposed interests between the North and the South. The paper develops the notion of the ‘glocal’ garden, where ‘glocal’ refers to a large number of likeminded local initiatives with a global impact and forms of worldwide collaboration. Starting point is a small-scale initiative with large involvement and some form of ownership by the local end-users, who are primary users of the yield. The glocal garden that unfolds is in many respects similar to many UA projects, but it is primarily an ideal type1: what makes it relevant is its supposed ability to overcome institutional barriers for environmental, social, economic and global sustainability. Institutional barriers are usually defined as rules of the game that shape the behavior of actors. Rules can be formal (like laws and regulations) but also, sometimes more importantly, informal, like the kinds of knowledge and values that actors—being companies, organizations or just persons—internalize as to determine their courses of action in interaction with others. So, the glocal garden that this paper anticipates has developed institutions of its own that allow it to survive and strengthen its position vis-à-vis the food system [15].

In order to keep the paper’s scope within reasonable limits, the glocal garden in this paper produces vegetables and fruits, thereby serving only part of food demand. Meat, meat consumption behavior and large scale production of animal feed, although core issues of concern as regards the sustainability of the food system, are not addressed. This is not meant to imply that the paper would be irrelevant for the food system at large.

The paper’s argument is built up as follows: Section 2 discusses the dialectics of sustainability transitions, elaborating the concept of a (global) food system as the dominant regime and the glocal garden as the niche. Sections 3, 4 and 5 envision the glocal garden as an environmental, a social and an economic project, respectively. Section 6 discusses opportunities for glocal gardens to become a really global project. Section 7 summarizes and concludes.

2. Sustainability Transition Dialectics

Transition theory is about system transformation, i.e. a change in social domains reflected in technology, economy and institutions [16–20]. A transition is defined as the shift from a relative stable (sub)system (dynamic equilibrium) through a period of relatively rapid change in which the system reorganizes irreversibly into a new (relatively stable) system again [21]. Transitions are supposed to take a long time frame (25 years or more), in which slow and rapid developments take turns. The outcome of a transition, i.e. how a sustainable food system will look, is uncertain, as actors involved learn during the process. A transition is always an interplay between multiple actors operating at three levels. The landscape level is relatively autonomous: developments at this level, such as international trade agreements, natural disasters, economic crises etc. trigger changes in the food system. The food system is featured by a regime, which is defined by the dominant institutions and the powers that be. At the niche level, activities and actors emerge, which are in one way or another opposed to the regime and may benefit from destabilizing developments at landscape level.

The regime this paper addresses is the worldwide food system, which includes all actors who are in some way involved in the production, (global) trade, retail and sales of food and feed. As Friedmann [22] points out, a global food regime first emerged as an international wheat regime in the 19th century. This regime, built on the idea of ‘free trade’, collapsed during the 1930s depression. Following World War 2, a regime emerged, which Friedmann labels the Mercantile-Industrial food regime. This regime was based on subsidies, import restrictions and, where developing countries are concerned, on subsidized exports or ‘aid’. This regime began to show cracks during the 1070s because of the rivalry between European and American food exports and the failure of the ‘green revolution’ in Africa.

Friedmann speculates about the direction of what could be labeled as an emerging Corporate-Environmental food regime. Drawing on Lang and Heasman [23] she identifies two competing paradigms. One anticipates a continuation of the industrial regime using advanced science for large manufacturing of (new) food products. The other builds on small scale ecological production. One salient feature of the food regime in the neo-liberal era is the increased power of the retail sector in setting food quality standards beyond those prescribed by public agencies, a trend largely encouraged by the policy catastrophe in the UK around the BSE scare in the 1990s, when supermarkets started to guarantee the safety of beef, while British government was paralyzed [24]. Friedmann notices that these standard levels (will) have an immediate impact on the diet offered to the higher and lower income groups.

UA, in its broad variety of forms [12] is the typical niche in the food system. Niches struggle in order to become (part of the) regime, which means that behavior, technology, infrastructure and institutions at large will have to change in favor of the niche(s). Not surprisingly, niches are opposite to regimes in that they are not (yet) institutionalized, whereas regimes by definition are. However, niches are not opposing the regime in all respects and they may also be as different among themselves as they are from the regime [25]. To illustrate, organic farming contrasts the food regime as regards principles and methods of farming, but it is not necessarily different where sales and business model are concerned. An urban farm is probably very different where the relationship with its clientele (local community) is concerned. Also in terms of business model, an urban farm is different from a conventional rural farm.

Taking a system perspective, Table 1 presents an overview of the different dialectics between regime and niches in the food system transition. The left column presents the current unsustainable situation as perceived from a niche perspective. The right column presents the alternatives from a niche perspective.

Table 1. Transition dialectics in framing the food system from a niche perspective.

Regime	Niche
Polluting	Clean
Negative impact on landscape	Positive impact on landscape
Industrial: no relation with nature	Ecological: focus on relation with nature
Large scale; gap between investor, producer and consumer	Small scale: knowing people, social interaction
Lock-in technologies in context of large scale business model	Sustainable technologies
Specialization, patents	Open access
Owned by a few	Owned by many
Consumer money goes far away	Money stays in the community
Fast food	Slow Food
Uniformity	Variety (forgotten vegetables)

Furthermore, a transition is featured by the involvement of multiple actors including governmental and non-governmental agencies in multi-domains (interactions between related but institutionally separated fields like agriculture, nature and water) and multiple disciplines. For a good understanding of the far reaching impact of system change for the food system, it is critical to focus on the interaction between different domains. A sustainability transition has to overcome physical and social cleavages that are reproduced in current unsustainable practices and, in a sense, help in reproducing these. It may be hard to imagine, but in the 'end' domains or separate systems that are currently taken as self-evident may have ceased to exist or have become articulated in a completely new way. In the context of the perspectives for UA we may think of the following cleavages to be overcome:

- the urban and the rural. In many places in the world, including large metropolitan areas, it has become difficult to point to boundaries between the urban and the rural; hence, researchers into urban landscape management have introduced the term urban-rural continuum [26];
- food, energy, waste, water and soil may become integrated in (a) new (sub)system(s);
- the distinction between knowledge production and knowledge application, scientific and practical knowledge may become obsolete;
- the current neoliberal economy treats consumers as passive (even if advertisements suggest otherwise); however, in a sustainability transition consumers are becoming producers of energy and food, which has led to the introduction of the term prosumers;
- private and public ownership, the distinction between market sector and public sector may vanish as consumers organize themselves in cooperative enterprises such as urban farms.

As today's physical and conceptual cleavages are part of commonsense thinking and of social institutions including policy agencies, (international) agreements and laws, science disciplines and even common language, changing these does not go overnight and will meet with considerable hardship. At the same time, it would open major opportunities, many of which we cannot imagine today. The next sections will unfold in more detail how reshaping domain demarcations helps in envisioning a glocal garden that fulfills ecological, social and economic needs.

3. The Glocal Garden as an Environmental Project

Unless agricultural land is used for industrial agriculture or mono-crops that hinder biodiversity, peri-urban landscape is enjoyed by many for recreational and health purposes. Functions, such as protection of biodiversity and small-scale recreation, can, at least in many European countries where subsidies are available, add to the farmers' income. For UA these functions are obvious, especially the landscape aspects of a garden in a vibrant city. This means that UA

as an environmental project will abstain from the use of agro-chemicals and will try to minimize energy and water consumption. However, there is more to say about the glocal garden as an environmental project.

An important synergy for agriculture in an urban context is the production of renewable energy. This is especially important in countries that suffer from regular electricity fall-outs. For cities and towns with a moderate climate, which have a large demand for heat, the concept of the 'greenhouse village' is interesting. For areas with a warm climate, but with large temperature differences between day and night or another natural cooling source available (the sea), the notion underlying the greenhouse village concept may serve for sustainable cooling. This concept [27] links agricultural production in greenhouses to the demand for heat in households. During summer, a greenhouse receives far more heat from the sun than it needs over the year. The excess heat can be harvested and stored in underground aquifers to be used in winter (aquifer thermal energy storage -ATES). The surplus can be delivered to the nearby neighborhood. Through digestion of black water from households' toilets, kitchen waste and biowaste from the greenhouse in an anaerobic high pressure digester adjacent to the greenhouse, gas is produced [28]. This can be used for power generation (electricity) and tap water heating. The remaining CO₂ and the waste water can be reused as fertilizer in the greenhouse.

This cradle to cradle option has not been realized in practice, but it offers future possibilities, as also recognized by Fresco ([5], p. 381). One of the implementation problems is that it challenges the dominant knowledge framework as regards energy saving and heat provision and gives rise to knowledge conflict [29]. The option supposes a radical shift in heating from the 'normal' way, with heat distribution systems that handle so-called low value heat (up to 90°C), to a system that provides Very Low Value Heat (about 35°C). Distributing systems for very low temperature heating (or high temperature cooling) find their way to the market slowly, meeting with resistance, where natural gas is the common heat source. The example of the Greenhouse Village is powerful as it shows how energy and food production can be combined through technologies that are not very complex and accessible for SMEs.

A second option that illustrates a possibility of integrating food and energy is known under the name 'Terra Preta' or Very Black Earth. This earth has been found in Amazonia and parts of Western Africa and goes back to 2500 BC. The native farmers have improved the soil by regularly adding charcoal to it [30]. Charcoal is produced from locally available biomass. Through pyrolysis (combustion without oxygen at relatively low temperatures) the biomass is split in an oil (or gas) and a carbon fraction. Storing the carbon underground enriches the soil and increases the harvest. Another advantage for local farmers is that the oily fraction can be used for electricity generation at local level. This offers a local energy solution for (remote) areas not connected to a (vulnerable) grid. These qualities

make underground carbon storage a much better idea for addressing CO₂ emissions than underground storage of CO₂ [31]. For industrializing countries in particular, this option might provide communities with energy as well as additional income [32]. Since the carbon stored is provided by biomass instead of fossil fuels, this option has the potential of leading to a negative carbon balance. Since it is cheaper than CO₂ storage [32], transnational energy companies could benefit if they transfer carbon credits to UA cooperatives in developing countries [33].

The Terra Preta option illustrates that for UA boundaries between expert knowledge and knowledge in practice, between knowledge production and application become blurred. The knowledge on Terra Preta existed long before academic knowledge became standard [34]. Knowledge on the benefits of carbon storage spread over the world since humankind started with agriculture in an era when physical distances could not be overcome with modern means of communication. Still, hobby gardeners all over the world know that carbon may improve the soil, although it is uncertain if this works for every soil type.

In conclusion, this section illustrates that the glocal garden can benefit from innovations that produce synergies between the urban and the rural, between agriculture, energy, waste, water and soil and that this is good for the environment. Another issue is that such synergies are beneficial for the finances that the urban farmers may need to provide their enterprise with a stable economic prospect.

4. The Glocal Garden as a Social Project

The main barrier for the glocal garden as a social project has been identified by Hardin [35] as the Tragedy of the Commons. The metaphor is the common pasture that in the end will suffer from overgrazing, as the farmers will do their best to get all benefits from the common land and will not invest in its maintenance. Drawing on this metaphor, modern people will do their own thing first and neglect or postpone their obligations as regards the community garden. Olson [36] had already referred to this phenomenon as the 'logic of collective action'. The main argument is that a rational individual will take a free ride when it comes to realizing or protecting a public good, i.e. a good that is accessible to all and from which no-one can be excluded (clean air, landscape view, peace etc.). The main driver for rational individual behaviour is not, as is often assumed, selfishness, but in Olson's words, that a person's individual contribution would not be perceptible ([36], p. 64). Olson argues that rational individuals want to contribute to a public good under two conditions only: (1) when there is coercion (government regulation and enforcement) or (2) when those who participate are provided with selective benefits.

Modern policy analysts argue that theories and metaphors like the logic of collective action and the tragedy of the commons are outdated. New institutionalists, like Ostrom [37], have shown that groups are perfectly able to enforce mutual agreement on sustainable behaviour, such

as fishermen protecting their fish stock. There are many examples of successful collective action, including citizens cooperatives for UA, which suggest that Olson and allies were wrong. Before jumping to conclusions on the social conditions for a glocal garden four issues need careful attention: (1) group size, (2) the degree of consensus on the values associated with selective benefits and (3) empowerment, control and trust.

4.1. Group Size and Social Cohesion

According to Olson's theory people are expected not to voluntarily protect public goods, especially if the public good relates to the interest of the largest possible group. In contrast, small groups are much more likely to succeed in promoting their interests. The large majority with an interest in peace is less well organized than the small group that at times has an interest in war ([36], p. 166). Therefore, the large group not only provides evidence for Olson's thesis, "they also suffer if it is true" ([36], p. 167).

The idea that small groups are more effective in promoting their interests than large groups can also be found in the literature on the so-called Not-In-My-Back-Yard (NIMBY) syndrom [38,39], which explains local opposition in case of locally unwanted land uses (LULUs). Unwanted land uses benefit the large group, including people living far away, whereas the costs (burdens) are for the local community in their immediate vicinity. Hence, the per capita costs motivating people to resist the LULU are much higher than the per capita benefits that motivate people to realize it. This explains why NIMBY resistance is often successful [40]. The remedy proposed is to provide locals with selective benefits, i.e. compensation or even reward, in exchange for acceptance. This approach is supposed to lose effectiveness, once values are at stake that cannot, according to those involved, be framed in monetary terms, such as health and safety.

So, the logic of collective action and concepts similar in that they are all based on economic rationality, support the idea that small groups are in a fairly good position to realize and maintain a public good, like a community garden, whereas a large group would probably fail. An (implicit) assumption behind the logic of collective action is that people act in social isolation, like in the prisoner's dilemma [41]. In reality, however, individuals act in accordance with their personal level of attachment to social norms [42]. This is especially the case for small groups, where people are likely to know each other and where social control may serve as an incentive for engagement.

4.2. Degree of Consensus on the Values Associated with Selective Benefits

Yet another factor relevant for both success and failure of the glocal garden as a social project relates to the different types of selective benefits offered to the people involved. Many of these are in kind, like vegetables and flowers from

the garden, but also of a non-material nature. Many urban farms started as community projects such as after school programs or educational centers for inner-city kids. People might very well experience the act of gardening or the opportunity to establish friendly relationships with others via the community garden as social benefits. Several students of community projects find that the need for social cohesion is a very important driver for people to engage [43].

However, the social act of gardening together with neighbours, which according to many makes a strong case for UA in a local community context, may also signify its vulnerability. After all, many people don't like gardening, many even dislike it, as it is at times dirty and very hard work. People may simply want to spend their time in a different way, for example, undertaking activities with their families and friends. Many would not care so much about the new social relationships offered, as they already lack the time to maintain their current ones. They may take care of their own garden or allotment garden first, before spending time in the community garden. Hence, there is reason to believe that these people, probably a large majority, are unlikely to either engage in an urban farming project or to persevere with their contribution in the long run. This has to do with the observation that the values at stake with a public good, like an urban farming project, are not the same for everyone ([36], p. 60). Dissent on the values related to the public good in everyday life undermines the glocal garden as a social project.

4.3. Empowerment, Control and Trust

A different type of benefits relates to the empowerment of people who experience lack of control in a world food system featured by huge distances, social as well as physical, between producers, wholesale, retail, investors and consumers. Consumers of food may (re)gain control over (part of) their food through a local cooperative, an inclusive local enterprise.

Agriculture cooperatives are not at all a new phenomenon. In the late 19th century, several countries witnessed initiatives to form producer cooperatives with the aim of getting a fair price for vegetables, flowers and fruits through local auctions. Auctions replaced the by then intransparent networks through which vegetables and fruits were brought to the (consumer) markets [44,45]. According to Tourte and Gaskell [46] the Netherlands in particular faced a spectacular number of cooperative auctions. Although the economic reasons for agriculture cooperatives were quite compelling, there were many obstacles to overcome. Auctions suffered from their members' unwillingness to bring their apples and pears to the auction [47]. The real breakthrough came in 1916, when the Dutch government ruled that vegetables and fruits had to go through an auction, preventing exports of Dutch produce to countries involved in the war, where demand for fresh products was high. When government coercion was lifted after the war, fruit growers in several provinces turned back to the old practice. Tourte and Gaskell [46] refer to other examples of hesitations to volun-

tarily offer products to the auction and the decisive impact of state intervention in the Netherlands and Japan. In countries like the United States, cooperatives appear to have been more effective without state intervention. However, as Tourte and Gaskell [46] state, the history of producer cooperatives has not been very well documented.

The case of cooperative auctions shows a nice example of a prisoner's dilemma or tragedy of the commons, even among relatively small local groups. In spite of a joint interest in advancing their sales through cooperative auctions, producers showed lack of trust in the new institution. Quite a number of social theories would lead to conclude that especially small, informal, homogeneous groups are effective in building trust, as these are able to reinforce normative sanctions [48,49]. However, there is no evidence that local initiatives for urban farming are a panacea for lack of trust. To the contrary, people who know each other personally may also know whom to trust or not.

Still, the UA cooperative, where consumers enact control over the production of their food, is to be considered a major institutional innovation. What is new is that the enterprise is owned by consumers rather than producers, that consumers become investors and share in the eventual profits of the undertaking. Being a legal entity, a cooperative can also work on building relationships of trust in the community by explicit and transparent rules of the game that can be controlled by its membership (cf. [37]). According to Tilly, who has contributed much to the foundation of resource mobilization theory, political rights and political opportunity rather than prospects for financial gain help a social movement to gain momentum. Interestingly, Tilly [50] found this a decisive element in a comparative case study on food riots in the medieval era and early modernity. The major relevance of the UA cooperative is not so much that it is an enterprise, but that it may become a vehicle to reduce distances between producers, consumers and investors and, as such, contribute to a different (circular kind of) economy [51].

To conclude, with respect to the glocal garden as a social project, its main challenge to overcome is the tragedy of the commons; many like the idea of urban farming but most do not sufficiently contribute to make it happen or to keep it going. Indeed, the project must be local and small-scale as to enable for sufficient social benefits. A cooperative enterprise is essential for the glocal garden as a social project, because, next to a variety of (material and non-material) benefits, it provides empowerment and control.

5. The Glocal Garden as an Economic Project

To address the economics of the glocal garden touches upon a sensitive issue. Many community projects related to UA are buttressed by volunteers and are not aimed at making profit. There are also internationally operating, profit seeking companies who specialize in (high tech) UA, but have little or no connection with local communities. There is a belief among scholars of social innovation and sustainable

business models that sustainable enterprise is—and perhaps should be—primarily interested in generating ecological and social values and in last instance only a ‘moderate’ profit at most [52,53]. Without having any problems with voluntary community projects, economic viability becomes an issue once the glocal garden is to become a challenge for the worldwide food regime. The garden needs protection, if only against urban land owners, developers and planners who may want to arrange for new activities on the garden land. The garden may need money to buy the land in order to safeguard it for future speculations by the land owner and local government. There are many more reasons for an UA project to make a profit. Perhaps more importantly, there is no compelling reason to deny a sustainable enterprise the right of making a profit.

Whereas the glocal garden must remain relatively small in order to meet its social challenges, from the point of view of economics this does not look like a reasonable request. After all, the global trend in agriculture, including the production of vegetables and fruits, is towards large scale farming, higher efficiency, producing more with less people and less space. Hence, the major challenge from an economic point of view is to remain small and, at the same time, realize some economic (financial) benefits. There is reason to believe that this is very well possible.

Firstly, economic prospects relate to the way local involvement and ownership are organized. When the consumers are simultaneously investors in the cooperative, their money stays in the local community. For a sustainability project such as UA, consumers are willing to accept a margin much lower than a professional investment company or bank.

Second, an end user cooperative with a local base can afford to offer the products to customers without intervention from wholesale or retail. This saves a lot of money. Van der Noll et al. ([54], p. iii) distinguish the following breakdown costs in the Dutch consumer price: (1) price for producer, (2) retail (package, logistics, transport and storage), (3) gross margin supermarket and (4) VAT. The breakdown is given for a typical Dutch product, the greenhouse paprika. For each euro received by the producer in a specific week the consumer paid €2.63 in the supermarket, i.e. a difference of over 60%. Without arguing about the average figures it would not be unreasonable to assume price differences over 50%. Since the (European) retail sector has producer contracts all over the world, the prices paid to small producers in eg. Kenya are probably not higher than those paid to Dutch producers. Up scaling in professional horticulture is to a large extent caused by the pressure on the farmer to raise efficiency and production, as buyer competition in the market has dropped under the growing power of an oligopolistic retail sector [22]. According to a leader of a Dutch farmers union, this trend is causing the collapse of the food system [55]. Avoiding wholesale and retail will not only lead to cost savings for the benefit of the cooperative, it is also an important disincentive to go for large scale farming.

Third: when it comes to costs and benefits, another issue is as to whether a small garden (even a few hundred square

meter) can realize an economically acceptable amount of produce, especially if the garden wants to avoid the use of pesticides. It may be no surprise that estimations vary considerably, but many are quite optimistic. According to FAO [11], garden plots can be up to 15 times more productive than rural holdings. An area of just one square meter can provide 20 kg of food a year. Especially for industrializing countries, the potential of UA for food security appears beyond dispute [56]. Also for industrialized countries there are optimistic reports. Japanese UA is more productive than its rural counterparts. According to government 2010 data, urban fields are the most productive kind of agriculture in terms of economic value of production per area—3% more productive than the national average [57]. An estimate for London [58] assumes a productivity level of over 10 kg per m². Bellows, Brown and Smit [59] state that a 100 m² garden in a temperate 130 days growing season can produce most of a household’s vegetable needs, including the nutritional requirements for vitamin A, B and C complex and iron. However, in so far as actual output is concerned, much lower figures are reported for the USA [60].

All in all, these figures are not conclusive, but what adds to the optimism is the trend, especially in North America, of small-scale commercial urban farming among young entrepreneurs [60]. A well-known example is Le Jardin de la Grélinette in St Armand, Quebec, Canada. The farmer, Fortier [61] describes in some detail how he manages to do intensive organic farming on a piece of ca 1 ha and make a living out of it. One important way to increase efficiency has been the development of tools that apply to small-scale farming. Another important strategy, found among urban farming projects to raise financial output is to diversify their produce. Urban farms can grow several varieties of one kind, with different shapes, forms and colors, including so-called ‘forgotten’ vegetables and fruits. Many of these are not available in the regular food store but they are attractive for customers interested in good food. For the near future, linking urban food production with the production of energy may also add to the economic prospects of the glocal garden.

An additional positive effect of the glocal garden, run as a for-profit company, would be its contribution to employment. Worldwide, small and medium sized companies (SME) are estimated to give a major contribution to GNP, about 60–70% [59]. Although wages might not be exorbitant, concern with respect to labor conditions in agriculture may not apply for the glocal garden, since many of the personnel will probably be co-owning the enterprise. According to ILO ([62], p. 25), job satisfaction tends to be higher for employees of SMEs. This may be related to factors such as greater work autonomy and a lower degree of division of labor.

6. The Glocal Garden as a Global Project

Realizing an impressive yield/ha is one thing, challenging the world food system is another. For this to happen, the glocal garden would have to make a significant contribution

to world food security. It is beyond the scope of this paper to quantify what significant would mean, but clearly it would be more than a small niche.

There are various reasons to question a significant UA contribution to meet the worldwide demand for fruits and vegetables. It can be argued that there will not be sufficient physical space in urban areas to get the amount of (sustainable) produce needed to feed the urban people. This argument can be supported by observations related to the available space in urban areas worldwide today, which has been estimated at one third of the total global urban area [63]. This estimate does not take into account the number of local circumstances that would in practice prevent UA projects to take off, including ownership, urban planning, soil conditions etc. The glocal garden would have to resist the global urbanization trend, demanding more land for developing settlements, industry, and infrastructure. Also from a sustainability perspective a significant contribution from UA is not evident. In mainstream thinking, 'biological' or 'organic' farming produces less than conventional farming. With these sustainable farming methods, feeding an increasing world population would require even more land, which would further diminish rainforest and other valuable ecosystems on the planet. From a sustainability point of view this would be unacceptable. Instead, even if UA could make a contribution, sustainable farming would imply producing more with less land and less people.

Several observations refute mainstream thinking. First, the physical space practically available over time is far from static, which is, ironically, due to the global urbanization trend itself. Turning more rural agricultural land and nature into metropolitan urban areas will at the same time create 'empty' spaces where green projects can flourish. Second, the trend towards urbanization triggers more demand for urban green. The UN and several member states have already defined standards, as not yet legally binding, for the amount of green space per urban inhabitant [64]. Considerations related to health and labor productivity provide an incentive for companies, citizens and urban planners to allocate more green space. Third, where in the 20th century (urban) planning was still dominated by the idea of competition and separation between functions, including agriculture and nature, or agriculture and recreation, today's mood is more towards integration, creating a so-called win-win. If rural agriculture would be sustainable in that the quality of the soil and its ecosystems are preserved, there is much less need to decrease the share of agricultural land. The same is true for UA, which potentially combines many positive functions of urban green. Hence, sustainability requirements in metropolitan areas will encourage that more urban space will be allocated for gardening, not only on land but also on rooftops, along walls etc. This will considerably increase (peri)urban landscape quality. It is however obvious that the (re)conquering of green space will not go without heavy political conflicts. The glocal garden stands a chance to overcome, if it is based on community involvement and ownership and if it adds economic value to the local area.

A fourth observation is that UA has always been and

still is quite significant in volume. World War I and II witnessed a peoples' movement, largely stimulated by the respective governments, to maintain so-called Victory Gardens in Canada, United Kingdom, United States, Australia and other countries [65–67]. The production of food was vital for winning the war. People used their back-yards but also public places to produce vegetables and fruits. The US Department of Agriculture estimated that more than 20 million victory gardens were planted. By 1944, fruit and vegetables harvested in these home and community plots was estimated to be 9–10 million tons, an amount equal to all commercial production of fresh vegetables in the USA.

Today, some estimates say that 15–20% of the world's food is already grown in urban areas [68]. Especially in poor metropolitan areas in Bangladesh, Vietnam, Nepal, Malawi and Guatemala between 40% and 80% of the population is participating in UA activities [69]. In Japan, almost one-third of all agricultural output in the country is generated by UA. Urban farmers account for 25% of farming households in Japan [57]. Even if the figures on the actual share of UA to the world supply of vegetables and fruits proved incorrect, the actual number of initiatives worldwide is impressive.

If the local gardens together would indeed be able to increase their production in that it would be significant enough to challenge the global food regime, there is still one element to be added in order to become a global project. Glocal gardens could really become global in character if they would start working together. Cooperation could take place at a bilateral or multilateral level, in informal networks sharing knowledge and skills. Cooperatives could constitute a lobby for political attention and for mutual support in their struggles with local developers and policy planners. They could help each other with loans for investments. Perhaps cooperatives in the North and the South could increase their attractiveness vis-à-vis their membership, joining forces and trading products that certain cooperatives cannot grow themselves given climate conditions. There are many examples of fruits and vegetables that can ripen during long distance transportation by ship, which is not necessarily unsustainable. Such collaboration may bring additional financial benefits and would strengthen cooperatives' competitiveness vis-à-vis the retail sector. Other forms of collaboration could be considered as well, such as sustainable tourism. Small-scale agriculture projects do not need expensive certification systems to convince their supporters with respect to the sustainability of the partner far away, there are sufficient online communication techniques to keep informed in a transparent manner. UA cooperatives may further be tempted to seek collaboration with SMEs in different sectors of rural agriculture. At this point, when (in)formal collaboration is established, institutions emerge with the potential of challenging the global food system.

7. Conclusions

This paper has set out to explore the conditions needed for UA to make a difference in accelerating a sustainability tran-

sition of the global food system, taking into account interests of urban farming in both the North and the South. Obviously, there are currently many views on the physical potential of UA within the food system as well as the drivers and motives for people engaging in urban farming initiatives. There are also critical assessments with respect to the sustainability of UA. In developing the notion of a glocal garden, which can trigger an acceleration of a food system transition, this paper takes stock from some of these, neglecting others. In that sense, this paper is biased toward possible trajectories for a food system sustainability transition. The conditions discussed relate to innovations at the intersection of sectors and fields that are currently still considered separately.

For the glocal garden as an environmental project, the paper discussed innovations in the knowledge system where new linkages are developed for food-energy-water-soil and waste. Environmentally sound innovations contribute to financial stability of the glocal garden. For addressing the vulnerability of the glocal garden as a social project, the social innovation proposed is the consumer cooperative that provides its membership with selective benefits, including financial gain. The glocal garden as an economic project will benefit from innovations that enable intensive farming, striving for the highest yield in a sustainable manner. As a global project, UA already makes a considerable contribution to the worldwide demand for vegetables and fruits. Given autonomous developments, including the global trend towards urbanization, an even greater share can be foreseen for the near future. Collaboration between cooperatives around the globe, between the North and the South in particular, as well as developing (new) forms of collaboration with rural agriculture will be a necessary and decisive step in accelerating the transition.

This paper does not at all deny or ignore the variety of interests, motives and concerns that underlie decisions by millions of people, each day, to participate in UA projects worldwide. It also recognizes the importance of a pluralist approach that enables people to take their share. Interestingly, however, a system's transition is in the end not only

dependent on individual drivers. Instead, the awareness of participants is shaped by the many (contradictory) tendencies today, some of which work in the advantage of the here presented view, whereas others do not. There is a growing dissatisfaction with neoliberal practices, large scale production and the interminable gap between investors, producers and consumers. There is an increasing interest in sustainability, in good and healthy food, locally produced, as well as in diversification including varieties of so-called 'forgotten' vegetables. More importantly, however, for an increasing part of the world the major concern is (still) fresh food availability. There is obviously no guarantee what the (virtual) end point of a transition in the food system will be. It is very well possible that an emerging food regime will, in terms of quality standards and products, split societies into the haves and the have-nots. Yet, what makes the glocal garden so interesting to explore from a system perspective, is exactly that it has the potential of countering such development. After all, gardening is traditionally for people from all social, ethnic and cultural backgrounds.

From the perspective of governance, too, the glocal garden is an interesting case. This is because, in contrast to the energy transition in many countries, UA is an issue primarily dealt with at local level. The glocal garden will face both resistance and opportunities that it must deal with by confronting local policy-makers and urban planners. Without doubt, the interests of land owners, developers and builders transcend in many cases local community and municipality borders, which makes them powerful as well as vulnerable. Instead, small local groups have an advantage in successfully promoting their interests, which is favorable for the glocal garden.

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Research Article

Siting Urban Agriculture as a Green Infrastructure Strategy for Land Use Planning in Austin, TX

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Abstract: Green infrastructure refers to a type of land use design that mimics the natural water cycle by using the infiltration capacities of vegetation, soils, and other natural processes to mitigate stormwater runoff. As a multifunctional landscape, urban agriculture should be seen as a highly beneficial tool for urban planning not only because of its ability to function as a green stormwater management strategy, but also due to the multiple social and environmental benefits it provides. In 2012, the city of Austin adopted a major planning approach titled the “Imagine Austin Comprehensive Plan” (IACP) outlining the city’s vision for future growth and land use up to 2039. The plan explicitly addresses the adoption of green infrastructure as a target for future land use with urban agriculture as a central component. Addressing this area of land use planning will require tools that can locate suitable areas within the city ideal for the development of green infrastructure. In this study, a process was developed to create a spatially explicit method of siting urban agriculture as a green infrastructure tool in hydrologically sensitive areas, or areas prone to runoff, in east Austin. The method uses geospatial software to spatially analyze open access datasets that include land use, a digital elevation model, and prime farmland soils. Through this method a spatial relationship can be made between areas of high surface runoff and where the priority placement of urban farms should be sited as a useful component of green infrastructure. Planners or geospatial analysts could use such information, along with other significant factors and community input, to aid decision makers in the placement of urban agriculture. This spatially explicit approach for siting potential urban farms, will support the integration of urban agriculture as part of the land use planning of Austin.

Keywords: GIS; green infrastructure; urban agriculture; urban planning; watershed protection

1. Introduction

1.1. Green Infrastructure and Urban Agriculture

The federal Clean Water Act (CWA) of 1972 provided a basic framework for the regulation of pollutant discharges with the intent of protecting water quality and human health in the United States (U.S.) [1]. To further the protective

benefits of the CWA, the Environmental Protection Agency (EPA) enacted its Combined Sewer Overflow Control Policy in 1994 [2]. This policy initiative established guidelines by which municipalities could better manage environmentally harmful stormwater pollution events that occurred as a result of infrastructural challenges in handling both sanitary sewage and stormwater runoff in the same sewer system during precipitation events. In response, many cities im-

plemented green infrastructure measures to help mitigate urban stormwater runoff as an alternative to expensive water main upgrade projects. Green infrastructure can be defined as the management of runoff through the use of natural systems, or engineered systems that act as natural systems, to allow stormwater to infiltrate the ground, recharging the water table and decreasing run-off. According to the EPA, Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water [3]. While this definition of green infrastructure is structured on water management, there are broader definitions of green infrastructure that focus on aspects such as clean air, wildlife habitat, and preservation of forests and grasslands.

With the industrialization of our food systems, most cities, whether intentionally or not, have developed in such a way that farms have become incompatible with the urban environment. There is, however, a tremendous amount of resurgent interest in urban farming and community gardening across the country. In general terms, urban agriculture refers to “the growing, processing, and distribution of food and nonfood plant and tree crops and the raising of livestock, directly for the urban market, both within and on the fringe of an urban area” ([4], p. 2500; [5], p. 4). As evidenced by the recent growth of municipal urban agriculture land inventories as a method to integrate urban agriculture into sustainable land management policy [6], we can infer that municipalities value the multi-beneficial attributes that urban agriculture offers. Urban agriculture has been characterized as a multifunctional land use because, through its versatility as a landscape, it offers a range of benefits to densely populated areas [4]. For example, the ecological functions of urban agriculture provide environmental benefits in the form of biodiversity, nutrient cycling (compost), or wastewater re-use (stormwater and greywater); the cultural functions improve the quality of a neighborhood or community through its visual appeal, recreational use, or the provision of rare foods to immigrant communities; the socio economic functions provide access to nutritious fresh produce for underserved communities in food deserts facing obesity and diabetes [4].

In fact, evidence suggests that incorporating appropriate types of urban agriculture into the urban environment will greatly improve the overall sustainability of U.S. cities [4,7]. The EPA, in collaboration with experts from academia, state and local governments, and nonprofits, released a general listing of the benefits of urban agriculture:

- Increases surrounding property values, beautifies vacant properties, increases a sense of community, and provides recreational and cultural uses [8].
- Increases infiltration of rainwater, reducing stormwater overflows and flooding, decreases erosion and

topsoil removal, improves air quality, and reduces waste by the reuse of food and garden wastes as organic material and compost [8].

- Increases physical activity and educates new gardeners on the many facets of food production from food security to nutrition and preparation of fresh foods [8].

While the positive ecological and environmental impacts of urban agriculture have been acknowledged, minimal research has been conducted to determine the feasibility of urban agriculture as a green infrastructure strategy to manage stormwater. Green infrastructure strategies include a list of practices that have been studied and quantified, making their engineering and performance outcomes predictable and reliable [3]. A lack in such quantification, or of carefully researched sets of best management practices, leads to a further lack in the promotion of urban agriculture as a green infrastructure strategy. As Dunn ([9], p. 58) argues: “Being able to quantify the effectiveness of green infrastructure on a small scale is one way to promote regulatory and enforcement acceptance, which thereby enhances its appeal to city officials”. As a productive, multifunctional landscape, urban agriculture offers answers to complex infrastructural challenges that are facing many cities.

1.2. Urban Agriculture Land Inventories

Over the last decade a variety of municipalities have begun the process of inventorying and assessing land to determine the potential for a broad range of urban agricultural initiatives. This effort is driven by a diverse range of community stakeholders, each with an interest in growing food locally, including capturing the social and environmental benefits urban agriculture provides. Yet, despite the realized and potential benefits for individuals and communities, urban agriculture is largely overlooked in urban and regional planning [4,10]. Instead of considering opportunities to preserve farmland or to integrate it as part of a land use management strategy in urban environments, agricultural landscapes are often considered by land use planners as areas for future development [4].

As part of the urban planning process, land inventories have been used and recognized as a basic tool for land suitability and site selection [11]. Many municipalities and researchers are now employing this tool to promote urban agriculture, integrating it into public policy and planning as a land management strategy. Horsts' (2011) paper “A Review of Suitable Urban Agriculture Land Inventories” provides a brief overview of urban agriculture land inventories in various cities [12]. Inventories have been performed in Portland, Vancouver, Seattle, Cleveland-Cuyahoga County, Detroit, Chicago, Toronto, New York City, Cincinnati, Oakland, and San Francisco [12]. Some of the inventories primarily focus on public vacant land and some open up their inventory to include private lands or residential lands such as lawns or rooftops.

Decisions made as part of urban agricultural land inventories typically require the input of multiple criteria involving social, economic, and environmental considerations

[6,13,14]. The success of multiple criteria decision making depends on an array of knowledgeable stakeholders making informed decisions [15]. Using this model, inventories rely upon the explicit use of an advisory committee with representation from municipal staff, non-profit organizations, urban gardeners, and academic researchers. Many inventories emulate the Portland model, wherein an advisory committee guided the inventory throughout the process, particularly in establishing evaluation criteria and reviewing preliminary results. Mendes et al. [6] points to Portland's inventory as more successful when compared to Vancouver due to the way Portland engaged many community partners throughout the entire process, from design to implementation, while Vancouver lacked community involvement. Mendes et al. [6] suggests this represents what the scholarly literature identifies as a "networked movement", where participation in local decision making is inclusive and citizen engagement is fully accepted, similar to Arnstein's [16] highest rungs in the ladder of citizen participation (Partnership, Delegated Power, Citizen Control). Likewise, Oakland established a Community Advisory Committee throughout the project that provided citizen input in a number of areas: the location of potential sites, criteria for selection of potential sites, and feedback on what type of information would be useful in the finished inventory [17]. The best asset mapping has been described, especially in the case of urban agricultural land inventories, to be a multi-stakeholder process for action planning and policy design [4,6,18].

Many of the inventories have involved multiple stakeholders in research and analysis phases, but have been less inclusive when performing technical analysis including Geographical Information System (GIS), aerial imagery assessment, and site visits or ground-truthing [19]. The key actors during this phase of inventory development have been municipal staff, experts from food policy councils and non-profits, and students [12]. The partnership among stakeholders from the city governments and student researchers from local universities has created synergistic opportunities. In Portland, Vancouver, Oakland, Seattle, and Cleveland among others, graduate students worked in partnerships with local municipalities to complete the inventory, thereby gaining valuable experience while the respective cities received cost-effective results.

Generally, the vacant land inventories followed a framework of identifying vacant or open land by ownership type, categorized as public or private, assigning suitability criteria, then eliminating the unsuitable sites and highlighting the best. Within this generalized framework, most inventories created suitability criteria for urban agriculture addressing physical and socioeconomic factors, assigned a ranking or scoring system for criteria, presenting the study results as publicly available reports [19].

The technical work for most inventories made use of one or a combination of methods including aerial photo assessment, GIS analysis, remote sensing, and site visits. Some efforts relied extensively on GIS analysis or remote sensing as in New York and Philadelphia [20,21]. The

potential exists for expanding the use of GIS and remote sensing for urban agricultural land inventories from other approaches developed by urban land use researchers. For example, Myeong et al. [22] developed vegetation indexes that estimate vegetation coverage and bare soil, criteria that usually requires labor-intensive visual assessment, using multi-spectral and hyper-spectral data to identify urban green areas [21]. Other inventories have made use of the satellite imagery from the National Agricultural Imagery Program (NAIP) overlaid onto the GIS city parcel data of vacant land in order to select parcels containing potentially arable land [23]. A more specific use of geospatial data in the Halifax, Canada inventory used the LiDAR data to model sun exposure, an important aspect of most inventories suitability criteria for potential urban agricultural sites [23].

As the practice of inventories is evolving, there are areas for improvement. In particular, many authors noted limitations because of incomplete data, limited availability of data, and frequency of updated data [13,21,23,24]. A common limitation expressed by researchers stemmed from low resolution and accuracy of the aerial imagery that resulted in possible visual interpretation errors [13,23]. As a result, researchers advised that post-analysis ground-truthing of potential sites would be necessary to quality check geospatial analysis [13,23]. Additionally, establishing a measure of community support is also an area that many inventories acknowledged needed further research to identify variables such as cultural preferences, skills and willingness, demand, resources, and the presence of local leaders [21,24,25]. Inventories with community advisory committees also noted that site visits, community outreach, and consultation with city staff are necessary to evaluate characteristics like soil quality, community interest, and security [6,14,23]. Soil quality, in particular, is an issue in many urban areas that was recognized by most inventories as an area for further research and analysis. In Oakland, for example, the completed inventory inspired further research about lead (Pb) contamination in the soil of potential urban agricultural sites. This research assessed Pb levels at over a hundred different sites identified in the inventory [26].

Beyond land identification, land inventories have been an effective tool to integrate urban agriculture into urban policy and planning as a land management strategy [6]. As a part of the planning process land inventories can identify opportunities for urban agriculture initiatives that result in positive changes. Some impacts have included increasing awareness and political support for urban agriculture, advancing social and ecological sustainability, and enhancing public involvement [6,17]. For example, Toronto, Seattle, and Portland experienced notable changes resulting from vacant land assessments. In Toronto, local zoning regulations and guidelines were altered to help guide an increase in urban agriculture [19]. In Seattle and Portland, the collaborative process increased community involvement and inclusion of urban agriculture into city sustainability planning [6]. Stakeholders have also built upon these assessments and conducted more targeted in depth studies that relate

to issues of public health, economic development, food security, and environmental sustainability [19]. As a tool, land inventories do not have to function in isolation and can be employed in conjunction with other strategies, such as surveys or scenario planning, to advance municipal goals such as stormwater management, reducing carbon emissions, increasing food access, and supporting workforce development [6].

Urban agriculture land inventories have been a useful step for many cities in evaluating the potential for urban agriculture, though the process and resulting impacts are unique to each city. The type of parcels considered, criteria applied, and stakeholders involved differ depending on the objective. The delineation of potential urban agriculture sites is only a preliminary step in a long process of mapping the potential of urban agriculture in a city [23]. That being said, such demarcations can be a useful starting point as cities begin to incorporate urban agriculture into community planning. The tools involved with a land inventory have the potential to facilitate participatory planning by bringing together community participants such as local residents, food activists, academic researchers, and farmers with city planners and government officials, in an effort to better plan and manage land use [4]. Nevertheless, the politics of negotiating competing uses of land is inherently complex and difficult. The viability of utilizing urban agriculture land inventories for planning will depend upon identifying and negotiating the varied interests of multiple stakeholders [23].

1.3. Can Urban Agriculture identify as Green Infrastructure in Austin, TX?

In 2012, the City of Austin adopted a major planning approach titled the Imagine Austin Comprehensive Plan (IACP) that outlines the vision for future growth and land use in the city until 2039. The plan explicitly addresses the adoption of green infrastructure as a targeted future land use with urban agriculture specifically being included as a component of the green infrastructure network.

The IACP identified eight priority programs, ranked in order of importance, which will guide policy and implementation of the plan. The fourth priority proposes the use of “green infrastructure to protect environmentally sensitive areas and integrate nature into the city” [27]:

1. Invest in a compact and connected Austin.
2. Sustainably manage our water resources.
3. Continue to grow Austin’s economy by investing in our workforce, education systems, entrepreneurs, and local businesses.
4. Use green infrastructure to protect environmentally sensitive areas and integrate nature into the city.
5. Grow and invest in Austin’s creative economy.
6. Develop and maintain household affordability throughout Austin.

7. Create a Healthy Austin Program.
8. Revise Austin’s development regulations and processes to promote a compact and connected city.

The building block actions listed as methods to implement the green infrastructure priority program include several references to urban agriculture (below; emphasis added):

- Integrate citywide and regional green infrastructure to include such elements of preserves and parks, trails, stream corridors, green streets, *agricultural lands*, and the trail system into the urban environment and the transportation network [27].
- Incentivize appropriately-scaled and located green infrastructure and public spaces, such as parks, plazas, greenways, trails, *urban agriculture* and/or open spaces in new development and redevelopment projects [27].
- Expand regional programs and planning for the purchase of conservation easements and open space for aquifer protection, stream and water quality protection, wildlife habitat conservation, and *sustainable agriculture* [27].
- Extend existing trail and greenway projects to create an interconnected green infrastructure network that includes such elements as preserves and parks, trails stream corridors, green streets, greenways, and *agricultural lands* that link all parts of Austin and connect to nearby cities [27].
- Permanently preserve areas of the greatest environmental and *agricultural value* [27].

This study looks at east Austin where there is 1) an established urban and peri-urban farm presence and 2) high future development potential of agricultural land due to the Austin-Round Rock Metro Area’s rapid growth (110 people per day) [28] and lack of land use constraints leading to urban sprawl [28]. Since the late 1990s, the City of Austin has viewed the eastern side of the metro area as a prime area of growth and development. Without an urban growth boundary most of what the city has determined as the “desired development zone” (DDZ) falls into much of east Austin (Figure 1) and beyond into the Austin’s Extrajurisdictional Jurisdiction (ETJ). The opening of the SH130 tollway, conceived of as a north-south alternative route to interstate 35 on the east side of Austin, has further opened up large areas of available land for new jobs, housing, and services for Austin’s rapidly growing population. The Imagine Austin plan conceives of growth corridors around the city, with the SH130 corridor representing one of those growth corridors in east Austin. According to 2012 land use data from the City of Austin, 94,961 acres of undeveloped land, much of it in agriculture, existed in the suburban portion of the DDZ. Information from the 2015 State of the Food System Report, released by the City of Austin’s Office of Sustainability, put the loss of farmland each day in Travis County at 9.3 acres and a 25% loss in farmland over the last 11 years [29].

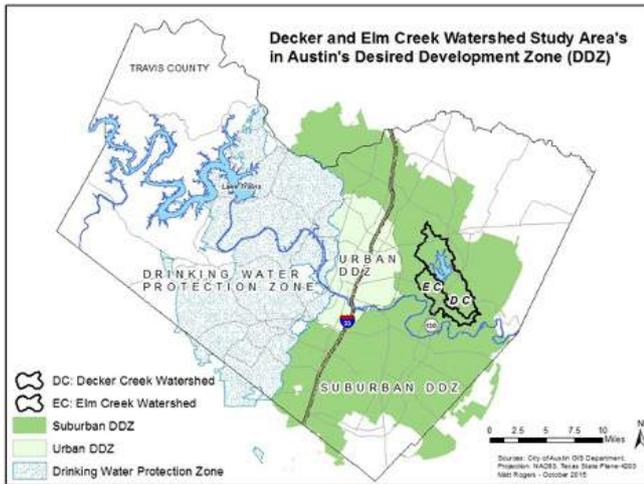


Figure 1. The Decker Creek and Elm Creek Watershed study areas, located in Austin, Texas in Travis County, reside completely in the Suburban DDZ, an area promoted for growth and development by the City of Austin.

Furthermore, the hydrologic environments in east Austin are already under much pressure as a result of being located downriver from the impervious cover of the central business district and at the bottom of several highly urbanized watersheds, effectively making east Austin the hydrologic drain for the city [30]. The creeks and watersheds within east Austin have experienced significant erosion problems and flooding associated with the increasing development and impervious cover seen upstream over the last half century [30]. Further exacerbating the erosion problems have been urban development patterns in the suburban DDZ that situated buildings on small lots close to the creeks. The Austin City Council itself has underscored the potential implications of increasing development and its effect on eastern watersheds:

“The eastern watersheds, with broader floodplains and more erosive soils, pose unique challenges to creek and floodplain protection. Development is currently being placed in close proximity to erosive creek banks in headwaters areas and creating future problems requiring significant and unsustainable public expense to maintain and repair. This development will likely accelerate as build-out proceeds along SH-130” [31].

As a response to city-wide watershed threats, the City Council updated the watershed protection policies in 2013 with Phase One of the new Watershed Protection Ordinance (WPO). The new WPO increased stream buffers and erosion hazard zones to ensure development is not built too close to waterways for over 400 miles of smaller headwater streams [32]. Phase Two of the WPO began in January 2015 with a Green Infrastructure Working Group as part of the City’s land development code rewrite process, called CodeNEXT, to discuss how to achieve the Imagine Austin goals of “integrating nature into the city and creating complete communities through revisions to our zoning and environment codes” [32]. Currently, green infrastructure techniques in the Watershed Department’s manual for best management practices include rain gardens, bio- filtration areas, and vegetative filter strips; however, there is no reference to urban

agriculture as a green infrastructure strategy for new development or as a stormwater management strategy in the city.

Nevertheless, within the last twenty years there has been a proliferation of urban agriculture in east Austin. A variety of urban agriculture exists in the city, ranging from community gardens to small market farms (defined as farms operating on less than one acre within the city’s full jurisdictional boundary) to larger urban farms (over one acre) within or on the periphery of the city. In addition, the Austin City Council has encouraged urban agriculture by authorizing relaxed zoning regulations for private urban farms. For example, the current land code allows for urban farming in all zoning classes, and, at this time, there are 23 urban farms in the city of Austin, classified either as “market farms” if less than one acre and as “urban farms” if more than one acre, and 52 community gardens [29]. Furthermore, in 2009, the Austin City council created the Sustainable Urban Agriculture and Community Garden Program with the expressed purpose of streamlining the process for establishing community gardens and sustainable agriculture on city land, further endorsing urban agriculture in the city.

Much of the land in the suburban DDZ is in Texas Blackland Prairie Geographic Region and contains prime farmland soils according to the classification by the National Resources Conservation Service (NRCS) (Figure 2). The soils in this region are known for being deep and rich with organic material, making them valuable for agricultural use [33]. With the quality of the soils, good drainage, and flat surface, prime farmland also serves as ideal land for development. Indeed, many new developments are going to occur in prime farmland as a result of the city’s priority to develop in the suburban DDZ and the substantial amount of open space in that part of the city. As a matter of debate, the question is how much of the land to develop and what positive and negative impacts are expected to occur. However, the City of Austin, through its Imagine Austin plan, has indicated that preserving a portion of different classifications of open land is important for making Austin a sustainable city. The function of urban agriculture in this plan, thus, has significance in terms of protecting and valuing the environmental, social, and economic well-being of Austin. Most significantly for this study, though, is the role of urban agriculture as a means to conserve prime farmland and serve as green infrastructure in Austin.

1.4. Purpose of Study

Urban agriculture acts as a multifunctional landscape with a variety of benefits including the ability to offset many facets of environmental degradation including preventing excessive runoff [34]. The increase of new development and predominance of urban farms in east Austin, combined with the rise of green infrastructure as a stormwater management focus in the city, makes east Austin an ideal study area for evaluating the potential role of urban agriculture as a green infrastructure strategy. While this is the narrow aim of this study, the true value of urban agriculture as green infrastructure can only be better understood by placing the results of this research into a wider systems framework that encompasses the multiple environmental, economic, and social benefits offered by urban farms.

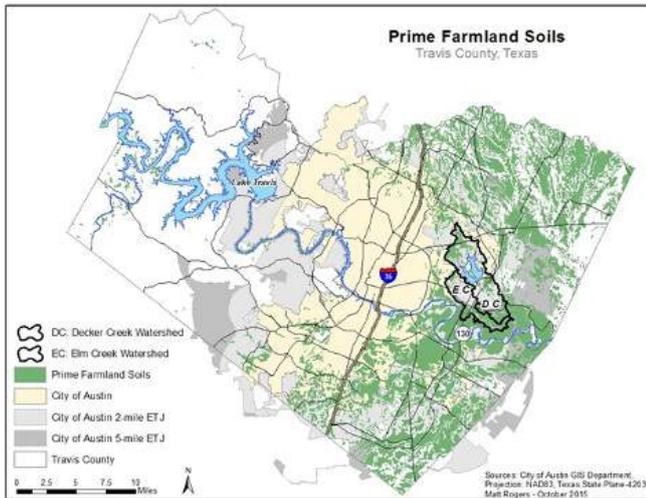


Figure 2. Prime Farmland Soils in Austin, Texas almost exclusively exist in east Austin, where the City of Austin is encouraging growth and development to occur as part of the Suburban DDZ.

The Imagine Austin plan explicitly addresses the adoption of green infrastructure as a targeted future land use with urban agriculture as a component of the green infrastructure network. Addressing this area of land use planning will require tools that can locate suitable areas within the city where urban agriculture can best act as green infrastructure. In this study, a process was developed to create a spatially explicit method of siting urban agriculture as a green infrastructure tool on hydrologically sensitive areas (HSAs), or areas prone to runoff, in east Austin. The method uses geospatial technology to spatially analyze open access datasets that include land use, a digital elevation model, and prime farmland soils. Through this method a spatial relationship can be made between areas of high surface runoff and where the priority placement of urban farms should be sited as a useful component of green infrastructure. Planners or geospatial analysts could use such information, along with other significant factors and community input, to aid decision makers in the placement of urban agriculture. Creating a spatially explicit approach for siting potential urban farms will support the integration of urban agriculture as part of the sustainable land use planning of Austin.

2. Data and Methods

2.1. Study Area

This study examines the sub-watersheds of Decker Creek and Elm Creek in east Austin (Figure 1). These

two watersheds were chosen because they are smaller watersheds that both exist completely within the suburban DDZ and reside in either the Full Purpose Jurisdiction or ETJ of Austin, whereas other eastern watersheds do not fit within those parameters. In addition, the SH130 growth corridor cuts through both watersheds as well as the FM 969 growth corridor. The impact of growth in the region and the expected loss of prime farmland and agricultural land use make these two watersheds ideal areas to study. Decker Creek watershed is 17 square miles and Decker Creek runs 12 miles from the top of the watershed to the outlet. Decker Creek watershed is less developed than other watersheds in Austin containing more agricultural land, but is projected to experience a rise in population growth from 3,156 people in 2000 to 12,341 people in 2030 or a 391% projected increase [35]. Elm Creek watershed totals only 9 square miles and Elm Creek runs 10 miles from the headwaters to the outlet [35]. Elm Creek watershed is comprised mostly of agricultural land, though with development looming there will be an expected increase in population of 180%, or from 3,136 residents in 2000 to 5,643 residents in 2030 [35]. By analyzing these watersheds, the study examines where current farmland can best be preserved for urban agriculture, especially in light of the area's continued development, and provides insight into the functionality of urban agriculture as a way to reduce surface runoff pressure on developing watersheds.

2.2. Data Sourcing & Methods

The entirety of the data for the geospatial elements of this project were sourced from open access datasets (Table 1). Data was pulled from the "GIS Downloads" website managed by the City of Austin. Other data was pulled from federally managed "Data Download" map viewers. The digital elevation model (DEM) was downloaded from the National Map Viewer managed by the United States Geologic Survey. Soil data was obtained from the Web Soil Survey Map Viewer managed by the National Resources Conservation Service (NRCS). Aerial imagery was downloaded from the National Agriculture Imagery Program (NAIP) and land cover data came from the National Land Cover Database (NLCD). Additional data and information about study area context were derived from informal interviews with urban farmers and City of Austin leadership, together with a site visit to an urban farm within the study area. The human subject's portion of this research was approved by the Institutional Review Board (IRB) exemption request on October 15, 2015 with ID # L4567180.

Table 1. Data layers used to inventory urban agriculture and create a topographic index at a watershed scale.

GIS Layer	Format	Source
Land Use 2012	Vector-polygon	City of Austin GIS Downloads (2012)
Watersheds	Vector-polygon	City of Austin GIS Downloads (2013)
Digital Elevation Model (DEM)	10 meter/raster	National Elevation Dataset- Geospatial Data Gateway
Soil Conductivity	Vector-polygon	Soil Survey Geographic Database: National Resources Conservation Service.
Soil Depth to Restrictive Layer	Vector-polygon	Soil Survey Geographic Database: National Resources Conservation Service.
Prime Agricultural Soils	Vector-Polygon	Soil Survey Geographic Database: National Resources Conservation Service.
Aerial Imagery	1 meter/raster	Texas Natural Resources Information System: National Agriculture Imagery Program

2.3. Geospatial Database Development

For use in this analysis, all datasets were projected to the North American Datum 1983 (NAD83), State Plane Texas-4203 with a Lambert Conformal projection to coincide with data from the City of Austin. Both the soils and land use data had to be transformed from vector to raster to correspond with other raster layers. In particular, the prime farmland data and the land use data needed transformation to perform a simple urban agricultural inventory that would be combined with another raster dataset.

Furthermore, a topographic index was performed to delineate HSAs, areas that are prone to generate surface runoff, within the Decker Creek and Elm Creek watersheds. The topographic index is determined with a GIS and requires a digital elevation model, soil hydraulic conductivity, and depth of soil to restrictive layers [36–38].

2.4. HSA Delineation

The topographic index (λ) is formed from two components. The first component is a steady state wetness index, formulated from slope (β) and drainage area (α) of the watershed [36–38]. This index determines the potential for surface runoff within the contributing area and for each cell within the raster. The steady state wetness index is defined as:

$$\ln \frac{\alpha}{\tan \beta} \quad (1)$$

where α is the drainage area per unit contour length in meters and β is the slope in radians.

The second component is soil water storage, derived from soil hydraulic conductivity (K_s) and soil depth to restrictive layers (D) [36–38]. Soil water storage determines the saturation probability for each cell in the raster. Soil water storage is expressed as:

$$\ln(K_s D) \quad (2)$$

where is the soil hydraulic conductivity in meters per day and is the soil depth to restrictive layers in centimeters. In general, the deeper the soil depth or topsoil, and the higher the value of the soil hydraulic conductivity or the speed at which water percolates through the ground, the lower the likelihood of producing surface runoff [39].

The two components combine to make the soil topographic index equation, below, to determine the hydrologically sensitive areas in the watershed:

$$\lambda = \ln \frac{\alpha}{\tan \beta} - \ln(K_s D) \quad (3)$$

To calculate the steady state wetness index, a 10-m resolution DEM, clipped to the watershed, was processed by an open source tool, called the Compound Topographic Index (CTI), as part of an ArcGIS extension toolset. This extension allows the user to simply input a DEM into the CTI tool automatically calculating the steady state wetness index according to the first component of the soil topographic index equation. The CTI operates exactly like the steady state wetness index component of the equation above and can be shown as:

$$CTI = \ln \frac{\alpha}{\tan \beta} \quad (4)$$

where α is drainage area “calculated as (flow accumulation + 1) × (pixel area in m²)” [40] and β is “the slope expressed in radians” [40].

At this point, the raster layers for each component part of the topographic index equation were entered into the ArcGIS Raster Calculator to calculate the HSAs of the watersheds. The resulting raster layer indicates areas within the 10-m grid that are more or less likely to become saturated when a storm event occurs. The higher topographic index (TI) values correspond to areas most likely to become saturated and act as a source of surface runoff, also indicating the location of hydrologically sensitive areas [37,39]. During a storm event, runoff would likely accumulate and disperse in areas with higher topographic indices than any areas with lower topographic indices [39].

Hydrologically sensitive areas are areas most prone to surface runoff and must be delineated in a watershed by some threshold criteria to identify as distinct from the lower topographic indices that are less likely to produce runoff [36–38]. Many techniques have been used to derive such conclusions. Agnew et al. [36] proposes using the average saturation probability to determine HSAs. Others have used the delineation tactic of targeting 20% of the watershed with the highest topographic index values to prevent overland flow from reaching streams [39]. Community and stakeholder involvement also represents a method of delineating

HSAs based on funding, feasibility, or local expertise. Qui [39] selected an HSA threshold level for illustrative purposes considered as reasonable and Martin-Mikle [37] expanded upon that criteria by selecting TI values 1.5 standard deviations above the mean as HSAs. Following similar protocol, HSAs in this study were delineated by selecting topographic index values 1.5 standard deviations above the mean for each respective watershed. Decker Creek watershed TI values have a mean of 11.65, resulting in a threshold TI value level of 15. Any grids in Decker Creek with a TI value greater than or equal to 15, therefore, are delineated as HSAs. The threshold value for selection of HSAs in Elm Creek is anything above 14, or 1.5 standard deviations above the mean value of 10.20.

2.5. Delineation of Prime Farmland on Agricultural Land Use

To determine where current land use is best suited for transitioning into some form of urban agricultural opportunity, a simple urban agriculture land inventory was performed in both watersheds. This land inventory was derived from two datasets: City of Austin land use data and prime farmland soil data from the National Resources Conservation Service SSURGO soil database. Utilizing the ArcGIS 10.2 overlay analysis tools on the aforementioned datasets resulted in a new dataset of potential land suitable for urban agriculture. The inventoried lands suitable for potential urban agriculture are located on prime farmland soils and have an agricultural land use classification.

2.6. Combining HSAs with Land Use and Prime Farmland Data to Prioritize Locations for Urban Agriculture as Green Infrastructure

To prioritize locations for urban agriculture as a green infrastructure tool, the urban agriculture land inventory, composed of land use and prime farmland data, had to be converted to a raster layer to enable a combination of the delineated HSAs in each watershed with TI values 1.5 standard deviations above the mean. In the Decker Creek watershed, TI values greater than or equal to 15 were overlaid onto the potential areas for urban agriculture to find HSAs located on agricultural land use and prime farmland soils. In the Elm Creek watershed, TI values greater than or equal to 14 were overlaid onto the potential areas for urban agriculture to find HSAs located on agricultural land use and prime farmlands soils. The resulting datasets showed where in each watershed agricultural land use and prime farmland soils should be considered as areas for potential urban agriculture as a green infrastructure tool according to the spatial relationship with HSAs in the watershed. To further prioritize the sites considered as potential sites for urban agriculture as a green infrastructure strategy and for conserving prime agricultural land in Austin, an additional step derived the top ten areas in each water-

shed holding the most HSAs in acreage according to Travis County Appraisal District (TCAD) parcels. TCAD parcels identify bounded property lines in Travis County and their owners.

2.7. Combining Prioritized Locations of Urban Agriculture with TCAD Parcels to Identify Sites with the Most HSA Acreage

TCAD parcels from the City of Austin were downloaded and clipped to each respective watershed to delineate the boundaries of the parcels within the watershed. The application of the ArcGIS spatial analyst tool zonal statistics derived how many 10 meter pixels of HSAs on potential urban agriculture sites were located within the boundaries of individual TCAD parcels. Parcels with no HSAs were eliminated from analysis. Calculations utilizing the field calculator in ArcGIS were then made on the parcels containing HSAs to derive the total amount of HSAs acreage within each parcel. Through sorting, a ranked list of parcels containing the most HSAs acreage was generated for each watershed. This list shows the most viable parcels so that a structured attempt can be made to identify those landowners that hold the most HSAs in an effort to conserve areas of prime agricultural land from incoming development and locate possible urban agriculture opportunities as a method of green infrastructure.

3. Results

3.1. Delineated HSAs on Agriculture Land Use and Prime Farmland

The derived TI values for Elm Creek watershed range from 3.5 to 23.3, while the TI values for Decker Creek watershed range from 3.3 to 27.0. In Elm Creek watershed, areas with TI values greater than or equal to 14 (1.5 standard deviations above the mean) are delineated as HSAs (Figure 3). In Decker Creek watershed, areas with TI values greater than or equal to 15 (1.5 standard deviation above the mean) are delineated as HSAs (Figure 4). HSAs indicate areas prone to surface runoff as a function of a topography's slope and drainage area and a soil's saturation potential derived by soil hydraulic conductivity and soil depth. To prioritize where potential urban agriculture sites could serve as a green infrastructure strategy in both watersheds, HSAs were combined with areas deemed as agricultural land use by the City of Austin and those containing prime farmland soils. The total area of agricultural land use on prime farmland for Elm Creek watershed is 1218 acres and 1504 acres for Decker Creek watershed (Table 2). The areas of the delineated HSAs within potential sites for urban agriculture as a green infrastructure tool are 62.7 and 111.7 acres for Elm Creek and Decker Creek, respectively. HSAs represent 5.1% and 7.4% of the total agriculture land use on prime farmland in Elm Creek and Decker Creek, respectively.

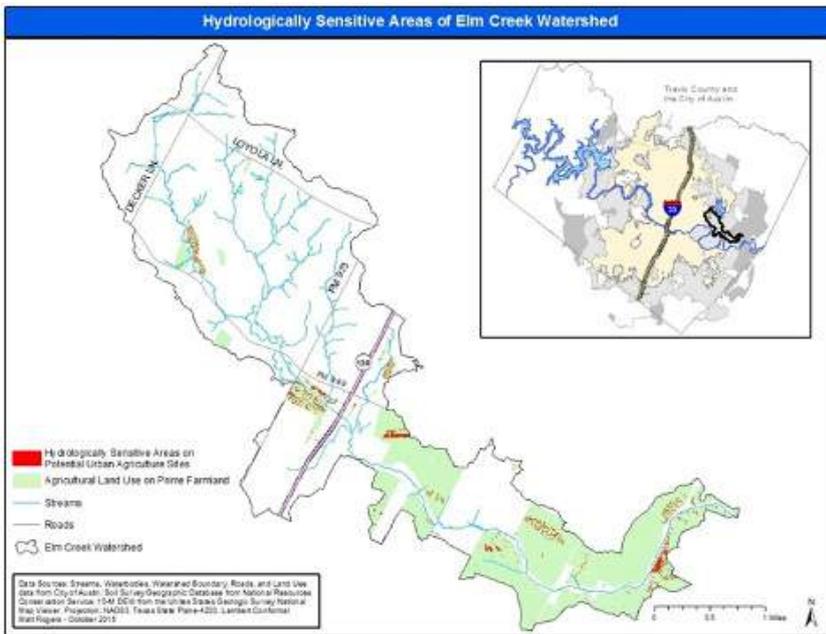


Figure 3. The spatial distribution of hydrologically sensitive areas (HSAs) in Elm Creek Watershed in Austin, TX. HSAs in Elm Creek watershed have topographic index (TI) values 1.5 standard deviations above the mean or greater than 14. These particular HSAs are on potential urban agriculture sites as determined by their location on land deemed agricultural by the City of Austin and considered prime farmland by the National Resources Conservation Service (NRCS).

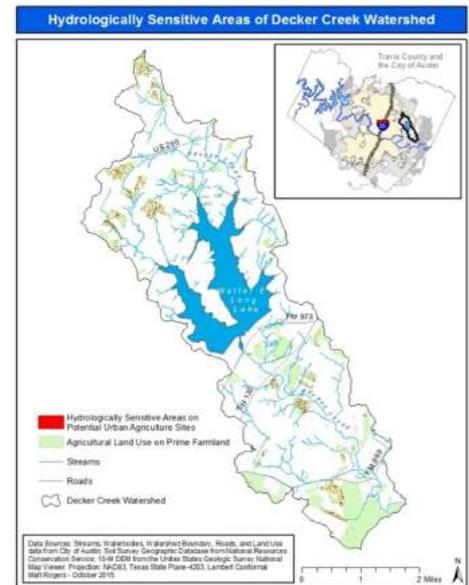


Figure 4. The spatial distribution of hydrologically sensitive areas (HSAs) in Decker Creek Watershed in Austin, TX. HSAs in Decker Creek watershed have topographic index (TI) values 1.5 standard deviations above the mean or greater than 15. These particular HSAs are on potential urban agriculture sites as determined by their location on land deemed agricultural by the City of Austin and considered prime farmland by the National Resources Conservation Service (NRCS).

Table 2. Potential urban agriculture land totals in Elm Creek and in Decker Creek watersheds: agricultural land use on prime farmland, HSAs on prime farmland with agricultural land use, and HSAs on prime farmland with agricultural land use without Critical Water Quality Zone (CWQZ) restrictions.

	Elm Creek Watershed	Decker Creek Watershed
Total Acreage of Agricultural Land Use with Prime Farmland	1504 acres	1218 acres
Total Acreage of HSAs on Agricultural Land Use with Prime Farmland	62.7 acres	111.7 acres
Total Acreage of HSAs in CWQZ	20.4 acres	17.5 acres
Total HSAs left after CWQZ restrictions omitted	42.3 acres	94.2 acres

3.2. Delineated HSAs Protected Under Current Land Use Control

The Critical Water Quality Zone (CWQZ) restrictions set forth by the City of Austin’s 2013 watershed protection ordinance restricts development around waterways by establishing a buffer associated with the size of the waterway [41]. The suburban DDZ watersheds, including Decker Creek and Elm Creek watersheds, maintain unique buffer classifications associated with the size of the waterways. In minor waterways, CWQZ boundaries are located 100 feet from the centerline of a waterway [41]. Intermediate waterways retain CWQZ boundaries

200 feet from the centerline of a waterway [41]. Finally, major waterways have a restriction of no development within 300 feet of the CWQZ [41].

The areas of the delineated HSAs found on prime farmland with agricultural land use that are already protected under CWQZ restrictions total 20.4 acres for the Elm Creek watershed (Table 2) and 17.5 acres for Decker Creek watershed (Table 2). With the Elm Creek watershed that leaves 42.3 acres of HSAs on prime farmland with agriculture land use unprotected from potential development (Table 2). While, in the Decker Creek watershed 94.2 acres of HSAs remain unprotected from future development (Table 2).

3.3. Prioritized HSAs on TCAD Parcels

In an effort to include tangible results for the City of Austin (as suggested by the Food Policy Manager at the Office of Sustainability) so that they may reach out to landowners about conserving portions of their land to incoming developmental threat, TCAD parcels were sorted into a “top ten list” of areas that contain the most HSAs. These areas not only hold the potential to serve as urban agricultural opportunities, protecting prime farmland, but also to act as a green infrastructure land use control that further protects the watershed beyond the CWZQ zone.

In both watersheds, the spatial distribution of the HSAs in the parcels varies because the parcels are based on an individual’s ownership. As a result, some of the parcels show an even spread of HSAs throughout the parcel, while other locations show clusters of HSAs only in portions of the parcel. As a means of validation, aerial imagery from the National Agricultural Imagery Program (NAIP) and land use data from the National Land Cover Database (NLCD) were used to identify land use within the parcels to validate potential urban agriculture sites.

The top ten parcels in Elm Creek watershed contain 51.5 acres, or 82%, of all HSAs. The total acreage for HSAs ranges from 10.7 acres in Parcel 1 down to 1.9 acres in Parcel 10 (Table 3). In Parcel 1, a mid-size parcel containing 57 acres, the HSAs spread throughout the parcel in an even density, while in most others the HSAs cluster in certain areas of the parcel. Parcel 1 encompasses 41 acres of prime farmland and 26% of that land contains HSAs. With the relative density of HSAs in Parcel 1, this parcel may best be conserved as an entire plot suitable for a large urban farm. Verification with NAIP imagery and land cover data from the NLCD, demonstrates that this plot contains a large pasture and hay field with HSAs (Figure 5). In contrast, Parcels 2 and 3 contain 8.9 and 7.3 acres of HSAs, respectively, but include only a minimal percentage of HSAs relative to their total percentage of HSAs on agricultural land use with prime farmland. For example, Parcel 2 has 132 acres of agricultural land use on prime farmland but only 6.8% contain HSAs. The HSAs are highly clustered in the southeast portion of the parcel and, through NAIP and NLCD verification, the densest network of HSAs lies on cultivated fields (Figure 5). In this case, it would make sense to target the portion of the land with HSAs for conservation, adding protection to the watershed by allowing it to remain free of development, enabling it to become a potential site for urban agriculture.

In contrast to Elm Creek, the top ten parcels in Decker Creek watershed encompass a total of 57.5 acres of HSAs, or 51%, of all delineated HSAs in the watershed. Delineated HSAs in the Decker Creek watershed parcels range from a total of 11.1 to 2.9 acres (Table 4). The spatial distribution of HSAs in the Decker Creek watershed parcels vary, though in the northwest corner of the watershed five parcels feature somewhat evenly spread out HSAs. Through validation

with NAIP imagery and NLCD data, Parcels 6 and 7, in the northwest corner, contain HSAs primarily on cultivated fields, and have 4.6 and 4.0 acres of HSAs, respectively (Figure 6). Parcel 6 contains only prime farmland and 93% of the land in parcel 7 is prime farmland (Table 4). The percent of HSAs on prime farmland is 14.5% for parcel 6 and 18.9% for parcel 7. These two parcels, taken together as an urban agriculture site, could protect 8.6 acres of HSAs and 52.8 acres of prime farmland. As a contrast, parcel 8 contains 2.9 acres of HSA, but when verified through NAIP imagery and NLCD data, most of the HSAs are located on uncultivated fields within deciduous forest and scrubland (Figure 6). While maintaining this area as open land, protected from development, still has benefits for the watershed, its use as a potential site for urban agriculture as a green infrastructure strategy may not be the best use of the land. Rather, leaving the land undeveloped arguably poses the greatest benefit to the watershed.

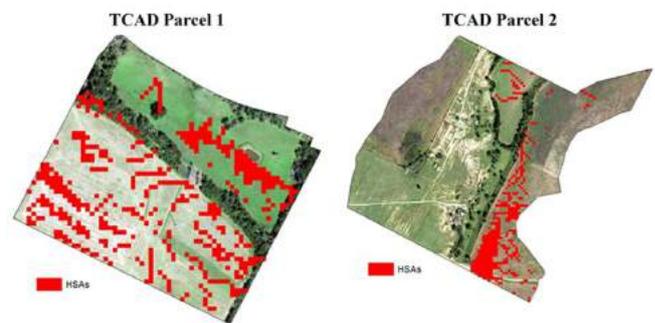


Figure 5. TCAD parcels in Elm Creek watershed. TCAD parcel 1 shows an even spread of HSAs across the land area, while TCAD parcel 2 shows a clustering of HSAs in the southeast portion of the parcel.

Table 3. Potential urban agriculture sites in Elm Creek watershed relative to their affiliation with TCAD parcels and the HSAs located on agricultural land use with prime farmland (Prime Ag).

Elm Creek Watershed					
TCAD Parcel	HSAs acreage	Total Land Acreage	Prime Ag Acres	Percent of HSAs on Total Land Acreage	Percent of HSAs on Prime Ag Acres
1	10.7	57.4	41.3	18.60	26.00
2	8.9	147.3	132.3	6.10	6.80
3	7.3	275.4	256	2.70	2.90
4	5.4	165.1	154.3	3.30	3.50
5	4.4	82.2	60.5	5.40	7.30
6	4	29.5	19.2	13.60	20.80
7	3.5	79	75	4.40	4.70%
8	2.8	27.2	9.2	10.10	29.90
9	2.6	42.4	33.2	6.10	7.80
10	1.9	20.6	20.6	9.40	9.40

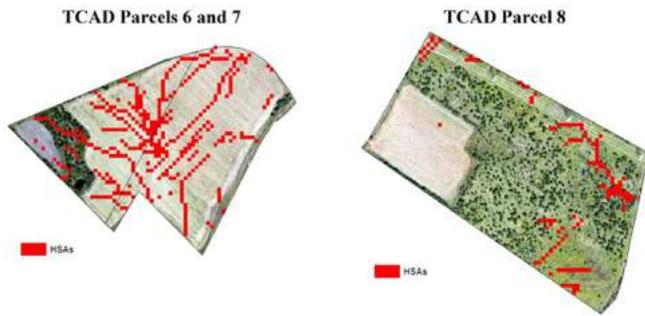


Figure 6. TCAD parcels in Decker Creek watershed. TCAD parcel 6 and 7 show an even spread of HSAs across a cultivated land area, while TCAD parcel 8 shows an uneven spread of HSAs mostly in a landscape of deciduous forest and scrubland.

Table 4. Potential urban agriculture sites in Decker Creek watershed relative to their affiliation with TCAD parcels and the HSAs located on agricultural land use with prime farmland (Prime Ag).

TCAD Parcel	HSAs acreage	Decker Creek Watershed			
		Total Land Acreage	Prime Ag Acres	Percent of HSAs on Total Land Acreage	Percent of HSAs on Prime Ag Acres
1	11.1	89.1	66.8	12.40	16.60
2	8.5	66.4	48.1	12.70	17.60
3	7.8	72	46.9	10.80	16.60
4	7.1	100.3	68.9	7.10	10.30
5	5.7	38.1	31.7	15.10	18.10
6	4.6	31.7	31.7	14.50	14.50
7	4	22.6	21.1	17.70	18.90
8	2.9	66.3	32.3	4.40	9.10
9	2.9	101.3	89	2.90	3.20
10	2.9	31.5	13	9.20	22.20

3.4. Delineated HSAs on Urban Farms

Green Gate Farms is a five-acre farm and the only classified urban farm in the Elm Creek watershed. The owners currently rent the land to farm from an owner who holds 106 acres of the land in the Elm Creek watershed. Analysis of the HSA data in the Elm Creek watershed results in no delineated HSAs within the boundaries of the farm. When HSAs are classified as existing on prime farmland with a TI value greater than or equal to 14, there are still no HSAs in the farm boundary, but there are 7.7 acres of HSAs within the wider 106 acre boundary under scrutiny. The densest network of HSAs resides within just 150 feet of the farm boundaries in an open field adjacent to the farm. When the CWQZ is accounted for, 2.5 acres of HSAs are protected from development leaving 2.2 acres of HSAs unprotected still within a dense network neighboring the farm.

Tecolote Organic Farm is the only urban farm within the

Decker Creek watershed. It comprises 65 acres in total and contains 0.5 acres of HSAs on prime farmland. There are only two 10m pixels within the CWQZ accounting for protection of four one-hundredths of an acre. In effect, Tecolote Organic Farm is protecting 0.46 acres of HSAs on prime farmland or 92% of the total HSAs. When HSAs are delineated solely by a TI value greater than or equal to 15 and not according to land use classification or prime farmland, HSAs total 2.1 acres on the farm.

4. Discussion

The Decker Creek and Elm Creek watersheds reside on the periphery of Austin and remain relatively undeveloped at this point. However, city projections suggest the watersheds will be rapidly urbanizing in the near future as Austin continues to increase in population and expand its urban impervious cover. The implication that much of the land in the suburban DDZ will be developed at some point poses a significant threat to those watersheds and open land within them including areas that hold value as prime farmland. Given population growth demands, it will be important to grow smartly, identifying areas best suited for development and organized around interconnected open spaces that protect the environment and add a social and economic benefit as integrated elements of a community, neighborhood, and city. The IACP provides the framework for this type of smart growth in Austin but will need to be implemented through new sets of land use controls and tools that allow planners and decision makers to make informed decisions about where to develop and where not to develop. As the city redevelops its land development code and initiates Phase Two of the WPO concerning green infrastructure, tools such as the one outlined in this research can provide valuable information to incorporate urban agriculture as part of the green infrastructure strategy in Austin.

4.1. Implementation of Urban Farms on HSAs: Best Management Practices (BMPs)

The approach outlined in this research prioritized HSAs by their spatial connection to potential urban agriculture sites that could act as a green infrastructure tool. HSAs in a watershed generate overland runoff and require land uses that limit the amount of water resource degradation. High-intensity urban land uses placed on HSAs such as a commercial development or low-density residential development have a significant impact on watershed degradation. For example, an increase in impervious cover increases the amount of stormwater runoff already generated in the area resulting in potential floods, incised creek beds, or more non-point source pollutant loads from residential lawns, leaking septic systems, or carbon particulates from streets and parking lots [38]. Furthermore, common stormwater infrastructure such as catch basins, detention basins, pipes and culverts quickly disperses polluted stormwater runoff to downstream waterways. Urban farms can decrease the

amount of surface runoff that would otherwise flow to an already overwhelmed storm drain by remaining as undeveloped land and increasing the amount of water that the land can soak up. HSAs on potential urban agricultural land protect the watershed by keeping it as low-intensity land use, with the proper BMPs.

Traditional farming techniques typically have negative impacts on water quality due to farming practices such as fertilization along with pesticides and herbicide use. As a result, HSAs in agricultural land uses have a higher potential to export pollutants from agriculture fields to streams. If HSAs were to be located on potential sites for urban agriculture, it would be necessary to implement BMPs that provide risk reduction techniques to reduce contamination of stormwater runoff from urban farms. Below are some of the best practices for urban agriculture [38,42,43]:

- Use organic farming principals that require no synthetic pesticides or fertilizers;
- Construct berms along the edges where the impervious surface and farm meet to prevent erosion and runoff;
- Incorporate bio swales and retention ponds to collect runoff and promote infiltration;
- Use crop rotation and plant cover crops to hold soil in place;
- Avoid input of animal manure, instead use organically produced compost as a fertilizer;
- Install a rainwater re-use system that captures rainwater then filters it into an underground tank for irrigation use.

Real Food Farm is an example of a farm that integrates stormwater management practices into urban farming. The farm is located in Baltimore, Maryland, in the Chesapeake Bay watershed, a watershed affected by the urbanization of the area leading to large amounts of polluted stormwater runoff. The farm installed a rainwater re-use system that captures rainwater off the hoop houses and stores it in an underground cistern. Additionally, the farm incorporated a retention pond and constructed bio swales and berms to help mitigate stormwater runoff from the farm [43].

Another BMP model that the City of Austin could potentially implement for urban farms is a sediment and erosion control plan. Seattle's urban farm code requires a management plan if an urban farm exceeds 4,000 square feet [44]. One provision included within that plan states a given proposed sediment and erosion control program for farmers to follow. To approve a farm, the city considers the potential impacts and mitigation of how a farm's proposed sediment and erosion control measures will affect the impacts of runoff on the surrounding watershed. In addition, Seattle resides in the King County Conservation District which provides free soil nutrient testing on up to five samples, including compost [44]. This program allows farmers to use soil amendments wisely in an effort to reduce water pollution from over-fertilization.

In a sheer size comparison, traditional farms compared to urban farms also typically have a broader footprint on the

surrounding environment. The larger the farm the higher the potential to export non-point source pollution into waterways. In Austin, urban farms (again, classified as farms over one acre) average only 4.5 acres in total land area, and, moreover, the actual plots that produce food occupy fewer acres. Often embedded within the total land area are woods, pasture, and fallow ground. If these areas remain undeveloped they may occupy space where HSAs are located. Hence, potential urban farms using BMPs and occupying space around future development in the two researched watersheds can provide valuable community benefits in the form of providing access to healthy food, enriching green space, and protecting prime farmland, as well as the added environmental benefit of leaving HSAs as undeveloped land.

4.2. Opportunities at the Local Scale

The situation at Green Gate Farms in Elm Creek watershed offers an instructive view of the pressures current and potential urban farms confront as development encroaches into the rural-urban fringe of Austin. In addition, Green Gate Farms shows the value urban farms bring to a community and why urban agriculture in the City of Austin should be considered as a valuable land management tool.

Green Gate Farm is an organic farm occupying five acres of leased land on a larger parcel of land that also contains a large RV park and undeveloped land. The land sits in an area experiencing major growth with the construction of new subdivisions. An informal interview with one of the farmers provided the following information. The farmers of the land have been farming on it for the last 10 years paying rent to one owner. Recently, the land was sold to a new owner who hopes to develop an upscale RV park and manufactured homes on the farmstead. Until recently, the two original farmers lived on the land in an old farmhouse, but a new condition applied by the current landowner stipulated that the house can no longer be used as a residence, forcing the farmers to move off the land. The farmhouse now operates as an office for the farm and a non-profit called New Farm Institute with a mission "to educate, assist and inspire citizens and a new generation of sustainable farmers, with a focus on the urban fringe" [45]. Currently, the farmers are still under lease until summer 2016 and continue to operate the farm, but whether or not they will be able to continue to farm the land is uncertain.

Furthermore, the farmer indicated that the mission of the farm has always been community oriented. As former health professionals, the farmers' priorities have been to provide fresh produce to underserved families living in a part of east Austin that is recognized by the USDA as a food desert, an area with limited access to fresh food or existing one mile or more from a grocery store [46]. As part of the mission to create a community resource for neighbors of all incomes, the farm accepts Supplemental Nutrition Assistance Program (SNAP) benefits (i.e. food stamps) and Women, Infants, and Children (WIC) vouchers so that

citizens in the community can buy healthy local produce. In addition, the farm has a robust community supported agriculture (CSA) program that provides boxes of organic produce, meat, eggs, and flowers to participating individuals that choose to enroll in a weekly, monthly, or yearly subscription service. During an on-site observation of the farm, it became clear that community involvement is something that is not just talked about, but actually exists. Many people dropped by on a Saturday afternoon to purchase certified organic vegetables, dairy, meat, and eggs from the farm stand, which is open to the public Tuesday, Friday and Saturday. At least two families purchased produce with food benefit cards. In addition, they have an open-door policy that allows the public to experience a working urban farm providing educational opportunities as well as a relaxing environment. On this particular Saturday, the farm hosted a children's birthday party surrounded by volunteers and workshare members preparing the fields for Fall planting.

To protect beneficial urban farms like Green Gate Farm and ensure that future urban agricultural opportunities exist on prime farmland within the suburban DDZ, the Austin Sustainable Food Policy Board (SFPB) serve as advisors to the Austin City Council and the Travis County Commissioners Court to improve the food system in Austin. As part of the land development code update in Austin (CodeNEXT), the all-volunteer SFPB working group is working with community and board members "to improve upon the existing code in a way that meets the needs of communities, farmers, and regulators in the interest of a healthy, safe, secure, and sustainable food system for all of Austin" [47]. The group's work includes providing recommendations on desirable land use policies in the suburban DDZ [47] (below):

- Prioritize preservation of prime farmland;
- Establish limits on sub-dividing farmland;
- Utilize community gardens in new housing developments;
- Allow for conversion of underutilized industrial sites/strip-malls into urban farms.

The Green Infrastructure working group in Austin is also currently working on integrating green infrastructure as part of land development code update to meet the provisions set forth in the Imagine Austin Comprehensive Plan. The SFPB working group and the Green Infrastructure working group both provide paths by which their recommendations can be integrated into the code revision process and ensure that urban agriculture is considered a viable asset in the updated land development code. The methods outlined in this research to delineate HSAs on potential urban agricultural sites as a green infrastructure strategy could prove useful to both working groups as they look for ways to conserve portions of Austin's green space.

For example, consider the situation at Green Gate Farm again: while the five acre farmstead does not contain any prime farmland soils nor HSAs, the undeveloped fields next to the farm do contain 2.2 acres of HSAs on prime farmland that are not protected under the CWQZ. If an updated land development code existed establishing land use controls that "prioritized preservation of prime farmland" to include HSAs

as a part of the criteria that functions as green infrastructure tool in the WPO then a portion of this land could be protected from development and potentially be used as urban agriculture site. Under this type of land management scenario there could be an opportunity to move Green Gate Farm onto the adjacent prime farmland that occupies the HSAs in order to preserve environmental and social functionality and services offered by the farmstead when the new owner builds the RV Park. The protection of Green Gate Farm would serve not only the underserved communities' needs with continued healthy fresh produce but also provide critical watershed protection from the incoming development.

4.3. Limitations of the Research

The ability to remotely prioritize HSAs and potential urban agriculture sites is one advantage of employing a GIS based approach as opposed to the costly and time consuming practice of visiting all sites. While the soil data collected provides the necessary components to complete the soil topographic index, it would be ideal to have on-site collected data of the soil infiltration rates and soil depths associated with urban agricultural land in east Austin, enabling a comparative analysis that quantifies exactly how much urban farms help to reduce stormwater runoff. Furthermore, ground truthing HSAs on the prioritized sites to verify that there is a potential for surface runoff would further validate the GIS based approach of delineating HSAs. Additionally, 2014 aerial imagery from NAIP was used to verify selected sites in this study where cultivated cropland could be recognized as potential urban agricultural land. It is also possible to ground truth data using Google Earth, similarly to Taylor and Lovell [48], who used this method to identify backyard agriculture in Chicago. Nonetheless, before making any policy decisions, on-the-ground site-checking of selected HSAs on potential urban farms should be a necessary component of any urban agriculture land inventory [13].

Another possible limitation of this study are the derived threshold criteria determining the HSAs in both watersheds. In this study, the threshold criteria for selecting HSAs are TI values greater than or equal to 1.5 standard deviations above the mean. This approach follows well-researched methods from Mickle et al. [37] and Qui [39] who use similar derivations. However, more information is needed on the local characteristics of the watersheds in Austin that could possibly determine a more suitable threshold value. This could result in either leaving the value the same, or increasing or decreasing the delineations of HSAs in the study area depending on if that value is equal to, greater than, or less than the value used in this study.

Another limitation of the study is the lack of analysis of other important factors related to the feasibility of urban agriculture. When determining land use for future development, urban agriculture faces strong competition from housing and commercial developers; simply creating urban farms instead of housing or businesses could decrease affordable housing options or minimize job creating commercial devel-

opments. Like the set of BMPs urban farms use to mitigate stormwater runoff, BMPs should also be created that properly locate urban agriculture without hindering access to affordable housing.

5. Conclusion

While urban agriculture is a valuable tool in a city's toolbox of methods which can be used to create a more sustainable city, it is by no means a solution to all the problems a city endures. This study will add only one piece of knowledge to an ongoing discussion and debate about urban agriculture's role in developing more sustainable cities. Nevertheless, this

research may help to further establish urban agriculture as part of the discussion about strategies that could lead to a more sustainable city. The social and economic benefits of urban agriculture are well established and well known, but the scientific inquiry into the environmental benefits of urban agriculture is still lagging behind current needs and popular enthusiasm. This research aims to add a spatially explicit method to urban agriculture's potential as a green infrastructure strategy that demonstrates the ability of urban farms to mitigate surface runoff and provide environmental benefits to a city. By validating urban agriculture as green infrastructure it will help to integrate urban agriculture into public policy and urban planning as a land management strategy.

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Research Article

Agricultural Land and the New Urban Paradigm: Coexistence, Integration, or Conflict?

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Abstract: The relation between “urban” and “rural” has changed and developed over the last few decades. The present contribution focuses on how the relationship between these two entities has developed, highlighting how it corresponds to a growing complexity and interdependence among the two. Awareness has increased that to the extent that proper management of these interdependences can contribute to solve problems, increase economic performance and also make a contribution to a higher quality of life in and around urban areas. In this framework, green infrastructures and agriculture practices in urban areas are discussed. The contribution concludes by suggesting strategies and actions for the proper implementation of green infrastructures and urban agriculture practices at regional and local scales.

Keywords: green infrastructures; landscape; quality of life; urban agriculture; urban/rural relationships

1. Introduction

The existence of urban-rural relationships implies that there is an “urban” dimension and a “rural” dimension. The characteristics and functions of each given context determine their interrelationships. We can actually define urban-rural relationships in terms of “structural” and “functional” relationships. Structural relationships are determined by how the physical environment is constituted and shaped, while functional relationships are determined by how the physical environment is utilized. Over time, particular functions and structures change as production, consumption, and behavior patterns change, with the effect that the physical environment is also constantly being redefined. From this point of view, all urban-rural relationships are part of a continuous reshaping process. It is generally possible to identify two distinct phases in the evolution of urban-rural

relationships. The first phase occurred when societies were predominantly rural and city-rural relationships were characterized by the consumption of agricultural products by urban dwellers in exchange for cities’ commercial products and services. In the second phase, the balance of urban-rural relationships began to shift towards an increasing dependency of rural areas on urban economies and dynamics. New urban-rural relationships became much more complex than traditional ones. Urban-rural linkages are now moving beyond single one-way exchanges and demonstrate a more complex and dynamic network of interdependencies. Moreover, urban problems are sometimes located in rural areas and vice versa, but solutions to urban problems can also be found in rural areas as well as in urban ones. This raises the question as to whether a proper management of the urban-rural relationship can contribute to the sustainability transition, by solving problems and conflicts, increasing

economic performances and improving the quality of life in, and around urban areas. In this way, from a methodological point of view, comes into play an incremental approach based on three specific objectives:

1. an adequate understanding of the dynamics of ecosystems and the landscape in order to probe the limits of resource usage and develop appropriate mechanisms to recognize ecological/environmental requests and risks in city management tools;
2. the marked reversibility of the planned urban transformations, that is, the possibility of analyzing ex, ante, the best use of land to avoid waste, and devising alternative means of use;
3. the possibility of affecting the formation and activation of public choices, planning techniques, the existing relationships between enjoying private property and using common goods, and citizen participation.

2. The Current Context: The Urban Discomfort and the Search for a New Quality of Life and Attractiveness of Rural Areas

The dire ecological, economic, and social crisis of recent years has strongly called into question the prevailing model of development. There are two main direct consequences of inappropriate land management: a progressive consumption of essential natural resources on the one hand and the abandonment and depopulation of the most marginal areas on the other, which significantly impacts the safety of the territory, the environmental balance, and the quality of life of communities. The condition of the city, and the quality of life of its inhabitants, is increasingly becoming a subject of attention. More than 50% of the world's population now lives in urban areas, so this is where the real challenge of sustainability and better quality of life has to play out. At this time, however, the positive outcomes of these challenges still seem to be far from reality. The reduction of open spaces and the consequent increase of impermeable surfaces, air pollution, poor water quality, traffic congestion, and the increasing "heat island" effect, are the urban discomfort and causes of the contemporary crisis of the city [1]. In this sense, many international organizations (starting with the Population Division of the United Nations) have sounded alarms regarding the future of cities. More than 70% of greenhouse gas emissions in the world come from cities [2], which continue to grow in an uncontrolled way and

become ever more unlivable, in addition to consuming more and more energy. The signs of this growing discomfort are manifest in the degradation of the urban landscape and the poor quality of life, and the continuous expansion of the city, that has increasingly projected toward the outside (Figure 1). In these cases the relationship between nature, agriculture and new urban areas, is developed in a continuous tension between the processes conflict, coexistence or (in the best cases) integration. With these dynamics, suburbs are mostly seen as an opportunity for growth instead of a limit. As a result of this change, the city has also lost its own identity and sense of place [3–6], mostly due to the following phenomena: the city has expanded but consequently has lost the shape of a real city, in the original sense of the word; inside the city, individual subjectivity is opposed to collective dynamics. People tend to model their surrounding space according to their own measure, with individual achievements most of the time more replicated than planned; places for leisure and free time are losing space because of the contiguity and/or overlapping of different uses and functions; the city becomes a patchwork of everyone's space, with no flexibility of uses [6].

This trend is a direct result of haphazard development resulting in sprawl, a phenomenon that disfigures the character that once gave the territory its charm. It radically changes rural landscapes and cherished landmarks, reduces opportunities for forms of outdoor and leisure activities, fragments wildlife habitats, pollutes the air, water, and soil, and represents an expensive land-use pattern for governments to build and maintain. All of these pressures generate direct impacts and put into crisis the sustainable and lasting use of natural resources (Figure 2).

Something paradoxical happens as a result: cities grow by welcoming new people but reject people who aspire to a higher quality of life [7–9]. The discomfort of the population leads to a gradual growth of consciousness and demand for nature. This led people to move from uncomfortable cities to more comfortable, open, wider spaces, rural areas, rich in natural resources and a better quality of life [10,11].

Rigid, large-scale planning, which we have seen on the regional and provincial levels, has not been able to respond to ecological and economic changes. The weakness of planning practices produced to date, which have been consolidated over time, can lead back precisely to the tendency to presume the irreversibility of transformation processes and to impose stringent rules in establishing end uses.

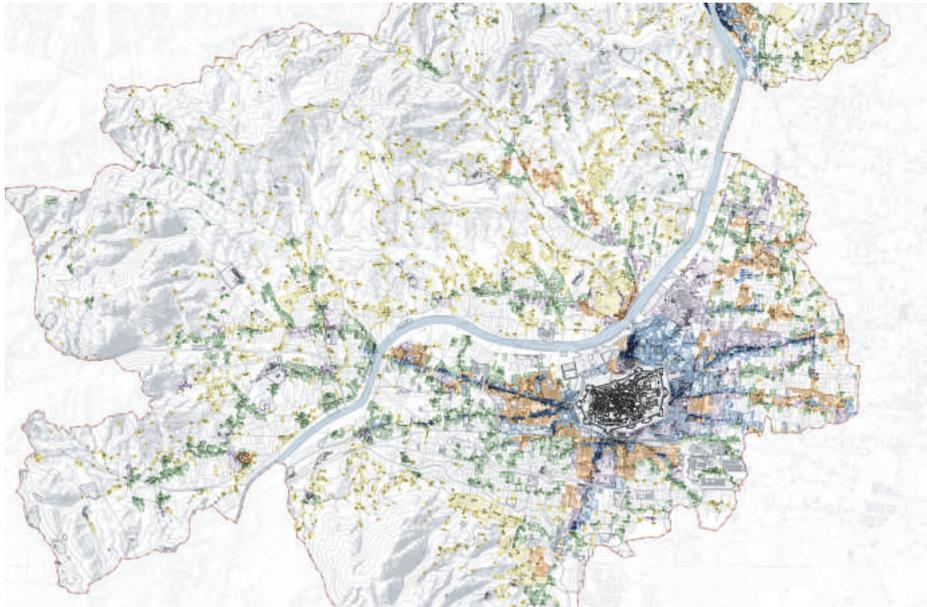


Figure 1. Urban development and the urban-rural relationship in the case of the Structural plan of Lucca, Italy. The map represents the morphological and figurative characterization of the urban fabric in the city of Lucca. In particular, it shows the development of the city toward the outside, by highlighting how the relation between the open (agricultural land) and the built environment (city) changes through the time (darker for historical settlements, lighter for newer ones; Source: Author's Archive from the Research Project "Analysis of soil consumption in the city of Lucca").

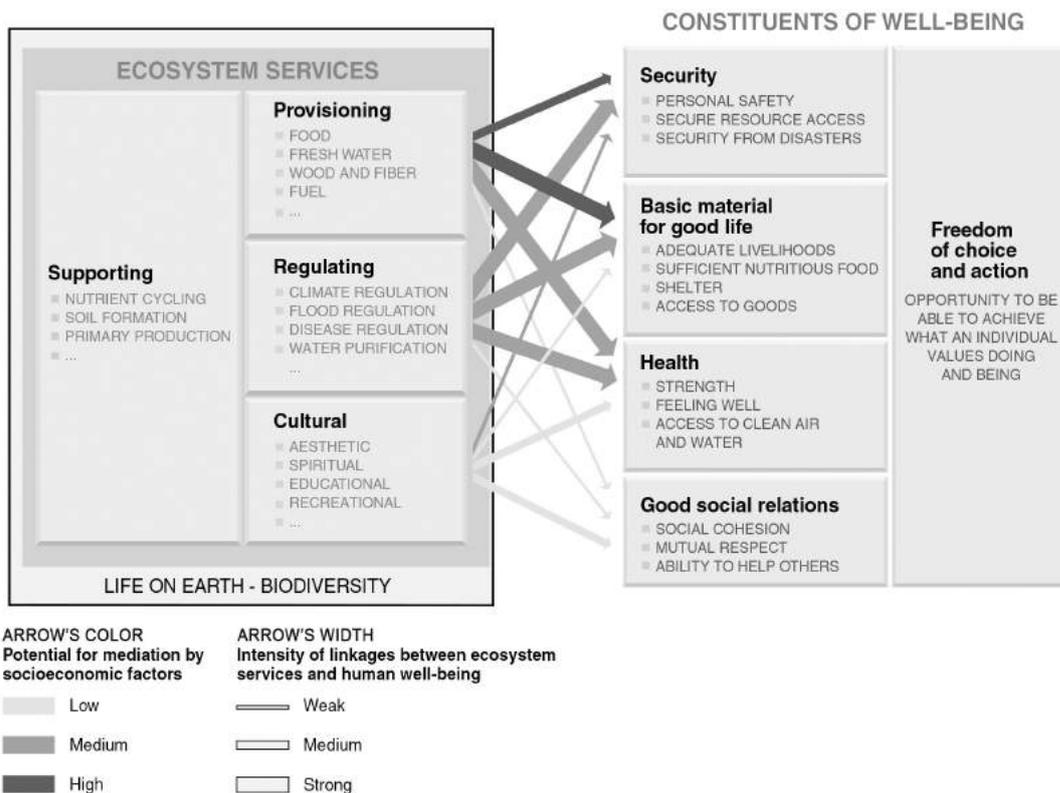


Figure 2. Linkages between ecosystem services and human well-being. The strength of linkages between categories of ecosystem services and components of human well-being and indications of the extent to which it is possible for socioeconomic factors to mediate the linkage. The strength of the linkages and the potential for mediation differ in different ecosystems and regions. (Source: [12]).

3. A Growing Need for Nature in The City: Toward a Better Quality of Life and The Sustainability Transition

The relationship between humans and the natural environment over the last century has undergone constant degradation, which is evinced in the widespread individual and social malaise. Today, reuniting humans with their environmental context in order to increase their quality of life cannot be delayed, and the landscape, intended as a “spatial configuration laden with meaning and an irreplaceable link between humans and natural resources”, can facilitate this reconnection [13]. The connection between landscape and well-being was also recognized by the European Landscape Convention (ELC), which highlights how the landscape “undertakes important functions of general interest on the cultural, ecological, and social planes. . . [It] constitutes an essential aspect in the context of the life of populations. . . [It] is an essential element of individual and social well-being” [14]. So, “Landscape is not only trees, shrubs and lawn, added for their aesthetic value. Rather, landscape combines landform, ecosystems and open-spaces networks that shape natural environment and sustain not only planting but all life forms, including humans” [6,15]. A sustainable approach to urban planning should reverse the traditional tendency to think city development opposed to nature, and consider urban and natural landscape fully integrated and strictly connected in a unique eco-system [16,17]. Every city has its own landscape; its unique location and the deep understanding of its site-specific characteristics should be the starting point for each urban design strategy. The benefits of pursuing a sustainable balance between nature and city are considerable in different ways: ecologically, socially and economically. In fact, nature and vegetation positively influences the local microclimate extracting CO₂ from the air, reducing dust and urban pollutants, absorbing noise, raising local humidity by evapotranspiration, retaining rain water and, in general, reducing heat-island effects. The variety of types of green areas and environments, and the diversity of species and combination of plants, make the local habitat more attractive for different birds, insects and small animals, improving the biodiversity of the city and therefore also increasing the accessibility to nature and different experiences to people. The increasing quality of the microclimate, the creation of greener spaces and likeable views improve people’s health and quality of life, reducing urban stress and discomfort. Studies in the Netherlands demonstrate that children with good access to green open space, fewer high rise buildings and more outdoor sports facilities, are more physically active. Similarly, studies of eight European cities show that people who live in areas with abundant green open space are three times more likely to be physically active and 40% cent less likely to be overweight or obese [17]. School children who have access to, or even sight of, the natural environment show higher levels of attention than those without these benefits [18]. Moreover, the proximity to parks, trees and quality green spaces makes living in the city more attractive which is reflected in property values.

3.1. Environmental and Sustainability Factors and Implications on the Quality Of Life

Quality of life is a term broadly used both by the general public and amongst policy-makers and practitioners. It is mostly used to evaluate the general well-being of individuals and societies, focused on separate dimensions of collective well-being, such as wealth and employment, quality of the built environment, physical and mental health, education, social disorganization, social belonging, and recreation and leisure [19]. Therefore, quality of life measures are based more on social indicators than just material living standards related mainly to individual or national aggregate levels of income. In a report of the EEA, *Ensuring quality of life in European cities and towns*, quality of life is mainly defined as the availability of having public services, employment, shopping, transport, green open space, culture and sport facilities as well as space to live, apart from income [20].

Undoubtedly, environmental and sustainability factors have great significance for quality of life. Illustrating this point, Brundtland’s definition of sustainability, the definition of sustainable development, begins with human needs: “Sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own needs”, and the World Commission on Environment and Development (WECD) further defines sustainable development as: “A global process development that minimizes the use of environmental resources and reduces the impact on environmental sinks using processes that simultaneously improve economy and the quality of life”. “Sustainability is the continuation of the quality of life for generations to come including the proper distribution of quality of life between groups and with other parts of the world” [21]. So, the very concept of sustainable development emphasizes the maintenance of natural resources and the natural environment as a prerequisite for developing any economic activity to achieve human well-being and quality of life. Economic activities are the means to utilize these resources and to release their potential value to society in order to meet human needs. A healthy environment and the wise use of natural resources are indispensable for sustainable development which provides the basis for long-term quality of life [22].

3.2. The Provision of Ecosystem Services

All ecosystems are open systems powered by other ecosystems in a number of forms, energy, and information. This flow of energy characterizes the work of ecosystems, that is their capacity to provide goods and services (water and air quality, CO₂ absorption, soil protection, raw materials, recreational and cultural services, and so on) named *ecosystem services* (ESs) [23].

According to the EPA ecosystem services are defined as the products of ecological functions or processes that directly or indirectly contribute to quality of life (more directly to human well-being), or have the potential to do so in the future [24]. Moreover, the Millennium Ecosystem Assessment (MA) defines ecosystem services as the benefits people derive from ecosystems. These include provision-

ing services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits [25]. There are several key components of human well-being, that can consistently affect a community's quality of life:

- *the basic material needs for a good life*, which refers to the ability to have a secure and adequate livelihood, including income and assets, enough food and water at all times, shelter, ability to have energy to keep warm and cool, and access to goods;
- *health*, referring to the level of nourishment and freedom from disease, and access to adequate and clean drinking water and clean air. Health can also be linked to cultural services since they affect spiritual, inspirational, aesthetic, and recreational opportunities, and these in turn affect both physical and emotional states of people. Health is the most complex key component of human well-being because it can be affected by a number of varying, sometimes unpredictable, factors;
- *good social relations*, these are expressed as the realization of aesthetic and recreational values, ability to express cultural and spiritual values, development of social capital and avoidance of tension and conflict over a declining resource base;
- *personal security*, this represents the secure access to necessary resources, and the security from natural and human-made disasters. It is affected both by changes in provisioning services (that affect supplies of food and other goods and the likelihood of conflict over declining resources), and by changes in regulating services (that could influence the frequency and magnitude of floods, climate regulation, droughts and disease regulation);
- *freedom of choice and action*, referring to the ability of individuals to control what happens to them and the ability to achieve their desires. It cannot be achieved without the existence of the other components of well-being and thus is influenced by changes in provisioning, regulating, or cultural services from ecosystems.

The concept of human well-being is complex and multidimensional. The linkages between quality of life and ecosystem services are even more complex. Even though some of these links are recognized, many remain poorly understood and controversial. The capacity of human communities to form satisfied societies, stable economies, and to plan for the future relies on environmental stability, availability of natural materials, and the adequate functioning of the cleansing and recycling processes of ecosystems [26].

There is a two-way interaction between ecosystem condition and human activities: the first refers to the services that ecosystems provide to people, and the second refers to the impacts of human activities on ecosystem functioning. Human transformation of ecosystems, and subsequently of services they provide, may add up to or reduce the benefits to society, or directly affect a person's quality of life. The man-made change

to ecosystem may lead to ecosystem services lost, which in long term may deeply affect the quality of life of communities, but also exceed the short term economic gains for society. Therefore an appropriate environmental management of urban area which takes into account the importance of ecosystem service in decision making processes could effectively contribute to the improvement of the quality of life of communities and human well-being (physical, social, economic, etc.).

4. Fighting The Conflict: Planning and Designing New Relationships Between Humans and Nature

As Botkin and Beveridge stated in 1997 "In more than 2000 years of city planning, those who have written about cities have agreed on three points: 1) cities are centres of innovation and creativity in civilisation; 2) the more pleasant a city is the more likely it is that residents will be innovative and creative; 3) vegetation is the key to making cities pleasant" [27].

The desire for a new human/nature relationship, the necessity of an appropriate environmental management for a better functioning ecosystem calls into play the role of open spaces, green networks and rural areas into (and around) urban ones. The search for a new order and a greener city starts from the so-called green networks (infrastructures), in particular from agricultural practices and their relationship with urban areas (urban agriculture) [28–30]. These networks of open green spaces in, and around cities, have the potential to effectively contribute to the regeneration of degraded contexts, stimulating the upgrading of natural ecosystems and the maintenance of ecosystem services to improve the quality of the urban environment, and therefore the quality of life of its inhabitants [31].

For example: in the United States, community green infrastructures and agricultural and rural practices in urban areas, have been greatly developed, not only for the achievement of urban and physical regeneration objectives, but also for social integration and economic development goals. Moreover, together with the most known *community gardens* (which is the activity of gardening a piece of land by a group of people, utilizing either individual or shared plots on private or public land [32–34]) and *retail farms* (which are retail essentially market featuring foods sold directly by farmers to consumers), there are a wide variety of different activities linked to agricultural production and fresh products in and around cities (*feeding the city, guerrilla food, urban beekeeping, urban agroforestry*, etc.). The real, wider framework at the basis of these programs is found in healthy food policies and correct eating habits as a way to tackle serious social illnesses such as high rates of obesity, diabetes, and cardiovascular diseases [6,35–38]. European trends differ in comparison, probably due the generally higher quality of urban areas on the one hand, and a higher quality food production on the other. Protection and conservation of peri-urban areas with agricultural uses and a demand for leisure activities linked to rural experiences have been growing in recent years and represent a stimulus for research and experimentation. For example, in Italy, the role of the Ecological Networks is being

redefined. The most common approach considers Ecological Networks as an essential driver for managing new ecological balance in urban areas under transformation, by assigning essential and irreplaceable roles to rural areas. (Figure 3). In a time of crisis like the present, this could lead to the development of an economic system based on the local scale, and respond to the growing need for sustainability of the urban system [39,40]. Green networks and agriculture can therefore effectively regenerate the complexity of urban and peri-urban areas, becoming the new binder and relational matrix, between what is urban and what is open space. Understanding the meaning of this opportunity means giving way to new economies, policies for social inclusion, projects for landscape regeneration and plans for the rehabilitation of large settlement contexts [6].

4.1. Green Infrastructures as Integration Process and the Real Challenge of Agriculture in and Around Cities

The term “green infrastructure” was first developed by Mark Benedict and Ed McMahon (2002) of The Conservation Fund

(TCF), in the early part of this century and is defined as follows: “Green infrastructure is an interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks, and other conservation lands; working farms, ranches, and forests; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality of life for communities and people” [41].

This definition goes beyond traditional environmental planning concepts to incorporate human livability while maintaining the importance of the natural system. However, its focus on ecological processes misses a more inclusive framework to apply systematic thinking and interconnected strategies to a broader range of elements beyond ecological systems, such as cultural, social, historical, economic, and political resources, among others. Green Infrastructure is about strengthening the functionality of ecosystems for continued delivery of goods and services [42]; as well as combating biodiversity loss by increasing spatial and functional connectivity between existing natural areas and improving landscape functionality [43–45].

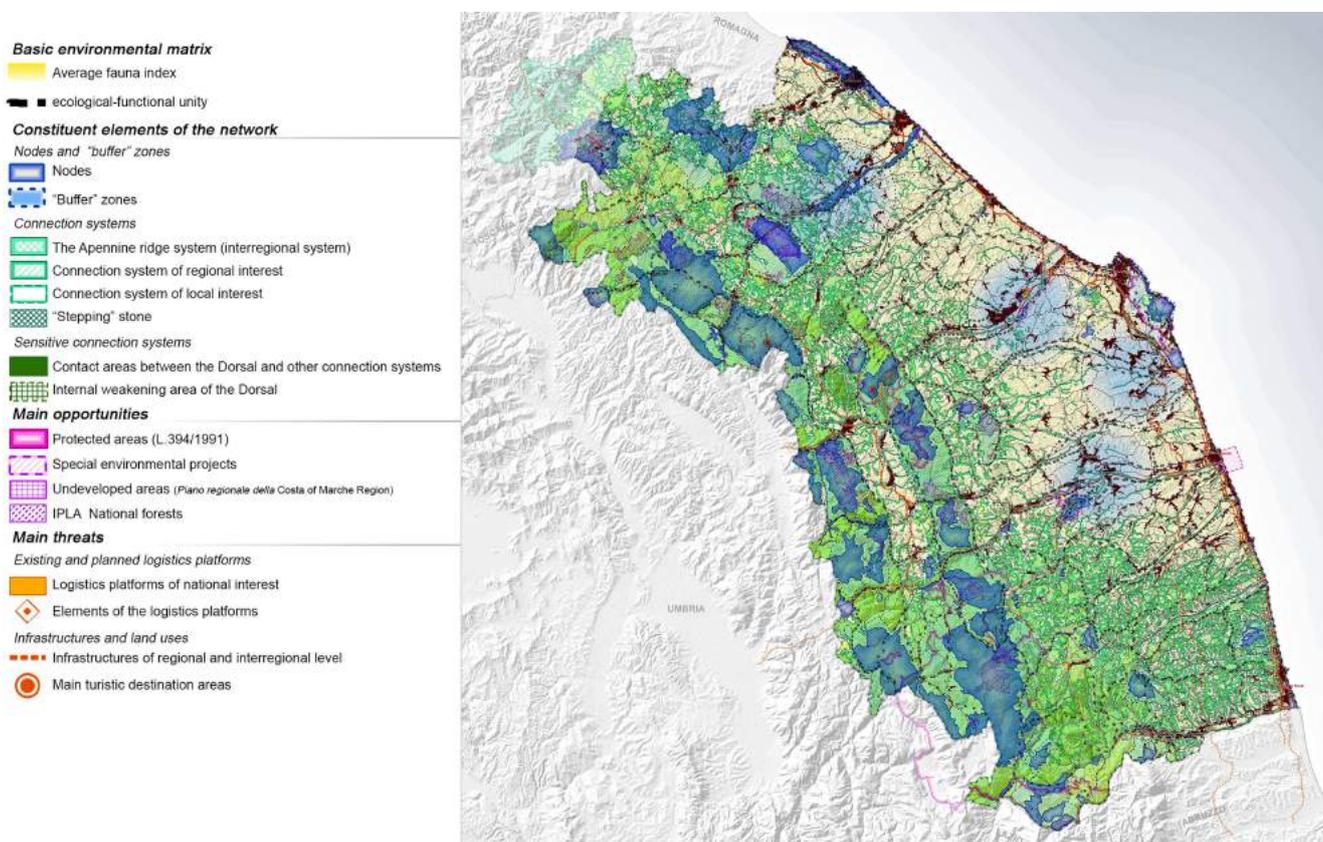


Figure 3. The case study of the ecological network of the Marche Region (REM), Italy. The map shows to Project strategy, that aims to: i) facing and planning the problem of protection and evaluation of the regional environmental heritage as a whole; ii) defining an area of intervention that concerns the entire regional territory (not just nodes and corridors), defining the forms of contact with Marche landscapes; iii) managing the regional environmental system, governing the functions of geographical and typological unity; iv) establishing modes of interaction between the REM and regional planning and programming instruments (Source: Author’s archive from the Research Project “The Ecological Network of the Marche Region”).

The American Conservation Fund stated the following as the eight Principles of Green Infrastructure Planning, Design and Implementation [46,47]: 1) identify and protect green infrastructure before development; 2) engage diverse people and organizations from a range of sectors; 3) linkage is key, connecting green infrastructure components with each other and with people; 4) design green infrastructure systems that function at different scales and across boundaries; 5) green infrastructure activity must be grounded in good science and planning practice; 6) fund green infrastructure up-front as a primary public investment; 7) emphasize that green infrastructure benefits are afforded to all (to nature and people); 8) green infrastructure should be the framework for conservation of natural and cultural resources. Emerges that integration, multi-scale approach and community involvement are the 'key-words' for the success of Green Infrastructure plans and project. It is also clear that Green infrastructure benefits are better achieved if green space creation and management are well integrated with more traditional land development and built infrastructure planning. But does a Green Infrastructure really consist of? With the European Green Infrastructure Strategy, the EU clarified that not all green open spaces are possible component of a Green Infrastructure, but only those of high quality and that form part of an interconnected network [48]. Examples: an urban park inside a city might be considered an integral part of Green Infrastructure if it acts as a cool air corridor, absorbs excess water run-off and offers an attractive outdoor area for recreation and wildlife; a patch of uniform grass that contains no other environmental features is unlikely to qualify as GI. In rural areas, intensively managed farmland would also not normally form part of a GI network unless it were specifically managed in a way that supports local biodiversity or that encourages a more multifunctional land use which combines food production with other benefits, like recreation or water purification [49]. This is the case of rural areas and urban agriculture, which is defined as growing, cultivating, processing, and distributing food in or around a village, town, or city [50,51]. This simple definition however, belies the complexity of the practice. Urban agriculture lies between many issues which are seen as critical to the ongoing sustainability and livability of our urban environments: public health, healthy food access, green space, air and water quality, economic development, and community engagement [52]. Urban agriculture represents a tangible, accessible opportunity for city residents to become involved in issues of food provenance and food security and to reconnect with a food system that many feel is somehow out of their context. Additionally, urban agriculture is consistent with, and is being bolstered by, new approaches to urban design and development, which emphasize diffuse, informal, community-based initiatives, open space, green space and "soft edge" interventions for the overall quality and sustainability of the urban environment [53–55]. At the same time, urban areas represent a relevant experimental opportunity to stimulate innovative practices (such as multifunctional agriculture, urban gardening, and

urban agri-farming) to be exploited in relation to the need to supply public services and products for the city [56]. The role of urban agriculture practices and related activities can actually be articulated on the basis of the spatial context within which they are implemented. Whether they are undertaken within small/medium towns or within large cities, their role and contribution to the social, economic and physical context is different, as is also the perception by the local population. Within large cities and metropolitan areas, urban agriculture practices are used for physical urban regeneration, land conservation, and residents leisure activities (see as examples the cases of large cities, such as Milan, London, or Paris with their plan for Green Infrastructures, Community Gardens, or Feeding the City programmes). The situation is different for small centres. The demand for "rurality" decreases with increasing potential and actual accessibility to rural areas. In such cases, their role is strictly and directly linked to the creation of opportunities for tackling decline and deprivation of the local economy (see as example, The Italian Strategy for Inner Areas, or the Community Economic Development strategy for US rural and small town). The community and neighborhood scale, therefore, plays a fundamental role in creating a sense of identity and community cohesion, which is necessary for the success of initiatives of this nature [57,58].

Taking the UK as an example, urban farming has a long history with urban gardening. The phenomenon of local "allotments" for personal farming dates back to the 1800s on national level. The multi-faceted character of urban agriculture (and the food system in general) has profound effects on many sectors, including public health, urban and land-use planning, energy, water, transport and economic development, social justice, etc. Across the country, in at least 20 cities that have experienced industrial decline, planning policies have been focused on reuse and regeneration projects for food-growing activities. As a consequence, derelict land has been substituted by green infrastructures and city farm projects [59,60].

5. Conclusion: General Strategies and Specific Planning Actions to Implement Green Infrastructures and Urban Agriculture in Local and Regional Governance

In preceding sections we observed that redefining the relationship between agricultural areas and urban spaces can be supported by the guiding role of green infrastructures and ecosystem services.

This guiding role may come into play through:

- assessing the reciprocal contamination between the landscape and ecosystem services, overcoming the physical discontinuities represented by the network and perspectives of making intersections more efficient;
- reassigning a potential role to decommissioned, marginalized, or abandoned spaces in the territories of settlement diffusion, which are offered to contribute

to the experimentation of regenerative strategies and forms of using the city and to offer congruent local communities the opportunity for enhancement;

- reusing residual open spaces and abandoned places as real test banks to initiate intensive processes to reconstruct spaces for urban agriculture and to strengthen ecological networks, which develop new universes of sense for settlement models;
- strengthening existing ecological connections that work to order the areas awaiting new functions and which are supporting axes for the operations to transform and manage the territory;
- identifying players and tools to regenerate territorial capital in a view of expanding opportunities to regenerate human and social capital, developing territorial regeneration plans if necessary;
- rationalizing the chains that ensure the coordination of territorial intervention policies, with the aim of identifying innovative territorial planning tools capable of guaranteeing the congruence of the objectives on different scales;
- developing innovative means of involving local communities in constructing participatory (open-source) processes and in the demand for temporariness and reversibility of the city uses.

In order to intervene in the urban and regional governance processes with a deep commitment to success in the above points, it is necessary to integrate the large and small scales, triggering micro-changes to activate extensive processes to renew cities and territories. The use of an incremental approach able to face and manage the relationship between green infrastructures, urban agriculture and

urban and territorial reorganization through “low-intensity” actions is also needed. This should imply low risk probabilities and not the simultaneity of large investments, allowing cross-pollination of more general, performing strategies.

This means initiating bottom-up planning in which citizens can actively contribute to pursuing ambitious objectives, such as studying effective responses to urban shrinkage and climate change, the abandonment of extended territories, and reworking collective uses of urban empty and interstitial spaces [6,61,62].

The close relationship between the general strategy and actions brings into play:

- relationships among the different planning scales. In this sense, it is necessary to overcome the traditional dichotomy between general planning and sectoral disciplines;
- relationships among directional and participatory choices. By progressively substituting the rituals of participation—with the proposals of empowerment and open-source urban planning—it is possible to give shape and substance to the constitutional principles of solidarity and subsidiarity.

The very final result of this process is not a directional plan, but the recomposition of multiple specific urban interventions to be developed incrementally, in a continuous process of integration and contamination. In this way, it is necessary to reactivate processes of identification and consolidate the formation of either more traditional relational goods, such as the landscape or community belonging, or new ones, such as saving non-reproducible goods or the exchange economy.

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Research Article

Reflexions on Urban Gardening in Germany

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Abstract: This article reflects on traditional and contemporary gardening movements in Germany. The focus is on forms of gardening, that take place in spaces subject to land lease agreements and similar forms of tenancy or of illegal land take or squatting. The author examines various definitions taking into account the variety of practices, the development of urban gardening over time, and the respective backgrounds or values that users relate to such gardening activities. The examination of definitions led to the drawing up of a timeline of traditional and contemporary gardening movements in Germany and to the tentative approaching of this issue from a semantic perspective. The latter is due to the usage of many different terms mostly as yet undefined in a legal sense. Translation into English or, most likely, to any other language, further blurs the common understanding of the terms used. The author concludes with some considerations on these gardening movements in relation to urban sustainable developments. A presentation at the *5th Rencontres Internationales de Reims on Sustainability Studies*, dedicated to *Urban Agriculture – Fostering the Urban-Rural Continuum*, which took place in October 2015 in Reims/France was the starting point of this article. The basis of this article is a literature review, nourished to a certain extent by observations randomly made over many years and complemented through talks with competent young colleagues. Special thanks go to Martin Sondermann, Leibniz University Hannover, who shared his research experience in various discussions with the author, as well as to Friederike Stelter, internship student at the author's place of work, who gave highly appreciated support to the preparation of the presentation.

Keywords: allotment gardens; urban gardening; contemporary gardening movements; urban agriculture

1. Introduction

If one starts to think about urban gardening, a whole range of terms appears to characterize gardening activities that take place in inner-urban spaces or at the fringe of settlement areas. As with most human activities, these are also an expression of individuals' needs and behaviours. The needs may be basic ones or desired luxury. They will have repercussions on our ways of living. The behaviours are in accordance with where the individuals concerned were raised (social stratum, nation, individual

socialization), their values, and their language. Overall, these factors lead to different understandings of gardening and of how and where it takes place. Whatever gardening activities exist in the spaces mentioned above, they have a direct impact on urban spatial patterns.

The manifold uses of private gardens directly attached to private houses also represent a form of urban gardening in the mere sense that the activities happen in urban areas, without, however, claiming any societal or public function in general. Nevertheless, they contribute to the green infrastructure and natural patterns of ur-

ban areas. In contrast, gardening activities in Germany based on land-lease agreements and other similar forms of tenancy are very often related to societal visions and the wish and willingness of parts of society to care for a better world. The very titles of relevant websites give some indication of this tendency: Urban Gardening—Mit Gärten die Welt verändern (Urban Gardening—Change the World with Gardens; author’s translation) [1]. In the focus of the current reflexions are new forms of gardens, as well as traditional gardens known as allotment gardens (*Kleingärten* or *Schrebergärten*) in Germany.

2. About Definitions

The broad variety of terms used in (peer reviewed) articles by professionals (landscape architects, planners, geographers, sociologists, etc.), popular scientific books and guidelines, websites of specific social groups, associations of allotment gardens or newspaper articles shows that there is still a great deal of ambiguity concerning the categorization of these different forms of gardening. Due to varying points of interest—who is writing why about what—a clear differentiation is not possible. However, this would be relevant, or at least helpful, for a common discussion—especially a cross-border discussion—and, from a planner’s point of view, for approaching the management of urban development processes with regard to citizens’ gardening activities that are presumably bound to foster the sustainability of the city. For researchers, clarification could lead to a better understanding of ongoing activities, their contribution to a number of social issues of urban development and their possible transferability in the sense of making use of ‘lessons learned’. This article does not go as far as to resolve the ambiguity of terms but reflects on some approaches to narrow the subject matter.

While some authors concentrate on the scale of the spaces in question, others look at their social or sustainable value for the urban fabric. Thus, the focus for some is on nourishing the world, and others try to introduce structure into an unstructured discussion. A good example in this regard are the deliberations of Berges et al. [2] who developed a typology of urban agriculture based on the levels of retail of the products, the interests of actors involved in the production, and the type of actors. The retail levels considered are micro, meso, and macro—connected on one hand to subsistence, socio-cultural and commercial interests, and on the other hand to individuals/private households, associations and start-ups, and enterprises. This three-dimensional categorization leads to ideal types, subtypes, and mixed types of urban agriculture (See Figure 1).

Berges et al. use the term *urbane Landwirtschaft* in their German publication, which translates as urban agriculture and/or farming. They thus describe a way of using inner-urban land to produce fruits, veg-

etables, herbs, and animal products (eggs, milk, and meat). This blurs the semantic border between terms (urban agriculture <> urban gardening). The term urban agriculture or urban farming seems acceptable for what they call the ideal type of macro-level related, commercial interests-driven enterprises. The term agriculture connotes—at least in the author’s perception of the German language—the more or less industrialized, professional (on the basis of specific knowledge & professional education) production of nutrition of different kinds with the objective of earning one’s living and supporting a family and/or further collaborators, and to respond to the market’s or consumers’ needs. This entails the use of contiguous spaces of certain dimensions that are not available in urban, densely settled areas, and also integration into a worldwide market, or at least dependency on this market and its influencing powers—mainly with regard to the prices of products and production conditions.

On the other hand, for the other ideal types depicted by Berges et al. (the subsistence type: micro level, individual or private household driven; the socio-cultural type: meso level, associations or start-ups driven) the term urban gardening seems appropriate. These forms of activities experience, at least to a certain extent, the same influences as urban agriculture or farming, increasingly so as they grow and become commercial, in a first instance most likely via barter trade or direct marketing. The semantic connotation perceived by the author stems also from the traditional differentiation between two professional and scientific disciplines in Germany: *Gartenbau* and the abovementioned *Landwirtschaft*. Here, *Gartenbau* (translated as horticulture or gardening) is more likely to permeate the urban fabric than agriculture (*Landwirtschaft*) due to the smaller areas needed. The author would go even further in claiming that the terms (agriculture > horticulture > gardening) reflect a decreasing demand in terms of the dimensions of spaces required.

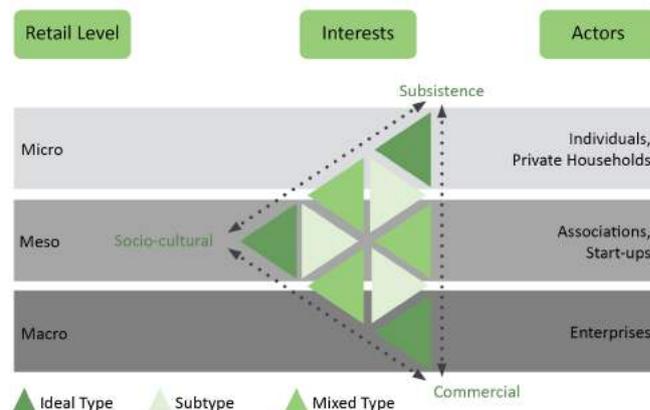


Figure 1. Typology of Urban Agriculture ([2], p. 12; Slightly changed and translated into English.

Karge [3] explains how understandings of the respective terms, at least in the German language, can be traced back semantically and to what extent these semantic developments provoked the dichotomy of ‘the’ Urban and ‘the’ Rural. Pointing out that the terms *Landwirtschaft* and *Agrarwirtschaft* describe the same activities, Karge [3] sees the former as defining, in contrast to the latter, the place where the activity is executed: in a rural area (*auf dem Lande*). Karge [3] goes on to explain the background of the antagonism between urban and rural, inducing the emergence of a different appreciation of urban or rural living and of urban or rural inhabitants. He finally reveals, quoting Sassen/Dotan and their concept of In-Between-Space [4], that urban gardens—and Karge does not use the term agriculture in this argument (!)—could be a good starting point to resolve exactly that dichotomy. Urgently needed solutions for the global challenges of the production of healthy nutrition on the one hand, and the reduction of the still increasing waste of natural resources, on the other hand, could be incubated in the complexity of the urban fabric with its highly innovative potential [5]. This could lead to the planting of another world—a very ambitious and challenging objective!

Rosol's PhD [6] concentrates on community gardens and describes them as a new type of open space. The main characteristic of community gardens is the still unusual manner of production and operation methods: shared and voluntary maintenance, open to the public. She differentiates between three types of community gardens: neighbourhood gardens, thematic gardens, and thematic neighbourhood gardens. The latter combine both characteristics: addressing the immediate proximity and concentrating on a certain thematic focus or a target group. With respect to the emergence and management of such gardens, Rosol [6] detected a broad variety of self-organization, support, and constitutive motivations. She explains their emergence with massive economic changes (Post-Fordism) leading to decreasing budgets in open and green spaces' administrations and, as a consequence, to a qualitative decrease in green spaces. These changes go along with new forms of local governance and, at the same time, with a higher appreciation of civil engagement [6]. Not surprisingly, Rosol [6] detects various positive as well as negative impacts of such gardens on both active individuals and the public. From her viewpoint, the community gardens deliver a functional and qualitative amendment to other arrangements of green areas (public green spaces, private gardens, etc.) without substituting them. Astonishingly, from a perspective of open space planning, she judges them to represent a positive alternative to both private and allotment gardens.

Nonetheless, later in her conclusions she calls for an increased support for these gardens through the expert backing of the public sector, paid jobs and better contracts implying time scales for their existence. At the same time, Rosol makes clear that community gardens do not provide financial relief for communities and they should not expect it either. One has to question whether, in times of budgetary difficulties in most communities, more support for community gardens would mean less support for their traditional sister: the allotment

garden. Sondermann/Steffenhagen [7] describe urban gardens as an extension of traditional allotment gardens, stating that they cannot be traced back to this traditional form but are rather linked to the community garden movement in New York City that started in the nineteen seventies. Nevertheless, both have the same social orientation, aiming to provide leisure and nutrition. Furthermore, in their contribution to the recently published book on “Urban Allotment Gardens in Europe”, Ioannou, Morán, Sondermann et al. [8] prove: “Many of these (forms of gardening) such as collective, community guerilla, intercultural or neighborhood gardens are quite similar in their affiliation to local and global movements or intellectual traditions like sustainability, green cities, solidarity and social cohesion or more natural ways of inhabiting urban space”.

It is not yet clear what kind of various connotations go along with this variety of terms. We can read not only about urban gardens but also about allotments, community gardens, neighbourhood gardens, balcony or roof gardens, and gardening activities such as guerrilla, social, intercultural, thematic, etc. Most definitions, both those addressing places—gardens—and those describing activities—gardening—do not have a legal definition in Germany, except allotment gardens. Hence, for now, the author subordinates all these manifestations of gardens and gardening activities under the more general term of urban gardens/gardening. In doing so, the author intentionally does not follow the proposals of Lohrberg and Timpe [9] to see urban agriculture as a generic term that would be superordinate to urban gardening. Nor does the author here open the debate on how the same activities should be denominated when they happen to emerge in rural areas. Instead, the author proposes to look at those more traditional forms of gardening: the allotment gardens.

3. German Allotment Gardens

Very often, a gnome acts as the brand mark of these kinds of gardening activities in Germany. German allotment gardens seem to have a special reputation in the world: in the television documentary *Deutschland Saga* created by Cambridge historian Christopher Clark and broadcast in autumn 2015, he discussed typical German characteristics. One of them was the German allotment garden. He describes it as the small, fenced freedom of the Germans where everything is in good order—even the gardens.

As Appel et al. [10] quote, as early as 1909 a French journalist, Jules Huret, described this phenomenon. “After a never ending ride through flat, monotonous, stodgy, and unfertile swathes of land, through woods of fir trees, fields of mangel-wurzel and potatoes, approaching from north, south, west or east to Berlin your eyes are hit by a peculiar view which I have not had in any other place than Germany. Imagine huge surfaces of land split up into rectangles of 20 m in length and 10–15 m in width. Simple wooden fences or wires separate one lot from the next. Each user constructed rough shacks on these pieces of land. The Berlin people call them bowers (*Lauben*)”. When and why did they appear?

Industrialization and urbanization went hand-in-hand with higher pressures on real estate markets and, thus, with them came the disappearance or reduction of gardens and fields within the vicinity of settlement areas. The wealthier share of the population could always afford to secure their private green spaces, even on top of a better provision of public green spaces in the areas where they lived. At the beginning of the nineteenth century, however, one initiative took first steps in Germany to provide poorer social strata with land for subsistence production. As Karge [4] details, the cities Kappeln a.d. Schlei, Kiel, Berlin, and Leipzig were the forerunners of this development.

With continuing processes of urbanization, these possibilities for subsistence production near cities underwent expulsion by middle-class strata. At approximately the same time, new social objectives emerged. The poor continued to be the focus but special concern began to emerge for the children's well-being. Today, Germans use the family name of the physician Daniel Gottlob Moritz Schreber (1808–1861) as a synonym for the allotment gardens that came into being with these social activities. In the mid-nineteenth century, gardens furnished with bowers represented a very similar form of garden also intended for subsistence production and leisure purposes. Bundles of these lots were called bower colonies (*Laubenkolonien*), as continues to be the case today. The tenants obtained the nickname *Laubenzieper*. Most likely, this derived from ornithological nomenclature: the pipit that flourished in the bower. Thus one term relates to a person who initiated a movement, the second relates to a certain element of the facilities, and a third one—*Kleingarten* (literally translated: small garden)—relates to the size of such gardens. The latter is that used in the corresponding law: *Bundeskleingartengesetz* (BKleingG; see below). Colloquially, people use these terms synonymously.

The establishment of workers' gardens around 1900 was fostered by the beginnings of the naturopathy movement and coincided with poor living conditions in more and more of the growing agglomerations and the need for quality food. It was in 1921 when a unified association of allotment gardens in the German Reich was established throughout the country. A legislative basis was developed even earlier, in 1919 (*Kleingarten-, Kleinpachtlandordnung* = small land tenancy order or allotment garden legislation, translation by author). After both World War I and World War II, these garden areas were of enormous value with regard to providing accommodation for refugees and bombed-out people as well as providing food. This led to them becoming an integral part of the urban organization of land holdings and regulations in this respect. In the years or decades following World War II these plots lost

some of their significance or were changed to serve other objectives: from nutrition production to more of a leisure orientation. However, we have to be aware that the allotment garden legislation [11] strictly defines the character of the land, stipulating a tenancy organization, the maximum size of garden and bower, strictly non-commercial use with non-permanent housing, and a compound arrangement of garden units administered by associations. Each of these associations establishes their own regulations. Most of them have clear rules with regard to the share of productive and non-productive square metres. Some have already adapted to the demographic changes of today and to an increase in tenants of foreign origin. For instance, on the website of the county of the Hanover Allotment Gardener's Association the regulations are available in three languages: German, Russian, and Turkish [12] (See detailed historical overview: [10]).

Figure 2 shows essential periods of development over time. The changes started slowly but steadily after World War II, and since the 1980s the allotment gardens have increasingly served leisure purposes. Furthermore, while on one hand the legal basis of allotment gardens guaranteed their long-term existence, on the other hand, the legislation led inevitably to a certain amount of bureaucracy and, not least of all, to a decrease of the attractiveness of these gardens for younger generations. Their disrepute increased as they became associated with middle-class narrow-mindedness. This ushered in a phase of the abandonment of allotment gardens, of course influenced by various other developments like changing lifestyles and demographic changes that led to abandonment because of issues related to aging. According to Appel et al. [10], the average age of the gardeners has increased over recent decades up to about sixty years which together with the bureaucratic aspects, might explain why younger people look for 'younger' forms of gardening activities. Nowadays, young families are again knocking at the doors of the allotment garden associations. They appreciate the gardens as part of their personal work-life balance. Appel et al. [10] describe in detail the presumed consequences of demographic change for consumer demand in relation to allotment garden infrastructure in different cities in Germany and their respective status quo.

For a long time already, the allotment gardens have been stable elements in the urban fabric – not only in Berlin. Although new forms of gardening are making their way in changing societies, Gröning [13] who has been working on allotment gardens since the early seventies of the last century, seemed convinced (at least in 2005), that they will continue to exist in the future despite changing needs and demands.

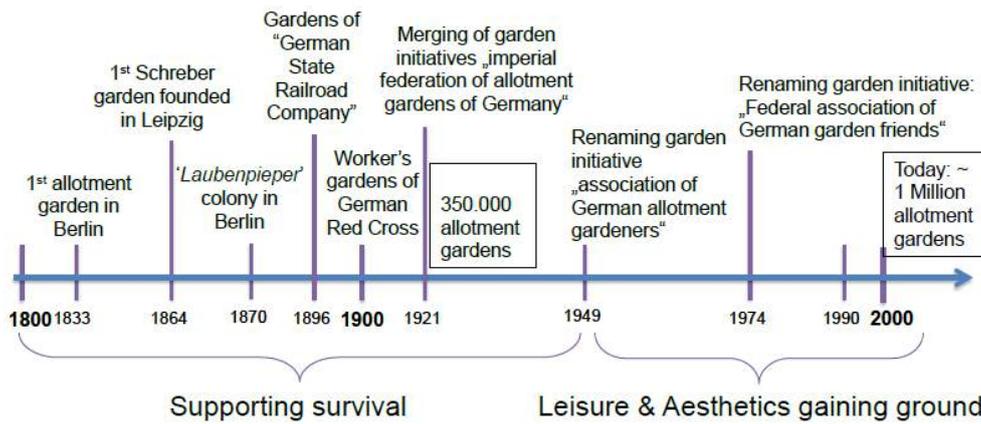


Figure 2. A timeline of allotment gardens.

4. Urban Gardens—Contemporary New Types

Always and everywhere new generations have wanted to satisfy their needs and express themselves with new activities in new spaces. Gardening and the shape of gardens are always reflections of the society of a given era. Thus, the emergence of contemporary new types of activities and gardens reflects social and economic developments or changes.

What are the differences between new forms of garden activities and allotment gardens? The allotment garden legislation ensures a very elementary difference: the denomination and consideration of such spaces in town planning instruments. Preparatory land-use plans and, particularly, binding land-use plans (see overview on the German planning system on the website of the COMMIN-project [14]) assure the existence of most of the allotment

garden areas in a fashion that does not yet exist for the majority of new forms of gardening. For the time being, the latter are in most cases simply based on temporary safeguarding. More or less, they are temporary or interim uses that may have very positive impacts on the urban area, but the people engaged in such projects face enormous uncertainty and in the end receive very little appreciation for their activities [10]. There is no evidence on whether the users of allotment gardens expect to receive appreciation in the same way, or, indeed, whether they already receive more or less appreciation for their activities.

The differences between allotment gardens and contemporary forms of urban gardening become very clear when comparing the pictures of a typical *Kleingarten* and a typical contemporary new type of urban gardening project (Figure 3).



(a)



(b)

Figure 3. (a) Typical *Kleingarten* in the Federal State of Hessen (photography by Evelyn Gustedt). (b) Typical contemporary urban garden in the Federal State of Bavaria (photography by Anne Ritzinger).

Looking more closely into the various types of urban gardens, we observe that both the notion of subsistence and the satisfaction of leisure exigencies are the main motivations to take part in gardening activities. Although these factors play a role, the improvement of the aesthetic and natural shape of urban areas, the enrichment of quality of life, and the shaping of new communities form a complex of motivational aspects. This goes along with awareness-raising objectives, societal learning, and the co-creation of knowledge. Some initiatives offer workshops and cultural programmes apart from gardening activities (see [1]). Certainly, one can assume that the development of civilization in general, involving fundamental economic, social, and ecological changes in ways of life in recent decades induces mental attitudes different to those held by former generations. The author hypothesizes that modern means of communication applied worldwide foster the exchange of such attitudes enormously and spread related ideas quickly. Figure 4 shows how fast this movement has developed in Germany. This growth is impressive, but the quantitative relation of urban gardens to allotment gardens is just 1:~ 2,218.

Various colleagues and institutions have investigated these new forms of gardening activities over approximately the last ten years. As Figure 4 shows, a certain boost in the establishment and registration of such areas took place during the last five years. If we look at the research results of Appel et al. [10], anstiftung.de [15], and spatial.ext.zalf.de [16] as displayed on their respective websites with their ongoing changes (see references), it becomes clear that the hot spots of this movement are first and foremost in Berlin, Munich, the Rhine-Ruhr-Area, the Frankfurt agglomeration, and Hamburg. The ZALF website records the registration of 79 urban garden initiatives in Berlin in February 2016. In late September 2015, the same map contained only 68 such initiatives in Berlin. The hot spots are all characterized by internationality, a high degree of urbanization, locations of higher education to an important extent, and, most likely, a high potential for innovative capacities—"the young urban avant-garde reacts to global challenges" as Christa Müller expresses on the occasion of an interview. This was published on the website of Stiftungsgemeinschaft anstiftung & ertomis of which Christa Müller herself is managing director. She answers questions regarding definitions, coming into existence,

trends and political aspects of urban gardening [17].

These contemporary forms of gardening break new ground, probably comparable to the development of squatting activities in the early nineteen eighties. Active people working on related initiatives see themselves as part of an innovative civil society of a city or city region. They wish to foster community work and to perform something meaningful and ecologically worthwhile. As Karge [4] states, urban gardening is regarded as being something Utopian, working for global equity, living in compliance with nature, safeguarding cultural techniques, and belonging to a greater global movement. A higher proportion of younger people does not wish to be separated from each other with fences, hedges and walls, although each may have a box or a container of his/her own to grow vegetables or flowers. They appropriate spaces that, very often, either private owners or the local authorities neglected.

In the majority of German cities, the departments of urban planning or urban green spaces or similar nomenclatures are responsible for the public spaces although, in most cases, a multitude of actors is necessary to realize new garden projects as Sondermann [18] demonstrates. The authorities responsible do not always appreciate voluntary initiatives to improve or up-keep neglected or derelict spaces. Sometimes the authorities would appear to face limitations caused by a lack of adopted regulation and a legislative situation that urges them to prosecute regulatory offences even where this makes no sense or even turns out to be unnecessarily negative. A young landscape architect in a northern German middle-sized city encountered the power of the authorities when she used her own financial means to give a new shape a new design, to neglected containers of washed-out concrete that dated back to the nineteen eighties. The municipality itself had originally provided the containers to refurbish a pedestrian walkway with flowers and small shrubs. With past cuts in the public budget, the municipality had long before stopped maintaining the containers but had not removed them. People had used the containers for some time as rubbish bins or dog litter boxes. The young landscape architect received a fine for unlawful appropriation. Should we therefore not think about carefully removing the dust from regulations wherever this has not yet happened?

Testing new lifestyles and societal models

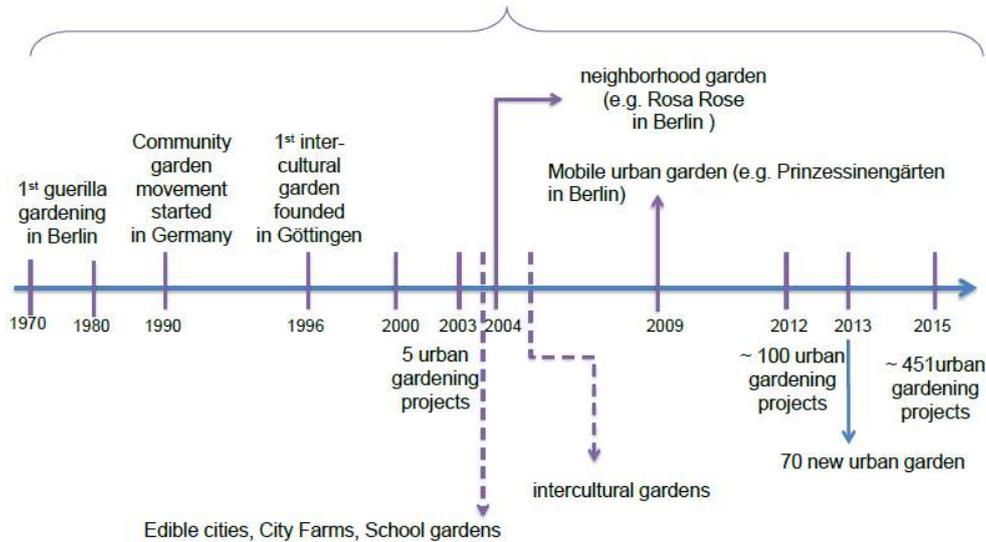


Figure 4. Testing new lifestyles and societal models—A timeline of urban gardens' development.

5. Summarized Sustainability Aspects

With every seedbed maintained or newly installed, a piece of nature stays or returns to town. The gardens are experimental laboratories for society. At the same time, they make people experience nature and the production of healthy food. Although the author does not join in arguments that suggest this production will ever represent a substantial share in the world's food production, the gardens nevertheless have their place with respect to social and ecological aspects of sustainability.

With regard to ecological values, one can certainly not deny that both types of gardens are to some extent stepping stones in the biodiversity patterns of a settlement area. Whether they have a high value in this respect or whether they are less important is a question that one can only answer for each specific space in relation to the surrounding situation and the city's biodiversity facilities as a whole. The same applies to the question of whether the gardens contribute to better micro-climatic conditions. Whether the food produced in allotment or contemporary urban gardens is healthier than purchased food depends on at least three variables. Where do people normally buy their food and how much are they willing to spend on it? How do they carry out the work of production in the sense of: Do they use chemical fertilizers and pesticides? One can assume that—given the general values behind the activities—the actors in contemporary urban gardens do not use these aids, although this is not to claim that those in allotment gardens do so intensively. Other questions are whether the gardens were established on derelict and therefore sometimes contaminated land or whether motorways or similar polluting elements in their direct neighbourhood exert heavy impacts on these areas.

Economically considered, the aspect of subsistence

plays a certain role. However, some evidence exists (see [10]) that the individual gardeners do not really earn any significant money out of their gardening activities. The contrary seems to be more likely. Many contemporary urban gardens quite often seek subsidies from official bodies. We can presume that the municipalities, on their part, do not really gain in terms of hard revenue. However, one can argue that someone other than paid municipal staff takes care of derelict land and undertakes the necessary work to embellish such spaces or upgrade natural values. The municipalities may gain, at least, with regard to non-material goods. Such achievements might improve the reputation of a city. The engagement of citizens and their voluntary work in publicly accessible spaces goes hand-in-hand with certain municipal efforts that lead to an upgrading of the affected areas. The author argues that these effects will increase as more co-operation exists between both spheres.

The idealistic values behind the urban garden movement entail elements of post-Fordistic thinking, of critical growth theories, or new prosperity models. We can thus expect that the activities will have repercussions on society, first presumably on the avant-garde itself and on the direct social neighbourhood, namely encouraging a greater sense of identification with the local area, more social control, and the stabilization of the affected parts of society. If the processes continue successfully, the development may result in gentrification effects. This would require community intervention in other parts of the city (See [10]).

In any case, both types of gardens, allotment as well as contemporary urban gardens are an expression of social development. They both play their role and have their own value. It seems clear that they will continue to develop further and to have an impact on urban structures. It makes sense to safeguard these spaces for the sake of a liveable city.

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