1 Urban agriculture: a framework for agricultural policy – present and future[2]

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Abstract

As a result of rapid urbanisation and the formulation of the "Smart Cities" concept, and of trends in sustainability and renewability, growing cities have begun to introduce basic measures for the return food production closer to them. There has always been a very particular connection between food growing and technology. Traditional thinking maintains that technology and urban life stand in opposition to the peaceful and quiet life on the farm.
Food is produced and distributed globally nowadays. This makes the chain of distribution significantly more complex, and great stress is laid on food safety. Contemporary consumers are more and more interested in the origin and production technology of the food they eat. The provision of organic food, locally produced food, food "picked that day" are only some of the trends that have been on the increase. Vertical food growing requiring the intensive use of energy is still in its infancy. There are, however, many initiatives which are leading to rapid advances. Vertical farming in open or enclosed spaces has, therefore, the potential to respond to the demographic challenges faced by Smart Cities. Rapid urbanization will make urban agriculture more significant. Peri-urban, or suburban agriculture, is a part of urban culture. It can greatly contribute to the food supply of the entire city. This raises the question of the designation of the peri-urban zone and of its capacity to feed big cities.
This paper is an attempt at describing the elements of a new agrarian politics that could help tackle the problems of resource allocation and, at the same time, provide citizens with a better quality of life.

Keywords: food, smart cities, sustainability, agriculture
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1.1. Introduction

Urban agriculture can be defined as an agricultural activity – in other words, as the cultivation of plants and the rearing of animals in and around cities. And yet, this simple definition needs to be further analysed and clarified. Cultivation has to be further defined as: the cultivation of plants and the rearing of animals for human nutrition, or for use as industrial raw material. The bureaucracies which underpin our contemporary cities banished animal rearing in general from the cities in the twentieth century. In almost all countries, there are laws that strictly prescribe that farming activities be located outside the city boundaries and away from urban settings. The location of plant cultivation away from urban settings was somewhat less rigorously prescribed; the location was determined more by economic reasons and by the quality of available soil.

Several factors contribute to accelerated urbanisation, rapid growth of cities, and the formulation of the concept of smart cities. The two most important are a decrease in food transportation costs and the self-sustainability of the food industry.

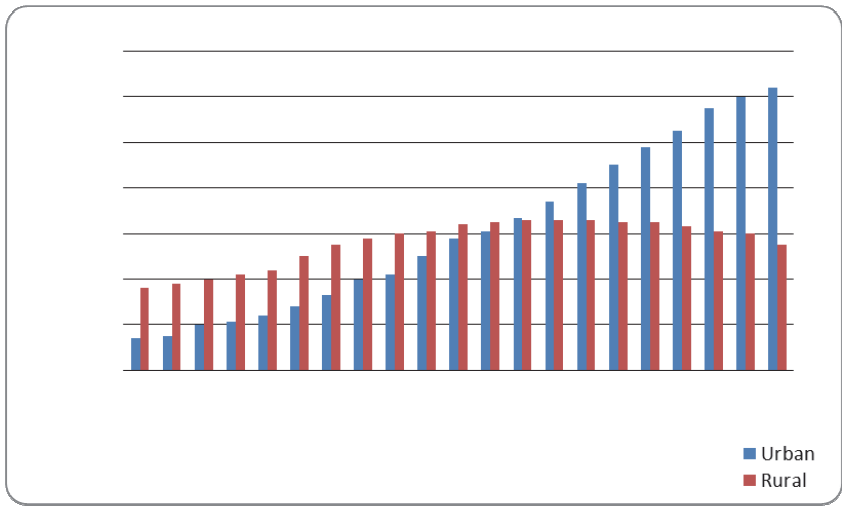
Urban agriculture requires the use of new technologies and ways of producing food; and even a different social attitude to food. "Urban Agriculture may not be the most glamorous sub-sector in the Smart Cities sector but while in today's heavily populated cities some of the 3.3 billion people living in cities are using the Internet, smartphones, and computer tablets; all of them must eat, after all. There are challenges to establishing the viability of urban production as compared to more conventional agricultural practices, including scalability, energy efficiency, and labor costs" (Maroto, 2014) (Table 1).

Table 1. Projection of the urban: rural population ratio in the years leading up to 2050

	2007	2008	2018	2019	2050
Population	Urban: 3.3 (billion)	Urban: 50% (for the first time in human history)	Rural population reaches its maximum	Rapid increase in urban population. (A decrease in rural population to 2.8 billion)	Rapid increase in urban population. (A decrease in rural population to 2.8 billion)

Source: "Forrester Research Inc."

Figure 1. Projection of the world population divided into urban and rural population and expressed in thousands



Source: United Nations Secretariat for Economic and Social Affairs - Population Department, "World Population Prospects", 2006 Revision; and "World Urbanization Prospects", 2007 Revision

Feeding today's population is an extremely demanding task; feeding 9 or 10 billion people, which is the projected human population in 2050, could turn out to be an impossible task (Fig. 1).

1.2. Advantages of urban agriculture

As has already been mentioned, the development of agricultural capacity in and close to urban areas has the potential to decrease food transportation costs and related environmental impacts. This also makes economic development possible; it enables the supply of healthy food where food shortages would cause human nutrition to be inadequate, leading to increasing health problems. These problems are, primarily, obesity, diabetes, and cardiovascular diseases. These diseases mostly affect city populations from poor social backgrounds who, due to low income, cannot afford healthy food.

Contemporary Food Supply Chain

The demands that are placed upon the contemporary food supply chain include the satisfaction of the social and health needs of the individual. The food in the contemporary food supply chain has to be produced in a sustainable way; it has to be healthy and safe for consumption. Twenty-first century production, including contemporary food production requires: greater yield; better

distribution; and minimisation of waste. Sustainable food production with or without organic production in or close to urban areas could provide solutions to all of these requirements. As we have previously stated, the lack of quality food affects mostly people from poor social backgrounds. The provision of sufficient healthy food in the food chain could significantly reduce the risk to these people of diseases caused by poor nutrition. These diseases have a considerable negative effect on the quality of life, shorten life span, and placing a burden on health budgets.

According to Smil, it is important to understand that many problems can be solved by innovative technology, but, in order to help build sustainable society, it is also necessary to develop individual responsibility (Smil, 2016). One of the most prominent of these problems is: how to produce food in a sustainable way. Sustainability is seen as an imperative. Therefore, the number of indicators of sustainability to be included in the food production system will continue to increase so as to better document this sustainability. These indicators will be observed to ensure the compliance of the production system with parameters relating to climate change, ethical aspects of production, and resource efficiency. In order to meet new requirements, and due to developments in the application of modern technology, food production methods undergo changes. Certain examples of these changes can be found on the Internet and in the bibliography, and will be referred to briefly further in the text.

1.3. "Smart Cities"

In order to grasp more fully the scope of the challenge, it is necessary to refer specifically to particular numerical indicators:

- There were only three mega-cities until 1975: New York, Tokyo and Mexico City; while today (2017) there are 21 mega-cities.
- 60% of the World's GDP is made by the 600 biggest cities in the world.
- There will be a total of 29 mega-cities by 2025.
- In 2011, there were over 500 cities with over 1 million inhabitants.
- China alone will have 221 cities with over 1 million inhabitants by 2025.
- 60% of all energy consumed annually in the World is consumed by cities.
- Lighting alone consumes 19% of electricity produced in the whole World.

The definition of "Smart Cities" varies significantly from continent to continent. Also, there are several similar terms that are more or less synonymous, for example: "Intelligent Cities", or "Digital Cities". "Specifically, the term Digital City (a.k.a., digital community, information city and e-city) refers to: a connected community that combines broadband communications

infrastructure; a flexible, service-oriented computing infrastructure based on open industry standards; and, innovative services to meet the needs of governments and their employees, citizens and businesses." (Yovanof and Hazapis, 2009). Other terms used instead of "intelligent" that found in bibliographical sources are "Interconnected" and/or "Instrumented" Cities.

"The foundational concepts are instrumented, interconnected, and intelligent. Instrumented refers to sources of near-real-time real-world data from both physical and virtual sensors. Interconnected means the integration of those data into an enterprise computing platform and the communication of such information among the various city services. Intelligent refers to the inclusion of complex analytics, modeling, optimization, and visualization in the operational business processes to make better operational decisions" (Harrison et. al 2010). The evolution of the descriptive names of various strategies and initiatives which provide an insight into the process of development of a city through these names is traced in certain scientific papers These names are: "Virtual City, Knowledge Bases, Broadband City / Broadband Metropolis, Wireless / Mobile / Virtual City, Smart City, Digital City, Ubiquitous City, Eco-city" (Anthopoulos, 2013). All these terms overlap to a degree. The term "smart city" is obviously the most comprehensive.

"Smart cities are not, by practically any stretch of the imagination, new. While proponents of the smart city, and its more academic cousin 'urban science' (cf. Lehrer, 2010), believe their interventions to be guided by the rational, rigorous and more 'scientific' methods of quantitative and computational data analysis, very little is novel about this approach. Indeed, planners and engineers have sought to make the study and management of cities more scientific for over a century" (Shelton et. al, 2015). "As Rob Kitchin lays out in his article in this issue, however, the origins of the smart city are not found solely in the search for technological utopias (Kitchin, 2015). They also originate in the 1980s prescriptions for managed, entrepreneurial cities – whose speed and flexibility in adapting to global markets make them more efficient and competitive (Logan and Molotch, 1987)". (Glasmeier and Christopherson, 2015).

"However, experiences from earlier Smart City initiatives have revealed several technical, management and governance challenges arising from the inherent nature of a Smart City as a complex Socio-technical System of Systems" (Ojo et. al, 2014). Smart Cities try to resolve the problems of resource allocation and provide a better quality of life for their citizens at the same time.

The better resource allocation in cities is primarily the better management of energy and drinkable water. This is the first problem that arises in growing urban areas. The problem with energy and drinkable water is double –

the increase in consumption due to population growth is accompanied by bad management. Better resource allocation and increased mobility; a more stable energy supply; better management of waste and infrastructure; a better social component; innovation; and quality education bring comparative advantages. These comparative advantages should justify the financing costs of strategy implementation, as well as smart city project costs. Not only do they bring comparative business advantages, but they also provide individuals with a higher level of participation in the city management, mobility, interconnectedness, communications, and access to health care. These factors attract a certain profile of citizens to whom factors such as leadership, innovation, infrastructure, together with social and humanistic factors, access to education and health care are especially important. The university is one of the key resources of smart city development. It should be a moving force of all strategies and innovations.

The quality of life itself leads to a competitive advantage. Populations demand better chances for personal, economic and social growth that smart cities can provide. The high level of automation and the use of heavy machinery will, in the future, make human operations outdated in industrial and rural work. Populations will turn to the service economy and to innovations based on knowledge. Apart from this fact, big cities have infrastructural elements that are necessary for this kind of social and economic development: universities, airports, ports, motorways, ICT infrastructure, better electro-energy networks, quality internet, etc.

The relevant bibliography defines the smart city as "these cities focus the attention on places in need of identity and culture, and whether they exist in cities or not there is never an end for the need to create spaces for those to learn, share ideas, and connect with other individuals of common interests" (Rios, 2008). It is important to emphasise the human dimension of the smart city. The aim is to create an environment that suits the development of the creative dimension within society. The quality humanistic dimension can be perceived in the creative and highly educated workforce, professional associations, the low level of crime, charities, humanitarian organizations, environment protection organizations. Creativity is seen as the main moving force and, together with knowledge, plays a key role. This kind of social and intellectual capital is the heart of the smart city as a system. Smart cities comprise a coherent system of social, cultural, technological and business systems whose synergy increases the quality of life of their citizens.

A short overview of definitions and how these and other connected terms were formed, such as the "Intelligent City", the "Digital City", which are similar

but still different, provides a theoretical framework for understanding the concept of the intelligent city.

"Smart city is the city where investments in human and social capital and in traditional and modern infrastructure provide sustainable city development and high quality of life with wise use of natural resources and with smart use of the city potential (human, ecological, economic, management, absorption, and marketing) based on the participative management" (Ishkineeva et al. 2015). Smart mobility stands for the efficient, fast, and cheap flow of capital, resources, people, and information in the smart city. Fast and cheap information flow is achieved by the provision of broadband fibre-optic networks and freely accessible wireless signals within the city, which everyone can use. Contemporary smart cities have their own optic networks that are often based on the OPEN network principle. These networks are the key prerequisite for smart city development, as they provide infrastructure for collecting information and managing the city, as well as the infrastructure for business organizations and individuals. With the help of a network of sensors and devices that are connected to the Internet of Things (IoT), it is possible to manage the population of an entire city on a macro level and of that residential units on a micro level.

Smart environment management requires constant pollution monitoring and pollution management where and to the extent that this is possible. Efficient transportation and the efficient and rational consumption of energy decrease the negative effect of cities on the environment. Most smart cities have a so-called "Smart Grid", that is a smart electrical energy network to provide a safe supply of electrical energy, the predominant type of energy consumed in urban areas. These management elements are combined with an efficient system of health care and other services, such as fire service, police force, utility services etc.

1.4. Manifestations of Urban Agriculture

There are numerous examples in the world of urban agriculture being put into practice. There are many experimental urban agricultural research farms, and more and more urban agricultural commercial and small farms created by individuals of groups of enthusiasts. Some examples are provided here of what urban agriculture actually is and how it looks in practice. The example of vertical farms is interesting to the author of this essay because of the claim of their developer that „vertical growing technology and local distribution methods reduce energy use, travel time and costs tremendously, making this model one of the most sustainable ways to guarantee access to fresh, healthy produce in city centers, in any season" (Lutero, 2015). This example is also interesting because

of its bold claim that vertical farming is the answer to the demographic challenges of Smart Cities.

The produce is cultivated in a sustainable environment in such a manner that 97% of water is reused and plants are grown without using pesticides and herbicides. The vertical farming technology and local distribution methods decrease energy and time consumption, as well as transportation expenses to a large extent, creating one of the most sustainable models that guarantees fresh, healthy food in city centres at any time of the year.

Gardens as Part of Urban Agriculture and Sustainability

One of the terms used in professional literature in the English language to describe gardens is “Allotment gardens“, often abbreviated to “Allotment“. In North America they are also called “Community gardens“ (Picture 1).

Picture 1. Garden in the Schwabing part of Munich

Source: Wikipedia.. Available from https://en.wikipedia.org/wiki/Allotment_(gardening).

According to Batista, the rapid process of urbanization has led to the continuous spreading of the city towards the rural suburban settlements, putting large areas under the direct influence of urban centres. The Ebenezer Howard (“Garden City”) model, used for the building of new cities, envisaged that the city should have an integrated agricultural zone.

The community and urban farm parcelling project is extremely flexible and can be adjusted to the needs of the local community. It stimulates community participation and the creation of a sustainable community. Projects

of this type contribute directly to community development, generating social participation and promoting urban regeneration through:

- more open spaces built from materials such as water, soil, vegetation in urban areas;
- more formal and informal educational opportunities;
- more pedagogical information about agriculture and livestock breeding;
- garden, landscape architecture and animal rearing education;
- schools; excursions and educational, didactic and pedagogical activities;
- leisure time and sports activities;
- inclusion of people with learning disabilities and/or other special needs;
- development of company involvement in this type of urban agriculture, through coffee shops, horticultural markets, garden centres and other business communities (Batista, 2013).

According to Veenhuizen, the following elements justify the development of urban agriculture:

- economically vulnerable and unemployed population, urban poverty, uncertainty when it comes to food supply etc. Reasons for these are temporary crises: natural disasters, wars or disease outbreaks. Many of the problems linked to starvation and poverty have become common and structural. Urban agriculture has an impact on the social security network of poor population within the city;
- relative advantage that an urban setting gives to farmers: direct access of their produce to the market places; accessibility of cheap inputs such as the food and water; waste disposal, proximity of the institutions that provide information on markets; credit possibilities, availability of technical advice;
- possibility of quick adaptation of urban agriculture to: urban politics and programmes, conditions for the sustainable development of the city (water, air and soil cycle balance, local economic development and food supply, as well as waste recycling, promotion and maintenance of open city spaces, promoting recreational activities, social inclusion of minorities) (Veenhuizen, 2006).

1.5. Challenges of Urban Agriculture

Modern agriculture encounters great difficulties that come with the growth of human population, which is something that even urban agriculture cannot solve in the near future. Urban agriculture can raise the level of efficient and effective resource allocation in the field of agriculture and raise

the percentages of self-sustainability of city areas through locally produced food, but it cannot solve the problem of how to feed the world population. All the advantages aside, the biggest challenge facing urban agriculture when compared to conventional agriculture in terms of its scope, energy and workforce costs is its sustainability.

Many practices that are now in use, or are being experimentally introduced, reveal the difficulties that are encountered in the supply of food to urban areas. There is already not enough arable land to feed the World's population, and, in theory, better production methods should make up for the shortage of food. Those production methods can hardly count on small local farms on the outskirts of cities as a part of the solution.

Urban agriculture is trying to provide answers to these challenges by applying new inventive food production methods. Vertical farming and aquaponics are being considered as the methods with the most prospects for success. Vertical farms have the better prospects, because they grow plants one on top of the other in multi-story closed spaces in order to achieve a required farming area.

1.6. Conclusion

This paper is a short overview of the development and prospects of urban agriculture, made by using available professional literature as well as Internet-based articles that are not scientific. The first articles date from the late 1970s. Urban agriculture returns to the spotlight of scientific interest at the beginning of the twenty-first century. The literature overview and the author's research demonstrate that urban agriculture:

- Has a strong socio-economic character, includes all social groups, and helps include many communities;
- Has a prominent educational character, reconnects people with nature and the entire food production chain;
- Helps the poorest population groups to improve their nutrition;
- Redresses the balance between the urban and the rural;
- Decreases energy consumption required for food transportation;
- Shortens the from-farm-to-table time and the time required for food processing;
- Provides food that is organic, without pesticides and herbicides;
- Does not pollute water and arable land.

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