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Possibilities of Urban Aquaponics in the EU – Constraints and policy options D3.3

Ecoponics

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1. Introduction

The strong interest in urban agriculture worldwide embraced by many sides of civil society, municipalities and urban planners addressing urban food policies, has also drawn a wide range of disciplines within academia publishing journal articles on the topic. The main drivers for this global attention towards urban agriculture, can to a great extent be summoned up by:

- The food crisis of 2007/08 caused by the spike in oil and food prices in late 2007 and early 2008 leading to social upheavals and food riots especially in the net food importing of Northern Africa and the Arab region (also known as the 'Arab Spring') (Harrigan, 2014) (Cohen & Garrett, 2010).
- Increasing devastating floods and heavy rains of cities with tremendous cost and health impacts to people and their properties inclined to climate change as the cause (just to mention a few on global news: hurricane Katrina New Orleans 2005, flood and mudslide Rio de Janeiro 2011, Hurricane Irene New York 2014, Dallas 2015, Paris 2016).
- The collapse of the global financial service firm Lehman Brothers in September 2008 causing a global financial crisis and the worst recession in 80 years followed by millions of job and property losses hence an increase in urban poor.
- A rapid urbanization process with now more than 50% of the world population living in cities and the number expected to reach 70% by 2050.
- A continuing population growth where 'two more China' in terms of numbers (2½ billion) are expected to have entered the world by 2050 claiming their right to food and a more prosperous life.

Together, these global drivers have spurred a growing recognition that cities in both developed and developing countries are facing enormous challenges in terms of ensuring climate resilience, food security and social peace in a more volatile future. This goes in regards to:

- a) the enormous dependency cities have on a very centralized food and distribution system, all based on stable supplies of cheap fossil fuels, but where 2/3 of the stocks are situated in a region where wars and ongoing social unrest seem to prevail.
- b) From an environmental perspective the intensification tendencies of industrial agriculture, with its heavy reliance on the use of pesticides and fertilizers, have exacerbated urban water pollution and waste problems (Pothukuchi & Kaufman, 1999).
- c) The need for food policy actions on municipality level, that encompasses the challenges mentioned above - be it through both bottom-up and top-down approaches.

In this context, municipal governments like New York, Chicago, Rome, Belo Horizonte, Toronto, London, Amsterdam and Dar es Salaam are devising integrated food policies and strategies that move beyond the traditional focus on urban agriculture (Sonnino, 2009; Reardon et al, 2016).

Although urban agriculture is not a new thing it has come to be seen as an important contributor and denominator for solving the many problems cities are facing worldwide today all related to the three pillars of sustainability: the environment, economic and social sphere, and hence gathered a growing interest and support.

The food technology of aquaponics placed in an urban context supports in this regard the prospects of a sustainable urban food production by in the same time producing high value proteins, high value crops with very limited pollution and no smell compared to raising cows, pigs or chickens. However, when advocating for producing food in an urban context urban agriculture immediately comes into competition with other productive sectors and interests on a very specific scarce resource: space. The utilization of space as a scarce resource in an urban context becomes automatically a conflict of interest between the need for housing, transportation, roads, leisure areas etc. In a market economy space availability becomes automatically a question of price, ability to pay to get access and hence access for whom. Access to urban space and for whom becomes therefore also a question of power, and how this in an urban context politically will be levelled out.

2. Constraints encountered

The economics of space

Johann Henrich von Thünen (1783-1850) developed a theory on land use and location of crops in relation to urban markets, hence he developed a theory on spatial economics and economic geography (Fig. 1). In his model, the use of a piece of land is put to a function of a) the cost of transport to a market and b) the land rent a farmer can afford to pay (determined by yield). A product with a high- expected return, and therefore high rent paying ability, will be able to outbid a product with a lower profit level and, therefore, a relatively modest rent bid ceiling. In other words, the location of crops will be determined by

- Market prices
- Transport costs
- The yield per hectare

The model generated four concentric rings of agricultural activity around the European city in the 19th century. Perishable and intensive farm products such dairy, vegetables and fruits would be produced in the first ring close to the city. Timber and firewood would then be placed in the second ring since wood for fuel was important, and due to its heaviness and difficult to transport, would be placed close to the city for minimizing transportation costs. In the third ring extensive fields for grain production would be found, due its durability and lightness in transportation. In the fourth ring ranching would be found, since animals could walk to the central city for sale.

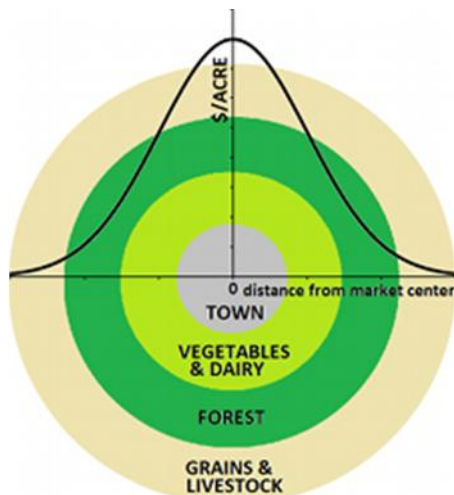


Figure 1. Johan von Thünen's model of crop location in relation to urban markets in a European city in the 19th century (Source: http://www1.udel.edu/johnmack/frec343/land_econ.html)

Modern industrialization, cooling technologies and various transportation options today has in many ways abolished the concept of location of specific agricultural products in relation to an urban market. However, as a general theory on location of agricultural land the model of von Thünen still holds relevance. First of all, it explains why agriculture all together has 'moved outside' the city since with industrialization other 'commodities' such as housing, financial services, etc. can return a much higher rent than agricultural produce for the same (urban) land. Secondly, the theory explains why urban and peri-urban farmers in general will choose to produce high value crops such as vegetables, fruits, meat of some sort rather than produce grain in order to make a living on limited urban space. Thirdly, the theory points to the fact that if a municipality today wants a local oriented urban food production of significance, it needs to have policies installed that protects the space for agricultural produce from the competition of other sectors. Suggestions based on IGFF's experiences on this will be explained more in details in section 4: urban food policies for the future.

3. Rooftops as a space for food production

The challenges of space and land as a scarce resource in the urban context, and the conflicts of political interest it creates, has made the concept of utilizing flat rooftops for urban food production an interesting option. Rooftops are normally an un-utilized space, placed above the ground and potentially free from shade, theft and vandalism. Likewise, green roofs for food production has the environmental prospect of isolating the house during winter, and contribute to the cooling of the city during summer from plant evaporation.

IGFF started therefore out with the goal of placing an aquaponic food production on a flat rooftop. The experiences from this approach, trying to establish a food production on an urban rooftop, encountered the following practical as well as specific institutional challenges and constraints:

- 1) *Question of ownership.* Who owns the house? Does the house have residents? Often the owner and the residents are two separate groups of a building and acceptance has to be obtained from both before a food production can be placed on their roof.
- 2) *Access to and from the roof.* Will the residents have free access to the urban rooftop farm, or will it become a restricted privatized area due to food safety regulations if production is planned for market sales? Do the food producer have a 24 hour access or a limited access to the rooftop? What kind of access to the roof will be allowed for bringing farm inputs (soil, fertilizer) as well as transporting the outputs for markets? Will access only be specific hours during daytime or other limitations?
- 3) *Terms of production conditions.* What conditions are the food producer given in terms of paying rent, and having access to water and heat? The latter is important if a greenhouse with all-year-round production is installed. For how long a time-period can a lease be agreed upon, and what time-period is needed if, and when, a termination is necessary? Depreciation value of a greenhouse is normally 20 years, so if termination possibilities is shorter, a type of compensation has to be negotiated beforehand.
- 4) *Carrying capacity of the building.* Normally in Denmark most flat roofs are built to carry a snow weight of 100-250 kg/m². The carrying capacity of a roof therefore normally just allows for one or two persons to walk around upon it, and hence does not allow for any possibilities of establishing plant beds or even a greenhouse. If an aquaponic food production then is in the planning one has to be aware that a fish tank with just one m³ of water per m² is already providing a weight of one ton per m², hence producing fish on a rooftop becomes an even greater challenge. Forces from any extra weight on the roof has to be led into the ground. Either through existing pillars placed inside the building or via the walls, or new pillars has to be established inside or outside the building. In most cases, new pillars outside will be the only option and a necessity, since the foundations of most residential buildings are not dimensioned for carrying any extra ordinary weight. If pillars outside has to be established then questions of architectural aesthetics will come into play as well as the extra economic cost depending on the height of the building.
- 5) *Legal permissions.* Permissions for establishing a food production has to be obtained as well permissions for running the food production itself. Likewise, permissions and periodically control on food safety measures has to be in place if sales are directed to a market. Also security measures on fencing for being allowed to walk on the roof has to be approved, as well as runways (minimum two) in case of fire has to be in place before any permission of access will be given.
- 6) *Insurances.* Insurances will primarily be required by the owner of the building in terms of securing the building from any damages that could potentially occur from the production (i.e. water leakages or mold entering inside the house as well as questions of fire coming from electric faults).

The most significant constraint for making use of flat rooftops for urban food production was however found to be the present carrying capacity of most existing residential buildings. They are simply *not* built for such extra weight loads, and will demand high costs if farms with greenhouses and even fish production are to be established. Likewise, the food production alone will not be able to pay for such an investment, but will require some kind of economical support. Those urban farms that have been established on rooftops are often placed on formerly abandoned industrial buildings,

which originally were designed for carrying heavy machines etc. Likewise, some farms have found space on top of a one-storey warehouse/supermarket, where extra support pillars could be established for a smaller sum of money.

Utilizing rooftops as a significant space for urban food production in the future will first of all require that it becomes part of an overall city- and architectural planning. Secondly, an overall policy goal has to be followed by targeted instruments of enforcement and motivation from the municipalities that encourages architects and housing investors to design and include space for urban landscapes on the rooftops. Be it for food, leisure, or a mix of both.

4. Urban Food Policies for the Future

There are very few cities in the world that actually has a specific policy of promoting urban agriculture. Hence, an urban food entrepreneur will not be able to approach a specific urban agriculture administration in the municipality for advice or obtaining various permissions. Instead, one will often have to go to several administrations - be it for food control, housing issues, environment, social issues etc. It is therefore crucial before approaching a public administration that one has considered from the start if the urban food production will be targeting *commercial market sales*, *non-markets* or some kind of *hybrids*, where public support can be involved and sales semi-commercial oriented. The type of market orientation will automatically involve different types of public administrations as well as open up for the prospect of different kinds of public support.

In Figure 2 the type of existing aquaponic food systems have been organized according to its market orientation. The *non-market* food system will allow for certain types of public support in relation to educational services, food supply to local school meals supporting existing public policies on combating obesity, education on eating healthy etc. It could also be a cooperation with a university doing research on aquaponics where the food in return is supplied to the staff or university canteen.

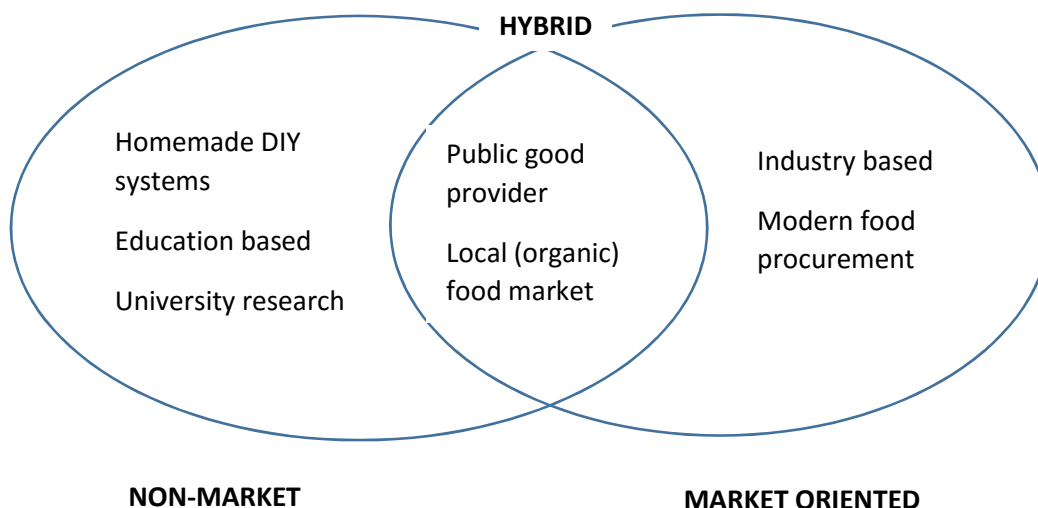


Figure 2. Type of aquaponics system according to its economic organization (Kledal & Thorarinsdottir, 2016)

Hybrids are a mix of semi-commercial sales supported by the public. This could be in regards to job training, supporting disabled people or a demonstration garden that gives advice to the public in a local neighborhood on urban farming methods, and in the same time runs a small farmers market with a café for example.

The *market oriented* production will demand a whole new set of permissions especially when it comes to food safety regulations, controls and book keeping. Public support could be in regards to job creation in green start-up companies, technology support etc.

Based on the 'land-use' theory on spatial economics, and in relation to the practical experiences IGFF has made trying to pursue the establishment of an urban aquaponics rooftop farm, the following suggestions for an overall urban food policy will be presented:

- It is important that a municipality has established an overall urban food policy, because this makes it clear what the roles and obligations are for the civil servants when approached by entrepreneurs interested in starting various types of businesses within urban agriculture. If there are no rules or policies on the matter it becomes extremely difficult for the civil servants to dedicate time and support various urban farm initiatives.
- However, policies on paper is not enough. An administration (or figuratively: an entrance door) targeting specific urban agriculture has to be established, but includes already existing expertise from the various departments on business and jobs, environment, social issues and education. This will reduce transaction cost enormously for entrepreneurs interested in starting various types of companies operating within urban agriculture.
- Inner city areas where the building stock is often high and dense the potential for urban farming lies on rooftop farms. Since most residential buildings do not have any carrying capacity for extra heavy weight loads supporting farms on a roof - and seldom have flat roofs - a legislation promoting such requirements when making new houses or renovating existing buildings is a necessity. Legislation combined with tools of motivations could be tax reductions, or economic support to cover the extra costs when preparing roofs for being able to carry and run various types of urban farms. These schemes should be instruments that are part of the overall urban food policy.
- In peri-urban areas, a zoning regulative protecting land-use from other competitive sectors has to be installed. IGFF proposes a *dynamic* approach rather than a conservation approach of a zoning specifically targeted agriculture, but supports the principle of CPULs (continuous productive urban landscapes) (Viljoen, 2005). This means always protecting and keeping spaces of wedges open and green in the urban, but the land-use can change depending on people's or society's preferences - be it for example more for leisure or simply having the possibility of actively engaging in urban agriculture. For commercial urban agriculture, the zoning should imply lower rents to the producer - just likes farmers today are benefitting from their land use in rural zones - and hence in this way support a competitive food production in the city or its proximity.

Figure 3 shows the Urban Farmers pilot rooftop farm in Basel.



Figure 3. Urban Farmers pilot rooftop farm in Basel, based in the Dreispitz area south of Basel, just a few tram stops from the centre of the city. Photograph: Raphi See (Raphael Seebacher)/Urban Farmers

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