Food Systems in European Cities

Deliverable 7.12 Practice Abstracts, Second Set of 10 PAs

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Document Control Sheet

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0.2	14 October 2022	Revised draft by the internal reviewer and circulated to partners	HCA, Hague BE
1.0	28 October 2022	Final version including feedback from partners	HCA, Hague BE, APT

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1. Introduction

The interactive innovation approach under the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) fosters the development of demand-driven innovation, turning creative new ideas into practical applications thanks to interactions between partners, the sharing of knowledge and effective intermediation and dissemination.

The knowledge sharing is facilitated, amongst others, by the development and distribution of easily accessible end-user materials that follows a common format - practice abstracts. A practice abstract is a summary describing the main recommendations, information and practice that can serve farmers, advisers, researchers and all other actors across the EU in their practice.

In the context of FoodE, WP7 develops a series of practice abstracts which will feed into the EIP-AGRI website for broad dissemination of the insights gained throughout the implementation of the project. Ultimately, the goal would be to contribute to underlying objective of FoodE: acceleration of the growth of sustainable citizen-led City/Region Food Systems.

The following deliverable presents a second set of 10 practice abstracts.

2. Methodology

The practice abstracts are based on scientific articles by the FoodE partners developed in the context of the project that cover topics related to the City/Region Food Systems (CFRS).

Following the EIP-AGRI common format, the practice abstracts do not exceed 1500 characters and aim at providing information related to:

- The main results/outcomes of the activity.
- The main practical recommendation(s) highlighting the main added value and opportunities to the end-user if the generated knowledge is implemented.

3. Practice Abstracts (PAs)

PA N°1: How to feed the cities? Co-creating inclusive, healthy and sustainable city region food systems

The scientific paper developed by FoodE scientific board member addresses the current urban living conditions, challenging the health, wellbeing and coherence of individuals and societies. .To create resilient communities, it is important to reinvent the way food is produced, distributed and consumed. According to this study, sustainable local food systems can be created through the empowerment of urban multi-stakeholders as the agent of the transition. Above all, human-centred actions make future proofing food systems.

A public-private approach can boost sustainable local economies. The promotion of sustainable production modes diversifies and optimizes city region food production, increases retail of regionally produced food via e.g. markets and canteens, and improves access to nutritious food for vulnerable households. Community-supported agriculture, as the latter explains, links producers and consumers and changes food lifestyle behaviours, such as waste minimization. In addition, it has a direct impact on the regional economy.

Knowledge and practice are the basis of lifestyle changes. Therefore, it is recommended to:

- Enhance the overall literacy of urban communities on food knowledge and skills through the dissemination, co-implementation and monitoring of policy impact,
- Change the societal paradigm toward healthy lifestyles (e.g. re-use oriented),
- Create local green economies through sustainable business and job creation.

Link to scientific publication

PA N°2: Aquaponics: a promising tool for environmentally friendly farming

Agriculture faces many challenges, including the need to produce more food with fewer resources. Aquaponics can tackle this problem without stressing the environment. The closed cycle of aquaponics means that the bacteria from fish poop converts into a perfect fertilizer for plants growth, which they take up with their roots and, in doing so, also clean the water which makes it possible to farm fish again. There are three main systems in use today: raft, substrate, and channel aquaponics.

This teamwork between plants, fish and bacteria allows farmers to produce both fish and plant-based food. Aquaponics uses 90% less water than traditional agriculture and is suitable for both outdoor and indoor use on all scales. This makes aquaponics very suitable for urban farming and can help to reduce the transport footprint, support social initiatives, and provide cities with a large variety of local organic and seasonal fresh produce.

To sum up, implementing aquaponics is environmentally friendly. It is recommended to:

- Consider the application of urban aquaponics to take advantage of the named benefits.
- Pick the best-suited type of aquaponics for optimal harvest and water use:
    - Raft aquaponics which is most appropriate for small plants like salad greens,
    - Substrate aquaponics, which is suitable for all types of plants, but often used for tomatoes,
    - Channel aquaponics which is suitable for plants that need little support, such as strawberries.

Link to the scientific publication

PA N°3: Potential key factors, policies, and barriers for rooftop agriculture in EU cities: Barcelona, Berlin, Bologna and Paris

In recent years, rooftop urban agriculture took an important role in improving the adaption to climate change, decreasing the transport footprint and help with the social cohesion in cities. But on the other hand, barriers like missing policies, economical, and environmental disadvantages must be addressed for a successful integration. This study compared the perceived benefits and barriers of rooftop urban agriculture (RUA) in four different cities: Barcelona, Berlin, Bologna, and Paris and shows a variety of factors that play an important role in implementing RUA.

The study showed that there was missing explicit public policy for the practices of RUA in all cities. In addition, the study concluded that key promoting factors are technological innovation, research activities, growing local food and high costs of urban land in cities. However, the major factor that hinders RUA is high water costs. Although several cities have sustainability programs, there is still a lack of urban, architectural, and product sales regulations for this kind of infrastructure, which continues to make the integration of RUA difficult.

Further research should build on these findings which recommend to:

- Focus on innovation, particularly innovation based on lowering the water costs of RUA,
- Come up with new initiatives to improve the infrastructure to benefit the sales out of RUA,
- Approach politicians to get more uniform and universal rules to the benefit of RUA.

Link to the scientific publication

PA N°4: Formalizing objectives and criteria for urban agriculture sustainability with a participatory approach

Urban agriculture projects become increasingly important in global North countries. These projects aim to cope with the challenge of sustainable urban development. However, no set of criteria has been designed to assess the environmental, social and economic sustainability of these projects. Therefore, this study identifies sustainability objectives and criteria applicable to professional intra-urban agriculture (PIUA) with the aim to create indicators to measure the sustainability criteria and allow sustainability assessment of intra-urban farms.

Research shows that sustainability criteria to assess sustainability would hardly be used by urban farmers without incentives. However, as decision makers are in need of these criteria, they could encourage their use by urban farmers, through call for proposals for instance. Finally, research shows that decision makers might be ready to subsidize farms.

Overall, agro-environmental and socio-territorial criteria were assessed by stakeholders as more important than economic criteria, whereas food production was not mentioned. Combining the internal sustainability approach of farmers with the external sustainability approach of decision-makers, a holistic perspective of sustainability within PIUA projects is reached.

Link to scientific publication

PA N°5: Perceptions on barriers and opportunities for integrating urban agri-green roofs: a European Mediterranean compact city case

Cities with high population density experience a lack of (green) space(s). Rooftop urban agriculture (RUA) offers an answer to this issue. This study analyses the perceived barriers and opportunities regarding the implementation of urban agri-green roofs (UAGR) in cities by discussing five categories.

Opportunities and threats per barrier:

	Barrier	Opportunity
Social	• Lack of qualified personnel for educational purposes • Incompatibility of UAGR with city activities • Loss of rural jobs • Lack of information	• Social cohesion to generate new attitudes • Creating community garden spaces • Education
Environmental	• Climate conditions	• Energy saving • Improvement of thermal and acoustic insulation • Carbon footprint reduction • Water retention
Legal/administrative	• Disparity in legislation • Permitting • Legal commercialization of	• Private-public cooperation

	agricultural rooftop products	
Technological/architectural	• Building load limitation • Conflict with spatial planning	• Aesthetic improvement • New use of space
Economic	• Capital investment • Expensive investment • Maintenance costs • Low perception of UAGR benefits (often perceived as a cost)	• Savings in energy bills • Local production chain • Creation of new jobs

It is recommended to:

- Draft new/revised policies, taking into account:
    - Environmental goals,
    - The entire life cycle – e.g. flexible land use,
    - Existing buildings – stimulate through e.g. tax reduction subsidies.
- Proactively communicate and educate about UAGR projects to increase knowledge.
- Be aware of possible gentrification.

Link to scientific publication

PA N°6: Incorporating user preferences in rooftop food-energy-water production through integrated sustainability assessment

Sustainable food, energy, and water supply as well as the optimization of this supply based on their interconnectedness, normally referred to as the food-energy-water (FEW) are essential components of a sustainable urban area.

The study analysis a typical social housing estate in the Metropolitan Area of Barcelona which faces environmental, economic and social issues such as energy, as well water poverty and urban and social degradation. The paper presents an integrated method that combines participatory procedures and a multi-dimensional sustainability evaluation to build a successful strategy of FEW production systems on rooftops.

The study discovered that residents were more concerned with energy costs than with food insecurity, however, the environmental assessment revealed that the least impacting alternatives from a life cycle approach were those promoting vegetable production, which met 42 to 56% of the residents' fresh produce demand while reducing environmental impacts by 24 to 37 kg CO2eq m−2 of rooftop/year.

It is recommended to:

- Foster urban strategies, such as the roof mosaic;
- Design sustainability scenarios through comprehensive assessments;
- Propose policies to address the lack of knowledge of the environmental impacts of conventional supply networks and readapt current urban planning regulations;
- Inform and educate citizens by implementing policies meant to promote local resource production in municipalities.

Link to scientific publication

PA N°7: Beyond vegetables: effects of indoor LED light on specialized metabolite biosynthesis in medicinal and aromatic plants, edible flowers, and microgreens

Light is essential for the development and growth of a plant. Recent advancements in LED technology have enabled improvements in artificial light applications for horticulture. Artificial lighting enables light features to be controlled with potential effects on plants' primary and secondary metabolic responses.

The study examined the effects of indoor LED lighting recipes and management on the specialised metabolite content in several crop groups, namely medicinal and aromatic plants, microgreens and edible flowers, with a focus on the literature from the last 5 years.

The literature review highlights the potential of indoor LED treatments to enhance specialized metabolite content in microgreens, edible flowers, medicinal plants, and aromatic herbs. The analysis showed that in some species, lighting combinations, particularly the addition of far-red or green to the lighting mixture, resulted in an improved synthesis of specialized metabolites. However, in other cases, the best performances were also observed under monochromatic red or blue lights.

It is recommended to further investigate:

- Edible flower cultivation using artificial light;
- The application of supplemental UV light in indoor farming;
- In vitro cultivation with LED lights.

Link to scientific publication

PA N°8: Farming on top: rooftop agriculture for healthy cities

Food is often difficult to obtain in cities due to rising urban populations and climate change. To address this issue, it is vital to create a new type of agriculture that offers food security while simultaneously safeguarding the environment. Growing food within cities, on top of buildings, and in communal gardens, known as urban agriculture, may provide several benefits to cities.

Researchers discovered that rooftop farms are becoming increasingly popular throughout the world, particularly in developed countries. It is also critical to promote the development of rooftop farms in developing nations in order to secure the food security of the people who live there. Furthermore, studies discovered that rooftop agriculture can increase building inhabitants' well-being by providing them with a social community of gardeners.

Rooftop farms provide an opportunity to produce more affordable food closer to cities and solve the food security problems in urban areas while reducing the food miles and pollution factors of transporting food to longer distances.

It is recommended to:

- Develop business opportunities, in order to contribute to the evolution of more sustainable and resilient city food systems providing fresh crops from the inner urban fabric;
- Develop a strong policy to upscale rooftop agriculture practices to reach decisive environmental, economic and social benefits at the city level.

Link to the scientific publication

PA N°9: Closed-loop crop cascade to optimize nutrient flows and grow low-impact vegetables in cities

Due to the rising population in cities, nutritional demand is increasing in urban areas, resulting in long and complex supply chains. Urban agriculture (UA) has arisen as a promising solution that brings production closer to consumers.

UA can significantly contribute towards mitigating the impacts of inefficient and complex food supply chains and increasing urban food sovereignty, and it can lead to better environmental performance and improved nutrient management.

The study was performed in a rooftop greenhouse located on the campus of the Universitat Autonòma de Barcelona, where crops were grown in a hydroponic system, using rainwater. The research evaluates a cascade system with a long-cycle tomato donor crop and five succeeding cycles of lettuce. The assessment of the agronomic performance and the nutrient flows provide information on the potential of these systems to mitigate nutrient depletion in cities while providing food within the context of urban agriculture. The results suggest that the early stage of the donor crop could only yield 0.1 lettuces per tomato plant, with N being the limiting factor. The late stage of the donor crop, on the other hand, was able to leak enough nutrients to feed 9 lettuces per tomato plant.

It is recommended to:

- Test possible combinations of donor and receiving crops;
- Report the limitations of this kind of systems for a transparent process of decision-making;
- Further assess the nutritional flows of cascade systems.

Link to scientific publication

PA N°10: Pulse LED light: exploring the balance between energy use and nutraceutical properties in indoor-grown lettuce

The use of LED lighting systems has risen due to their potential use in indoor farming. LED lights are long-lasting, have great radiative efficiency, switch faster, as well as enable the selection and customisation of output spectrum features, meeting the demands of the plant and allowing for high-quality crop production. Even though LED lighting has the potential of providing indoor farms with more efficient light sources, its impact is still being explored.

The research analyses how efficiently lettuce grows under LED lights. Plants were cultivated for 14 days at the Department of Agricultural and Food Sciences of the University of Bologna, Italy, under red and blue LEDs, with two different switching frequencies (sf), namely, high sf of 850 kHz and low sf of 293 kHz.

According to the experiment, a low sf can lead to significant energy savings while obtaining the same yield. A low sf, on the other hand, does not reinforce the nutraceutical content of lettuce, which is enhanced by a high sf.

It is recommended to further research the physiological, biochemical and molecular responses of plants to pulsed LED light technology to achieve a balance between energy use and the nutraceutical properties of indoor-grown crops.

Link to scientific publication