



European guidebook on sustainable city region food systems

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Executive Summary

The results in this European Guidebook on Sustainable City Region Food Systems (CRFS) provide recommendations and guidelines for policies aimed at improving interactions among the stakeholders of the food chain, empowering local communities and cities to become sustainable food hubs. The first chapter provides a basic introduction to the topic of European urban food systems. Chapter 2 presents 13 different European pilot projects that aim to promote the transformation of the food system in Europe. These projects and their respective concepts can serve as inspiration to implement similar projects. Chapter 3 focuses on the vision of future food systems. It looks at how the CRFS could develop by 2050 if their transformation would take place successfully. It concretises this vision by breaking down four possible areas of innovation (policy, social, economic, technical) in terms of current and possible future developments. Finally, the results of the Guidebook are summarised in the Chapter 4.

The European Guidebook on Sustainable City Region Food Systems has been produced as part of the FoodE Horizon 2020 research project.

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Introduction to the Guidebook

About Sustainable City Region Food Systems

Cities and towns worldwide are growing at different rates and increasingly carry the burden of food and nutrition insecurity. Cities often find themselves with limited responsibility to ensure access to sufficient, adequate, affordable, nutritious and safe food for all their residents. Various factors, such as fluctuation and rapid increases in food prices, are disruptions in food supply caused by natural disasters and the impact of climate change. Cities can develop sustainable food systems to reduce food waste, create livelihood opportunities for producers, promote sustainable production, processing and marketing, and ensure food security for all. Urban policy and planning have paid little attention to food systems, but cities are increasingly involved in local, national and international discussions about the future of food and nutrition security (FAO and RUAF 2017).

The City Region Food Systems approach focuses on the complexity of the food system within a city region and its stakeholders. This approach has only recently been integrated into research (FAO 2022).



Oslo, Norway

Definition of City Region Food Systems

“Within the so called City Region Food Systems are all those actors, processes and relationships that are involved with the food chain (from where food is produced, to where it is processed and distributed) in a defined geographical region. This can be a city, the surrounding hinterlands, or a regional landscape. It can also vary in response to the environment, including for instance a coastal landscape, mountain ranges, hills, a rural plain, a dense urban or an industrial area. A systems-based approach contributes to a better understanding of the interdependencies between key parts of the systems (food supply, environment, nutrition, health, jobs), and makes addressing the issues in an integrated and holistic manner possible.” (FoodE 2021)



Romainville. France

The CRFS approach goes beyond just food, it includes all individuals, other commodities, and services that are interconnected with the local ecosystem. For example, this connectivity is evident when leisure activities are intertwined with a rural agricultural landscape, when community building and social inclusion are nurtured within a community garden, or when job opportunities are both generated and sustained by a fishermen's association that supplies local schools. The terms "cities" and "regions" illustrate the scales at which ecological, social, and economic relationships can be nurtured through collaborative governance and the active engagement of urban and regional institutions and stakeholders (FoodE 2021a).

CRFS examine alternative food networks, short food supply chains, urban-farm linkages, food storage, bioregions, territorial development and integrated policies. CRFS is a multi-stakeholder

approach and process that builds on sustainability and creates a common voice for food sector actors at all levels.

CRFS creates coherence between policymakers, ranging from the local to the international level, and offers solutions to policy recommendations, including the Milan Urban Food Policy Pact (MUFPF 2021), the Sustainable Development Goals (UN 2022) or the New Urban Agenda (UN 2016).

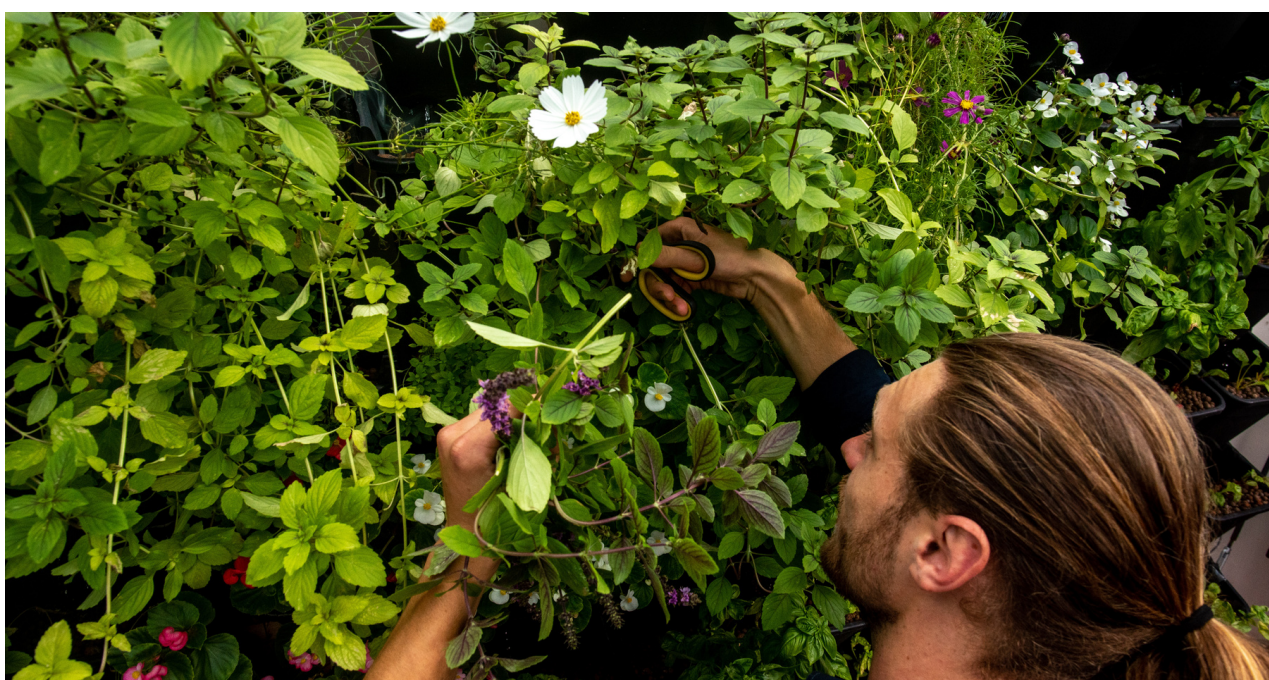
The CRFS approach aims at improvement in the sense of sustainable dimensions, i.e. on the ecological, social and economic level, for better conditions in the city region:

- Access to affordable and nutritious traded foods from local and regional producers will enhance consumer food security and nutrition, and improve transparency in the food chain.

- Access to markets and support for alternative markets (e.g., farmers' markets, community-supported agriculture) will enhance the livelihoods of both small-scale and larger-scale producers.
- Local and regional food hubs, shorter value chains, and more broadly, efficient and functioning agricultural supply chains connecting hinterland producers to market systems can contribute to sustainable diets, reduce food waste along the chain, and stabilise livelihoods in the distribution, processing, and manufacturing of food and fibre products.
- Water, nutrients, and energy can be sourced, recovered, and reused in agricultural production.
- Participatory governance structures are established to include stakeholders from multiple sectors in both urban and rural areas.

The CRFS represent the following characteristics, which can manifest at different spatial levels and contribute to the concept of a sustainable and local food system:

- Improves access to food for all.
- Creates decent jobs and incomes.
- Increases resilience to shocks.
- Promotes linkages between urban and rural areas.
- Supports sustainable management of ecosystems and natural resources.
- Provides participatory governance structures and transparency in the food chain (FAO and RUAF 2017).



Amsterdam, Netherlands

Goals of FoodE

FoodE (Food Systems in European Cities) led by the University of Bologna, brings together a highly qualified consortium of 24 organisations. The consortium includes universities, research institutes, SMEs, NGOs, as well as City Councils spread across 8 EU countries.

FoodE is financially supported by Horizon 2020, the EU's Research and Innovation Framework Programme. The project's main objective is to accelerate the development of sustainable and resilient citizen initiatives in European urban food systems. Involving various stakeholders, including citizens, start-ups, local authorities, and educational institutions, FoodE has implemented activities outlined in this EU Guidebook. The guidebook's results offer recommendations for policies to enhance interactions among stakeholders, empowering local communities and cities to become sustainable food hubs.



Romainville, France



Pilot Descriptions





Berlin, Germany

Berlin, House of Water

Located in a courtyard in the centre of Berlin, the pilot project recycles greywater from an apartment block with 250 residents for reuse as service water for toilet flushing and for the irrigation of urban agriculture. Its objective is to demonstrate through practical application that a circular economy in the water sector using safe and efficient water technology can reduce domestic drinking water demand by 30% - 70% through greywater recycling. Greywater is household wastewater that does not contain faeces, i.e. water from showers, sinks, washing machines or kitchens. The pilot project plays an important role in climate adaptation by supplying hygienically safe irrigation water for the Roof Water Farm greenhouse for food production and non-edible plants in the courtyard for microclimate improvement. When used as service water in households, i.e. for toilet flushing, greywater recycling preserves groundwater resources, while assisting in reducing operating costs for residents.

The technology has been promoted through public relations efforts to facilitate its wider dissemination, aided by the central location of the pilot project. Guided tours are available for businesses, government agencies and educational institutions to demonstrate the functionality, economic aspects, and knowledge transfer related to water, energy and nutrients.



Berlin, Germany

Main challenges and goals

Water recycling:

- must be hygienically safe.
- should not cause any loss of comfort for users.
- should reduce the burden on the environment.
- should also reduce water costs for users.

Usage patterns and substance inputs, including paint residues, vary among residents, causing significant diurnal fluctuations. The plant is designed to withstand such inputs, minimizing overall water quality impact. Online monitoring is crucial for process optimization, addressing the technical challenge of balancing material expenditure and operational safety through Digitalization 4.0.

While the project excels in its primary work areas, the circular economy aspect faces neglect or hindrances from the water lobby and administration.

Despite praise from civil society, the press, and politicians, there's a lack of substantial policymaker actions to address drought through water recycling.

Developing water recycling technology is crucial to achieving high rates, exceeding 30% and reaching around 70%. This technology treats both lightly contaminated greywater and heavily polluted fractions from washing machines and kitchens, ensuring stability against faulty discharges like household chemicals, solids, and paint residues, and minimising system damage.

It ensures stable, high-quality water production, reducing costs through digitalization. Comprehensive monitoring enhances system transparency and efficient thermal energy use from greywater. This technology is crucial for sustainable water use, minimizing environmental impact by treating both lightly and heavily polluted water. It opens pathways for efficient water recycling in residential and industrial areas, representing a significant step towards a resource-conscious future.

Besides technical and scientific aspects, the project organizes training, seminars, tours, and publications for professional associations like the Chamber of Architects, the Federal Association for Process and Rainwater, and universities.



Berlin, Germany

Project innovations

The pilot project stands out as potentially the first of its kind, as it not only treats wastewater from showers and washbasins for possible reuse but also handles more polluted water from washing machines and even highly polluted greywater from kitchens. The treated water leaving the plant exceeds the quality standards of conventional wastewater treatment plants by a significant margin.

In addition to assessing the quality of the incoming and outgoing water, the pilot project incorporates online monitoring. This enables real-time monitoring and control of water quality, levels and equipment status. This, in turn, significantly shortens maintenance intervals, leading to improved operational efficiency. Another noteworthy aspect is the energy savings achieved by extracting the heat from the warm greywater to use it for domestic hot water.

Replication of the project

For the implementation, it is advisable to address the following actors, usually in the order indicated:

- Investor or property owner
- Designers (architects, building services)
- Installation company
- System operation and maintenance company

Resources needed

The project requires an initial investment for design and construction costs. However, depending on local water costs for drinking water and wastewater, this will be recouped over time, usually in less than 10 years. The payback period depends on local conditions, including of course water and energy costs.

The involvement of experienced individuals is crucial for designing, building and operating the system. Maintenance, in particular, plays an important role in ensuring long-term success, as many treatment plants face challenges when users are unwilling to cover the costs of operators.

A business model, a civil society initiative, a public service innovation...?

It is a business model that benefits the environment and customers.

Advice for potential replicators

There is scarcely anything in this world that someone cannot make a little worse and sell a little cheaper, and the people who go by price alone become the just prey of such people.

John Ruskin (1819 - 1900)

While it is not wise to overpay, paying too little is even riskier. Overpaying means losing some money, but paying too little might result in losing everything, as the purchased object may not fulfil its intended purpose.



Berlin, Germany



Amsterdam, Netherlands

Amsterdam, Metabolic Institute Open-Source Aquaponics Farm

The main objective of the pilot is to develop and implement an open-source aquaponic farm, based at 'De Ceugel' in North Amsterdam. An aquaponic farm combines fish cultivation (aquaculture) and soilless plant cultivation (hydroponics). The open-source element entails that the necessary technical knowledge for replicating the farm and its diverse plant-growing systems are available and can be built upon. As such, this pilot aims to be a showcase and educational centre for urban food production. It combines various plant-growing systems and develops aquaponics management software to support urban farmers. Situated at De Ceugel, a former brownfield and industrial shipyard became a living lab for circular urban development. The pilot project first focused on expanding the existing aquaponics system to boost dish and vegetable production for the local community. The aquaponics greenhouse now serves as a training space for disseminating aquaponics techniques, enabling local citizens to design, build and manage their own small-scale aquaponic units.



Amsterdam, Netherlands

Main challenges and goals

- **Modular Plant Growing Systems:** Conducts R&D for developing modular systems in aquaponic farms, offering blueprints for replication.
- **Management and Monitoring Software:** Creates a system with sensors to monitor, and inform farmers for safe operating conditions.
- **Circularity Enhancement:** R&D methods to improve nutrient cycling in aquaponics systems, including insect feed and struvite recovery.
- **Education and Training:** Offers citizens and pupils training for aquaponics system

Project innovations

- **Technically:** Develops a modular growing system for aquaponic farms, offering urban farmers flexibility. Creates a simple Minimum Viable Product (MVP) monitoring dashboard for real-time insights into farm performance and health.

- **Social:** Trains citizens in a novel urban food production system and educates young pupils on sustainable urban farming.

Replication of the project

The main actors to work with for replication purposes can be divided into four groups:

- **Urban farmers:** Individuals within urban food communities keen on soilless food production systems in their local area.
- **Citizens and pupils:** Individuals interested in understanding and contributing to the sustainability of their urban food systems.
- **Restaurants:** Purchase local, nutritious food to enhance recipes, creating demand for local produce and serving as a platform for urban food products.
- **Municipality:** Often owning the land where urban farming activities take place and can influence rezoning to facilitate food production activities.

Resources needed

- **Financing and investment:** Funds for replication, documentation, R&D, stable monitoring software, and hardware system upgrades.
- **Business development support:** Assistance in refining the farm and ensure its long-term sustainability.
- **Legal support:** Guides in navigating regulations, especially for the sale of fish products produced at the farm.



A business model, a civil society initiative, a public service innovation...?

This activity operates as a civil society initiative rather than a conventional business model. Managed by Metabolic Institute, a non-profit research institute, its primary objectives are to showcase an alternative, sustainable urban food production system to the public and serve as an R&D location for other urban farmers. It is currently located at De Ceuvel, which is in itself a testing area for sustainable urban systems and managed by an association of organisations. Metabolic is one of these organisations. The initiative aims to continuously illustrate the importance of closing resource loops in urban systems (material, food, feed, nutrient, waste).

Advice for potential replicators

The R&D process demands long cycles of repetition, necessitating a significant investing of personnel hours. This can pose a challenge without a strong business model capable of buffering this time investment. Additionally, software development, being inherently costly and requiring substantial upfront investment for acquiring necessary skill sets, demands strategic planning.

Public subsidies serve as a valuable mechanism for initiating activities, enabling experimentation, and laying the foundation of an initiative. Therefore, it is advisable to develop a business model early in the process.

A fruitful approach is to establish partnerships with universities. This not only provides specific expertise to enhance farm operations but also transforms the initiative into a test bed for researchers, fostering a collaborative and mutually beneficial environment.



Tenerife, Spain

Tenerife, ECOTÚNIDOS

The main objective of the pilot on Tenerife, launched in 2018, is to promote the consumption of locally caught artisanal fish in the Canary Islands. The pilot seeks to establish a connection between local producers and their organisations with potential local consumers, starting with school canteens. Together with fisheries organisations, the project aims to reduce the reliance on imported fish and instead provide fresh, local fish to pupils in the school canteens across the Canary Islands, contributing to healthier meals. Overall, the project aims at optimising local seafood by implementing activities in different arenas, including supply, processing, and demand, to enhance the connection between both ends of the value chain.

Main challenges and goals

Areas of work and problems it addresses:

- **Enhance Artisanal Fishing:** Addressing the needs of artisanal fishing to increase profitability, reduce abandonment, and encourage younger generations to participate.
- **Safeguard Marine Resources:** Initiatives aimed at the preservation and conservation of marine resources, ensuring their sustainable use.
- **Revaluation of Fishing Heritage:** Promoting the cultural values inherent in the fishing heritage, emphasising its significance and contribution to the community.
- **Synergies in Seafood Production:** Encouraging synergies between local producers, the processing of seafood at the local level, and consumers to strengthen the local seafood industry.
- **Childhood Awareness and Sensitization:** Raising awareness and sensitization in the childhood stage about the importance of artisanal fishing and the health benefits associated with seafood consumption.



Tenerife, Spain

Project innovations

The project innovates in three main aspects. It features technical, as well as economic and social innovations.

Technical component: The project encourages new processing techniques for artisanal fishers, allowing them to customize products like loins, fillets, and deep-frozen options to meet consumer preferences. It aligns with evolving consumption patterns that favour cuts facilitating culinary tasks for efficiency, cleanliness, accessibility, and ease.

Economic standpoint: The project advocates a marketing shift from seafood exports to local markets, potentially being as or more profitable. This transition aims to eliminate the need for export-related subsidies, enhancing local producers' livelihoods and creating job opportunities, especially in the Archipelago's processing sector.

Social dimension: The project promotes local fish consumption, fostering healthier eating habits, ensuring food security, and strengthening food sovereignty within the Archipelago. Starting with childhood, it conducts training activities to highlight the value of artisanal fishing products and their gastronomic significance.

The project primarily focuses on transforming the value chain of tuna species in the Canary Islands, addressing all three sustainability dimensions. Environmentally, it promotes low-impact artisanal fishing, reducing carbon footprint and optimizing catches for marine ecosystem enhancement. Economically, it optimizes the local seafood value chain, replacing exports with a fair local market, and improving living conditions for producers. Additionally, the project actively engages with the social dimension.

The project aims to enhance healthy nutrition, and food security, and preserve artisanal fishing, local fishing heritage, and cultural values. It promotes collective action through cooperatives in the sector. Situated knowledge is crucial for environmental sustainability by safeguarding marine biodiversity, economic sustainability through promoting local consumption, and social sustainability through educational programs focusing on sustainability values, especially for children.



Tenerife, Spain

Replication of the project

The main actors to work with for replication purposes can be divided into three groups:

- Producers and local fishers' organisations.
- Potential local consumers: So far, school canteens and recently university canteens have been involved to reach local consumers with the idea of expansion to the Canarian society.
- Facilitators: The University of La Laguna and the Island Government (Cabildo de Tenerife) have played pivotal roles as facilitators, connecting different actors in the process.

The overarching goal is to expand the initiative across society, starting with schools. Presently, producers and fisher organisations from Tenerife, El Hierro, and a dozen schools from Tenerife are involved, with potential for expansion to other islands as well.

Resources needed

The necessary resources are the following:

- Financing and Investment: Funding for fish processing, covering the establishment of processing rooms across various islands and implementing changes in the business model and commercial activity.
- Human Capital: Adequate human resources to drive the initiative forward, encompassing skilled individuals across various roles.
- Support Staff: Inclusive of support staff, with a preference for involvement from the public. Their assistance is crucial for the implementation and expansion of the initiative.



A business model, a civil society initiative, a public service innovation...?

The pilot, a collaborative effort with the University of La Laguna and fishers' organizations like Islatuna and Pescaretinga, is supported by the local government. Together, they aim to establish a new business model for local producers and fishers, shifting from an export-oriented model to developing local markets and consumption. Processing rooms inspired by Ecotunidos are planned or under construction in El Hierro and La Palma, with regional government and Cabildos expressing interest, initially targeting school canteens and planning to expand to other market segments.

Advice for potential replicators

To implement the proposed innovations successfully, it's crucial to research the unique characteristics of the territory. This involves studying opportunities for introducing specific seafood products to local markets, understanding processing requirements, and analyzing collective actions within the sector or the involvement of local enterprises. Additionally, assessing potential demand and receptivity across various consumer segments is essential.

Implementing these innovations may require control methods for designing corrective or preventive actions if needed, ensuring quality during project replication. Early-stage feasibility investigations are crucial to check market viability and customer development. Public subsidies, including funds from the European Maritime, Fisheries and Aquaculture Fund (EMFAF), can play a crucial role in supporting these innovations in various local contexts.

Existing market strategies are often hindered by inertia, as seen in the Canary Islands' traditional export of raw tuna. Acknowledging the profitability of local markets, external advice from researchers may be crucial to exploring new possibilities. Public institutions play an essential role in deploying these strategies and supporting fishermen's organizations.



Iasi, Romania

Iasi, Centrul Urban de Inițiativă Bună (CUIB)

The “Centrul Urban de Inițiativă Bună” (CUIB) is a sustainable bistro located in Iasi, Romania run by Mai Bine. Not only is it renowned as one of the most popular local restaurants, but it also stands out for its commitment to the environment and social impact. Founded in 2013, the bistro strives to promote sustainable development by minimizing its environmental footprint and maximizing the positive social impact of its products and services. What sets the bistro apart is its dedication to the circular economy and the adoption of the zero-waste principle.

Main challenges and goals

CUIB is a regional pioneer in HORECA, setting sustainable standards. With more than 20,000 visitors, it's a beacon for good food and positive social/environmental impact. Exceptional locally, CUIB integrates multiple dimensions of sustainable food consumption, transforming the approach to address the need for alternatives.

Furthermore, the pilot carries out the following activities:

- Food delivery service: in November 2020 CUIB implemented a number of initiatives to develop solutions to the ongoing challenges on food systems operated by the COVID-19 pandemics. This led to the launch of daily food delivery services, embracing zero waste and low environmental impact. Open to all, customers get discounts for biking in and using reusable packaging.
- Educational and outreach activities: CUIB raises awareness through education and hosting events like urban horticulture workshops and events, promoting healthy diets and local producers.



Iasi, Romania

- Urban gardening and composting: A pilot community garden with raised beds was created, providing kitchen ingredients like mint, basil, chard, green beans, and zucchini. Youth under 30 actively participate in a bio-waste composting initiative.
- Zero-waste shop: Inside the bistro, a small zero-waste shop offers both food and non-food products.
- Food waste prevention: The pilot redirects more than 95% of supermarket food to vulnerable individuals. Since 2021, Mai Bine volunteers collected more than 60 tonnes, aiding people and refugees, especially Iasi's homeless. In the last three years, the pilot cooked free soup, helping more than 100 beneficiaries, around a quarter of Iasi's homeless. In 2022, 4 Ukrainian refugees were hired, cooking over 10,000 free portions.

Project innovations

CUIB's innovations focus on frugal, social, and policy aspects. Among these, integrating low-waste operational practices and redistributing recovered food waste stands out for its efficient resource use/impact ratio. Ambitious goals include becoming Romania's first zero-waste certified bistro and establishing the first local food bank.

Replication of the project

- Other HORECA actors: Collaborative engagement with like-minded HORECA partners to integrate practices reducing resource use and waste generation.
- Suppliers: Suppliers drive change by adhering to our packaging requirements, and influencing other actors with their modified practices.
- Consumers: Consumers can be ambassadors, supporting and promoting the replication of our practices by other economic actors.
- Activists: Advocates for change, activities contribute by proposing public policy changes

Resources needed

- Human capital: Expertise in green business practices is crucial.
- Support staff: Dedicated staff ensures project success.
- Equipment: Essential for food waste recovery is acquiring necessary equipment, ensuring compliance with health regulations.



A business model, a civil society initiative, a public service innovation...?

CUIB's activity was initiated and continues to be coordinated by the members of Mai bine, making it a civil society initiative. The activity was initially developed based on a business plan model. Looking ahead, our goal is to not only influence public policies but also to inspire the transformation of public services towards the incorporation of sustainability practices.

Advice for potential replicators

It is not at all an etymological coincidence that the word “ecology” and “economy” share the same prefix “eco”. In the long run, with proper knowledge and understanding of life cycle analysis and low impact operational practices, our frugal innovations prove to be both ecological and economical. The most important investments required for adopting these practices are represented by time – necessitated for team training, progress monitoring, results evaluation, proactive communication with public for awareness, and advocacy for public policies facilitating easier replication.



Lansingerland, Netherlands

Bleiswijk, Wageningen & Gemeente Lansingerland, Plant factory for demonstrational purposes

This pilot is a fully operational experimental plant factory, complete with artificial lighting. It is located in the research facility of the "Greenhouse Horticulture" unit of Wageningen University and Research, in the heart of Lansingerland Municipality. This is the second largest greenhouse horticulture municipality in the Netherlands. This pilot project aims to be a demonstration centre for growers, producers, and suppliers, seeking to answer questions related to crop selection, climate, and the most suitable cultivation strategy for vertical farming and commercial greenhouses. Its other core focus is to act as an educational centre for civil society (e.g., schools, families, etc.) to raise awareness on how fruits and vegetables are produced in controlled environments and what innovative and environmentally sustainable systems are available to address current and future challenges.

Main challenges and goals

- Optimize climate and crop management for increased production efficiency and resource utilization in vertical farms and greenhouses.
- Educate civil society about controlled-environment food production, like vertical farms, and their impact on the food system.
- Evaluate crop productivity and resource efficiency in controlled environments, emphasizing accurate measurement and data analysis for transparency and enhanced efficiency in vertical farming.



Lansingerland, Netherlands

By addressing these areas, the pilot initiatives strive to improve productivity, resource efficiency, and public understanding of controlled-environment systems.

Within the pilot, two distinct activities are undertaken: applied research and educational and dissemination activities.

- **Applied research:** The vertical farm's advanced climate control makes it an ideal tool for researching production recipes, light spectrum optimization, new crops, and more. This contributes to vertical farming and provides insights into greenhouse horticulture. The farm prioritizes airtightness and incorporates numerous electricity and flow counters. The vertical farm, with its airtight design and various counters, enables researchers to assess energy, water, and CO₂ balances, as well as the effects and efficiency of different climate recipes.

- **Educational and dissemination activities:** Master's and PhD students have opportunities to collaborate on projects, conduct thesis research, and pursue internships, partnering with Wageningen University and other international institutions. The team organizes training workshops on controlled-environment production for local growers and specialists. Additionally, the project aims to provide an educational experience for children and families, showcasing innovative and sustainable systems addressing present and future challenges.

Project innovations

The project innovates technically and socially:

- **Technically,** it integrates optimized protocols from collaborative research to address energy consumption challenges, aiming for efficient nutrient and water use while maintaining high product quality.
- **Socially,** it engages students in horticulture careers and conducts educational activities for pupils and families, inspiring them about sustainable food production.



Lansingerland, Netherlands

Replication of the project

The main actors to work with for replication purposes are:

- **Researchers:** Individuals responsible for conducting research and educational activities and dissemination of the outcomes.
- **Technical staff:** Personnel overseeing routine operations within the farm, ensuring proper operation of the system and the production.
- **Local administration/municipality:** Entities possessing the relevance and network to bridge the gap between the research institutions, schools and families.
- **Growers and horticultural suppliers:** Stakeholders with existing or potential systems, as well as available testing equipment.
- **Schools and pupils:** Individuals eager to understand and contribute to the sustainability of their urban food systems.
- **Funders/investors:** Entities offering vital multi-year funding for sustainable horticultural projects.

Resources needed

- **Financial Resources:** to support all the costs related to the farm activities including personnel.
- **Human Resources:** all the people who work on the project (researchers, high-skilled staff)
- **Physical Resources:** These are the resources that can be seen and touched, such as land, buildings, and machinery.



A business model, a civil society initiative, a public service innovation...?

The plant factory in Bleiswijk was established for research purposes. It serves as a primary research tool for gathering valuable information on the cultivation of various crops and resource use. The obtained results are used to inform stakeholders, policy makers as well as for academic and educational purposes.

Advice for potential replicators

Vertical farming presents challenges due to its high costs in terms of both technical requirements and labour. It is crucial to secure sufficient financial resources to initiate and sustain projects over time. In this regard, establishing a network of suppliers who offer discounted materials and services (such as software, equipment, sensors, seeds, substrates, etc.) in exchange for promotional opportunities can be advantageous.

For research institutes and universities planning to construct vertical farms for research and demonstration purposes, it is essential to consider the time and personnel required for outreach and educational activities. These aspects are often overlooked in research projects. Additionally, ensuring the presence of trained and highly skilled employees is essential for managing and operating the system effectively, guaranteeing optimal production.



Romainville, France

Romainville, Cité Maraîchère

Established in 2021, the "Cité Maraîchère" in Romainville, near Paris, serves a population of 32,000 in the Seine St Denis department, the youngest and poorest in continental France. Historically vital in agriculture, supplying Paris, it lost significance due to urbanization and industrialization. The project aims to improve diets, reduce the producer-consumer distance, and raise awareness about food production.

The project is a municipal facility for urban agriculture—a vertical farm housing various activities under one roof:

- Market garden: Enhancing local food supply with prices adapted to the public, producing among others, endives, and mushrooms;
- Educational spaces: Providing community spaces for training, workshops, meetings, and cultural events to raise awareness about food, health, and the environment.
- Open spaces: Featuring gardens for education, a community square, and a neighbourhood composter;
- Les Cheffes: A 50-seat cafeteria uses local produce, organizing events like cooking classes and concerts to enhance social cohesion and make cultural activities accessible to all.
- Le jardin e(s)t la recette: (private actor selected through a call for projects): A place for food transformation, from wild plants to dry food.

Cité Maraîchère, guiding urban agriculture policy, expands its impact beyond the vertical farm with initiatives like CasseDalle garden, school gardens, and orchards. Its dual goals involve raising awareness on food, health, and the environment, providing accessible local products, and fostering social cohesion through meaningful exchanges and gatherings.



Romainville, France

Main challenges and goals

In the poorest department of continental France, Romainville faces challenges with limited access to affordable fruits and vegetables, often due to both costs and limited cooking skills in disadvantaged households. As part of the Est Ensemble group, Romainville has limited green spaces—only 6 m² per inhabitant, one of the lowest in France. The pilot aims to connect residents with nature, raise environmental awareness, and highlight the impact of food production on health and the environment.

Project innovations

The pilot introduces innovations for better food access and community engagement. It includes a household income-based pricing system, offering reduced rates to residents based on family income. The standard rate applies to non-residents or those with higher incomes, while Romainville residents enjoy up to a 75% reduction.

Various tailored activities engage kids from preschool to high school, spanning all Romainville schools and extending beyond. Additionally, diverse weekend and occasional weekday activities target kids, parents, and adults, focusing on environmental awareness. These activities enhance community cohesion, social networks, and confidence. The pilot contributes to the skills of unemployed individuals through integration activities. Technologically, it's middle-tech, operating as an indoor vertical farm with low-tech practices like sowing plants in recycled substrate from city waste.

The production process minimizes LED light, and an area experimenting with limited light exposure now hosts a food processing company. This company, "Le jardin e(s)t la recette," produces herb mixes using harvests from non-professional gardeners, including weeds, contributing to a sustainable food system. Adjustments involve reducing production boxes at the lowest level to minimize shadows, and strategically relocating surplus boxes to another area overseen by Cité Maraîchère. The new Casse-Dalle Garden on an 800 m² wasteland, includes a collective garden, coop, fruit grove, and hives managed by inhabitants with the pilot's help. Renovation work on a former "peach wall" and regular cultural events with residents add to the community engagement.



Romainville, France

Replication of the project

The stakeholders involved in the project:

- Public authorities, including for grants
- Suppliers for seeds, plants, substrate, mushrooms, etc.
- Sustainable economic network, local and national
- Local business partners
- Local civil society organisations
- Schools
- Inhabitants
- Universities and researcher

Stakeholders, including public authorities, local partners, and universities, have been involved since the project's inception. Additional participants, such as suppliers, business partners, schools, and residents, joined later to align with their needs and opportunities.

Resources needed

- Enough space for cultivation and production (350m² for vegetables, 100m² for mushrooms, 30m² for endives, 170m² for outdoor farming).
- The technical facilities like storage, warming, office, etc.
- Area for integrated services
- Space for social and teaching events
- Sufficient construction costs: The total annual costs must correspond to the annual income. The municipality also provides the back office with financial support, law, etc. public grants for employment or innovative activities are needed, but it is a transfer of public service to the Cité Maraichère .
- Skills: Employees develop necessary skills as part of their training, requiring a farm manager and animation manager for crop production and diverse audience activities.
- Equipment: For food production, small agri-equipment and inputs (substrate, seeds, biocontrol agents), energy and water are necessary as in any farm.



A business model, a civil society initiative, a public service innovation...?

This activity is a public service innovation, however there has been a lot of work on the business model, including the services provided by the pilot (school activities, café-canteen) and sales to balance the business model.

Advice for potential replicators

The pilot, with numerous innovations, welcomes visits from both French and foreign stakeholders interested in replicating its management. While striving for a stable business model, it relies on continuous public funding for daily operations, offering all activities for free. Public funding and patronage for construction were essential, highlighting the challenge of building a sustainable model for such pilots. The investment, measured not just in money but also in working hours from conception to daily operations, involves many people to achieve production and education goals.

There is also an important need for long-term support by public authorities and politics as this pilot took nearly 10 years from the first idea to its opening.

Thirdly, it is important to be very careful in the project-development phase as the building in Romainville showed that the conception was deficient for the light availability in the lowest floors, thus could only be productive if additional lighting was provided, which would cost more.

All this work around market gardening and other urban productions has opened a new vista for the city administration, which is planning to create new urban agricultural spaces in the city with the help of local stakeholders including inhabitants, local private companies, and local associations in the development of these new spaces.



Bologna, Italy

Bologna, SalusSpace

SalusSpace is an urban regeneration project started in 2017 within the framework of UIA Programme (Urban Innovative Actions) on the grounds of the former private clinic Villa Salus, which has been neglected for many years. The overall objective of the project was the establishment of a hospitality centre in the local context, focussing on work, intercultural welfare, and well-being. SalusSpace is an example of a CRFS initiative that combines social inclusion, urban food production, public-private governance, and urban regeneration.



Bologna, Italy

Main challenges and goals

The pilot continues the innovative experience initiated within the UIA project. Collaborative governance involves a diverse community, including families of various cultural backgrounds, refugees, and asylum seekers. Originating as an Urban Agriculture project during the pandemic, it grew into a crucial element of the Sustainability Plan. Further developments are planned to explore new technologies with a community-based approach.

In particular, the pilot development has focused on the following areas of work:

- Experimenting with new urban agriculture technologies, especially vertical farming, and using two shipping containers for mushroom and microgreen production.
- Co-design and implementation of community gardens, for everyone's wellbeing.
- Co-design and implementation of a rooftop garden.

- Designing and implementing a bio-lake and fertigation system for productive gardens, following aquaponic principles. It serves as both a water basin during droughts and a biodiversity reservoir.
- Provide technical assistance to establish an agricultural social enterprise engaging vulnerable people in managing food systems in Salus Space. Economic plans should consider existing services and opportunities, exploring synergies for a sustainable food system (e.g., restaurant, food processing, delivery solutions, farmers markets, etc).
- training and raising awareness activities addressed to the local inhabitants and to the broader population of the district/city.

The pilot project addresses three sustainability dimensions. Energy for containers comes from photovoltaic panels, and crops use biolake-based fertigation systems, along with rainwater recovery, ensuring high environmental standards. Social sustainability is achieved through extensive participation and engagement of inhabitants in collaborative housing blocks. Long-term planning involves building partnerships and evaluating legal forms within the tested public-private collaborative governance. The ultimate goal is to create an agricultural social enterprise, aspiring to a replicable model for other Italian and European cities.

In the FoodE pilot phase, activities encompass training courses on aquaponic design, biolakes, and vertical farming.



Site visits and seminars were part of the MyLocalFoodE event in Bologna. Salus Space operates under a continually updated Charter of Values shaped by resident input, serving as the framework for the FoodE pilot with a focus on social inclusion, mutual respect, collaboration, civic participation, and environmental sustainability.

The Urban Farm call gathered ideas from international students on Urban Agriculture and Smart Horticulture and discussed them with Salus Space inhabitants. A resident group designed the community garden, considering budget constraints and the Municipality's technical requirements. Regular meetings have been updating Salus Space inhabitants on FoodE achievements, and involved the managing structure (ATS) and the Municipality in a supervisory role.

Project innovations

The key innovation is social, transforming the area into a hub for intercultural dialogue, social inclusion, capacity building, and income generation.

SalusSpace introduces policy and economic innovations, addressing economic sustainability and public-private management challenges. the pilot involves residents through participatory planning (co-design) with a focus on generative and intercultural welfare.

To achieve this, the original toponym "Salus" or Health is reclaimed, emphasizing well-being as "a state of complete physical, mental, and social well-

being and not just the absence of disease" (WHO definition). This applies to the city in general and the various target guests for temporary residency in the facility.

The pilot aims to test innovative technical solutions like vertical farming, involving scientific research with the University's active role. It supports economic sustainability through the creation of a business model and encourages the formation of an inclusive agricultural social enterprise.

Replication of the project

The main actors to work with for replication purposes:

- Local consumers (e.g. for the restaurant)
- Technicians and experts of the technologies (e.g. for the vertical farm)
- University and Research Centers
- Community (in a broad sense, including inhabitants, workers, visitors, etc.)

Resources needed

The necessary resources are the following:

- Financing and investment
- Human capital
- Support staff (public administrations would be desirable) for the implementation and expansion of the initiative
- Scientific support



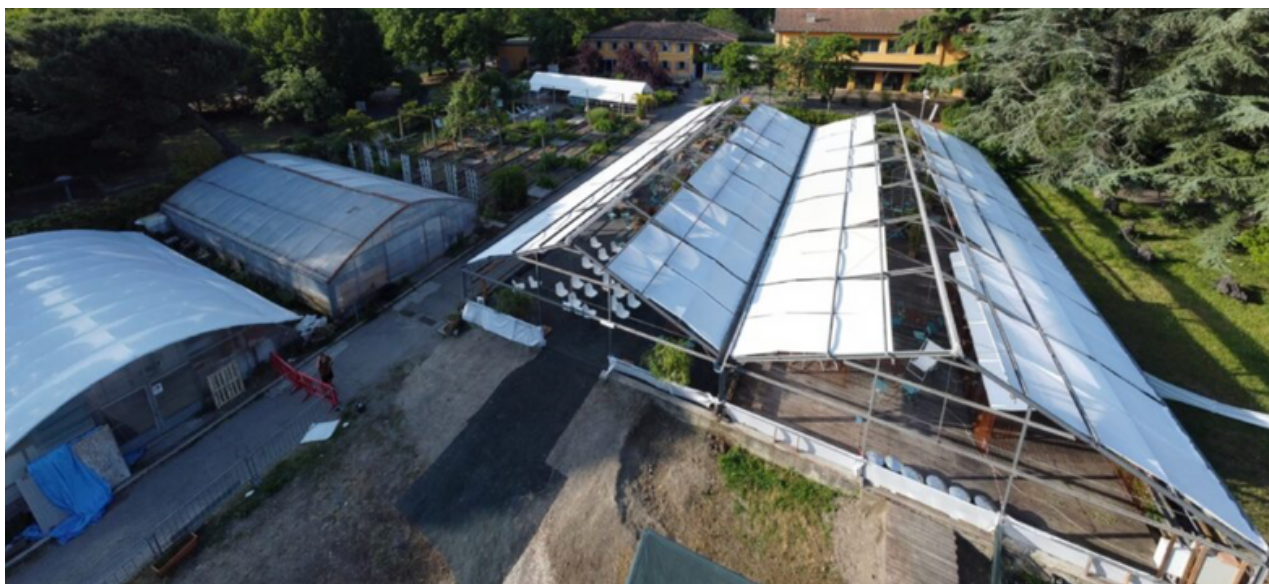


A business model, a civil society initiative, a public service innovation...?

This activity is a public service innovation, as the project leader is the Municipality of Bologna. The pilot is community-based in the sense that it involves the local community and provides a service that allows the empowerment and the inclusion of disadvantaged people. The business plan is a tool to achieve this goal.

Advice for potential replicators

The pilot implementation so far shows that the experience is self-sustainable and produces a social impact, however some specifications need to be made for potential replicators. First, the project requires an initial investment that can be provided by the public administration which is necessary to develop an effective monitoring and evaluation system to prove the economic and social impact of the investment. Second, it requires a scientific committee or advisory board to establish the best technologies and maximise the use of natural resources, such as renewable energy and water resources. Third, it must be strongly connected to the local social environment, engaging inhabitants from the very beginning to generate a collaborative ecosystem and involve the community.



Bologna, Italy

Bologna, Le Serre dei Giardini Margherita

Located in Bologna's largest urban park, "Serre dei Giardini Margherita" is a regenerated space and a cultural centre. The project was developed in 2014 after the requalification of the old abandoned municipal greenhouses and the pilot has created a new public space surrounded by nature and culture and filled with projects and activities. The project promotes free access and participation for all citizens, aiming to encourage the emergence of active communities, capable of combining art, innovation and culture in the creation of a new imaginary that contributes to the sustainable transformation of our cities. By creating an opportunity for a change, the project wants to be an example for the generation of spaces that not only aim at sustainability and inclusion but also redefine the relationship between man and nature by designing a new equilibrium.



Bologna, Italy

Main challenges and goals

Le Serre caters to urban citizens' needs, offering a space blending nature, urban agriculture, and art as a public square for relaxation, study, work, and socializing. The restaurant and bar provide sustainable, healthy food, while events and festivals address education on social and natural transformations. The project aims to bridge the gap by serving as a concrete example, inspiring people to envision and create similar spaces in their cities.

Le Serre is a multi-faceted project and includes several differentiated activities:

- The vegetable garden and aquaponic projects are innovative community horticultural initiatives, enhancing space design and serving as valuable tools for community education on diversified urban agricultural production.

- Le Serre strives to establish an artistic production centre that unites research, business, and art to address significant challenges like sustainability and climate change.
- The vegetarian restaurant utilizes ingredients from its on-site garden, promoting local sustainable sourcing. It not only offers sustainable gastronomy in Bologna but also educates patrons on food seasonality and diversity, featuring ancient and wild varieties on the menu.
- Le Serre is an open and inclusive space, accessible to all. Providing seating, free wifi, electricity and water, coworking and study spaces are integrated between the vegetable garden and the restaurant, creating an urban connection between what is usually separate. It also integrates an educational space for children, teachers and schools.
- By hosting workshops, lectures, conferences and other cultural activities, Le Serre continuously expands its activities to better represent the diversity of its visitors.

Project innovations

Le Serre pioneers social innovation within the pillars of Sustainable Development. Its design and activities promote community learning, education, and social integration through art and nature. Technical innovations, like hydroponic and aquaponic projects, engage citizens in transforming the space, blending food production with recreation and work. This citizen involvement fosters a new vision for a sustainable urban city system.



Bologna, Italy

Replication of the project

Key stakeholders range from the public sector to civil society and the private sector:

- The Regional Office plays a crucial role, actively supporting and funding territorial infrastructure development.
- The Municipality of Bologna has granted 15-year access to public space, ensuring long-term support for the innovative project.
- Cooperative Kilowatt plays a crucial role in fundraising, planning, and managing the project, serving as a bridge between public authorities, private foundations, and various stakeholders involved in community innovation.
- As the project is designed for people, the citizens also play an important role by participating and living in the space.

Resources needed

Several are the resources needed for the project:

- Financing and investment, both from private and public actors;
- The ability to access and improve an unused public space, rather than building something new and with the aim of regenerating an already existing space;
- A cooperative, start-up or association that is willing to manage the space and the other interested actors;
- Associations and stakeholders support the project by helping to organise activities and events.

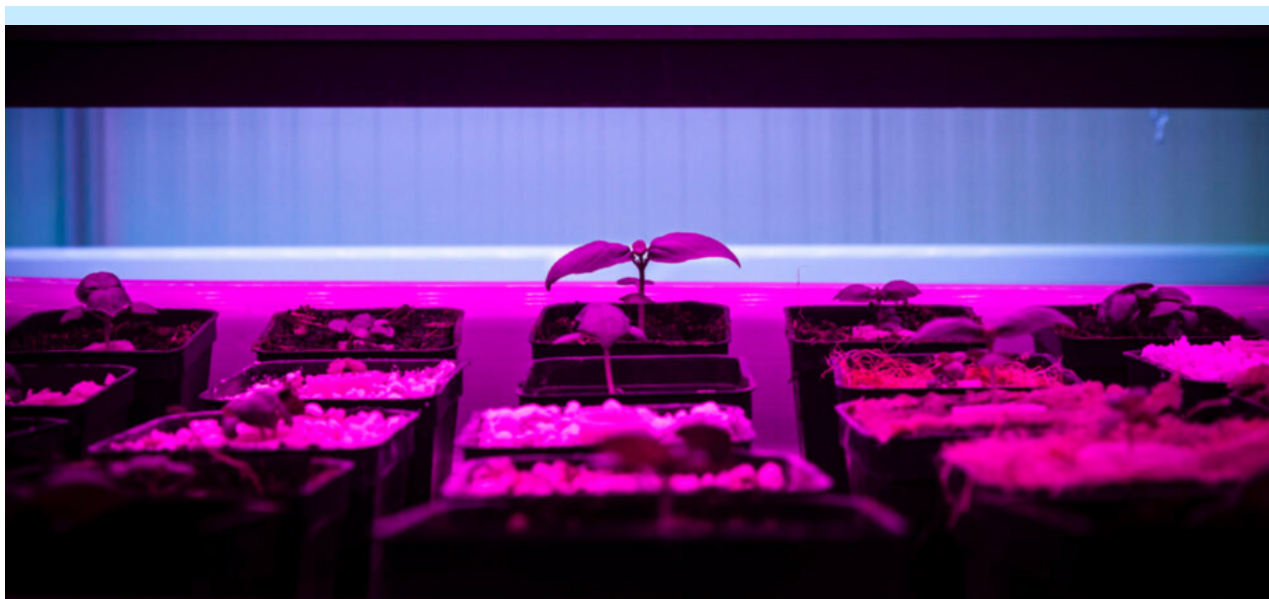


A business model, a civil society initiative, a public service innovation...?

The project develops as a business model with a strong social vocation, thanks to the hybridisation between private, profit and non-profit activities. The aim is to generate value through active participation and redistribute it to the community. The project represents an experiment in the development of social entrepreneurship that seeks to find new models to respond to the social needs of citizens while remaining sustainable on the market.

Advice for potential replicators

For the potential replicators of this project, there are a few main points that should be mentioned. Firstly, the adoption of an impact business model and a lean organisation. Another main aspect is striking a balance between B2B and B2C activities and business plans. In addition, it is necessary to build multilevel networks, both geographical and institutional. Finally, it is important to maintain continuous attention to emerging needs and involve stakeholders actively.



Bologna, Italy

Bologna, AlmaVFarm

This pilot has two main objectives: first, assessing the resource use efficiency (water, energy, soil, carbon footprint) of vertical farms. Second, communicating and disseminating new vertical farming practices to students and stakeholders, since AlmaVFarm is the first fully visitable research facility for vertical farming in Italy.



Bologna, Italy

Main challenges and goals

- Intensive urban food production through advanced soilless systems.
- Sustainability aspects of the vertical farms.
- Future perspectives and potential expansion of indoor cultivation facilities in (peri)urban areas.
- Resource use efficiency and overall carbon footprint of vertical farming.

The main activity involves studying crop production and resource use efficiency in vertical farming systems, primarily led by the University of Bologna:

- Opening the vertical farm for visits from institutions, companies, and private citizens to share knowledge on vertical farming.
- Organizing internships and training programs for students from the University of Bologna and abroad.
- Serving as a tool for master thesis and experiments by students.

Project innovations

The pilot innovates in technical, social, and economic aspects. Technically, it advances research on vertical farming, improving cultivation recipes. Socially, it raises awareness by opening the farm to students and visitors. Economically, it supports students through thesis development and training, aiming to create job opportunities in future vertical farming projects.

Replication of the project

The main actors to work with for replication purposes can be divided into two groups:

- System providers: companies supplying essential components for the vertical farm.
- Researchers and students: Researchers experiment for efficient resource use in vertical farming, educating students about these systems. AlmaVFarm stands out for its openness, welcoming those interested in learning and emphasizing dissemination activities for awareness and replication.

Resources needed

The resources needed are the following:

- Initial financing and investment: acquiring or renting a suitable building, installing cultivation systems, and setting up necessary infrastructure such as trails, racks, and artificial lights for food production.
- Knowledgeable staff with specific know-how on indoor cultivation systems.

A business model, a civil society initiative, a public service innovation...?

The pilot is specifically a research-oriented initiative, with the main objective being to better understand the technologies, potentialities, and sustainability of indoor cultivation systems. AlmaVFarm has therefore been set up to easily collect and verify all the input and output data of the system. Also, the production systems installed in the vertical farm are of two types: i) aeroponics, where plants' roots are immersed into the growing basins and irrigated by a pressurised mix of nutrients and water sprayed at regular intervals directly on the roots, and ii) ebb and flow, where plants grow in a growing media (e.g. a peat substrate) while the nutrient solutions are slowly provided directly inside the growing basin and later absorbed by the plants.

Establishing two growing systems at AlmaVFarm enables researchers to compare crop production methods, optimizing recipes for indoor food and plant cultivation.

Advice for potential replicators

The initial step in sustainable indoor farming is to design spaces and systems that maximize production, optimize climate control, and tailor fertigation for different crops and production methods. The design should align with the primary goal, whether focused on technological/economic innovation or the social aspects of urban food production.

To succeed in vertical farming, consider the local food, social, economic, and environmental context. The replicable concept centres on tailored indoor conditions, but factors like energy cost and water scarcity impact feasibility. Aligning vertical farms with locations offering cost-effective energy or abundant renewables is crucial.

In conclusion, the system and the technology are easily replicable provided the right design and operational know-how. Nonetheless, each vertical farm should adjust to the context in which it is designed and has a clear sight of the main objectives of indoor food production.



Sabadell, Spain

Sabadell, Urban agricultural park

Sabadell, the fifth most populous city in Catalonia, is a significant commercial and industrial center in the province of Barcelona, with over 200,000 inhabitants. Despite limited current agricultural activity, efforts led by the city council, agricultural unions, and environmental protection associations since the late '80s aim to promote the preservation of agriculture, local production, and the Mediterranean agroforestry mosaic.

Established in 2005, the Agricultural Park in Sabadell hosts active agricultural professionals cultivating fruits and vegetables for local markets. The Sabadell City Council actively supports urban farming initiatives and community gardens to promote local and sustainable production.

The pilot transformed two council open-air fields into the Agricultural Park and Ripoll River area and established an urban garden for experimental tests on traditional local varieties using organic production methods. The goal is to gather information to produce a local, quality product within a clean production system. Farmers from the Agricultural Park will directly sell their products to Sabadell's main market, involving local consumer cooperatives and schools.

The Sabadell City pilot project is located in Parc Agrari, Ripoll River and Hort urbà.



Sabadell, Spain

Main challenges and goals

The pilot co-creation included the pilot team, UAB researchers, students, agriculture promotion associations, consumer cooperatives, citizen associations, sellers of agroecological products, and food waste prevention groups. It addresses the demand for land access for social-pedagogical urban agriculture and local organic agriculture, covering three different areas.

- Can Gambús Pilot ("Parc Agrari" Peri urban Field).

Can Gambús, a one-hectare municipal land managed by Sabadell City Council, serves as a reference field for sustainable agriculture, emphasizing organic crops of local varieties to reduce water consumption, fertilizers, and environmental impact, while producing healthy foods to minimize food waste.

- Ripoll River Pilot (Horta de Can Roqueta)

Can Roqueta, a municipal vegetable garden space along the Ripoll River, comprises about 1,700m² cultivable land. For FoodE's pilot project, a 170m² plot is utilized through an agreement with Sabadell City Council's Economic Promotion service. Young people at risk of social exclusion receive horticulture training and cultivate the garden using organic criteria. The pilot serves educational purposes for secondary school groups, showcasing how Sabadell accommodates horticultural activities for fresh, quality, and local food production.

- Urban Garden Pilot (Carrer Borrell)

This rooftop garden was designated for Sabadell's associations, initiated with students in a horticulture course adhering to organic farming criteria. The garden includes areas for cultivation, tables, and experimental crops in reused textile material "sacks." Already in production, the first harvests support social canteens. Soon, the space will be raffled to social organizations in Sabadell, based on project proposals. The management is open for social organizations, with the winning entity responsible for conducting organic production workshops, community cooking activities, workshops, and food reuse initiatives for the next four years.



Sabadell, Spain

Resources needed

The resources needed are the following:

- Easy access to vacant municipal land.
- Financing and investment.
- Establish a land bank to connect producers with landowners, encouraging fair lease/sale prices, and exploring aid or subsidies to facilitate such agreements.
- Encouraging and facilitating the creation of associations and/or cooperatives that can manage farmland.

Project innovations

FoodE pilots innovate by repurposing unused municipal land for ecological and local agriculture, fostering both social use in urban gardens and professional orchards.

Replication of the project

The main actors to work with for replication purposes are:

- Municipality and Public entities: Municipality of Granollers, Sabadell City Council, Waste Agency of Catalonia, Catalan Climate Change Office);
- Research and educational institutes: University of Barcelona, researcher, schools, students.
- Cooperatives: Organic and Agriculture Cooperative;
- Non-profit organisations;
- SME in the agricultural sector.

A business model, a civil society initiative, a public service innovation...?

Urban gardens are both an initiative and a demand of urban civil society, and an effective public service that generates social and environmental improvements.

Professional peri-urban gardens are a business model that was gradually lost, but that should be promoted again, as it is one of the pillars of CRFS initiatives.

Advice for potential replicators

Administrations, like in this pilot, should simplify administrative procedures for municipal agricultural land, making it easy for professional farmers to access it. Additionally, small lots near the city should be awarded to individuals and associations through clear, quick, and simple administrative procedures for citizens.

Similar to other basic services (water, waste collection, parks, libraries, etc.), municipalities should treat local production and farmland as essential services. This involves developing the necessary infrastructure like paths, signage, warehouses, and irrigation if needed, to support urban farms.

All sectors involved in CRFS, professional local producers, neighbourhood associations, students and teachers, non-governmental associations, consumer cooperatives, agricultural unions, local administration, etc. must participate in the project to achieve its main objectives:

- Local, quality food from professional gardens with reduced food waste.
- Gardens for social and self-consumption, fostering food production and nature-city understanding.
- Training for neighbours and young people of the city, etc.
- To ensure success, support is crucial: organic farming trainers, mentor farmers, open days, and courses are essential.
- Unlocking disused farmland around cities is vital. Strengthening public-private land banks can facilitate new farmers' entry, overcoming challenges due to limited land availability and urban competition.
- It is also important to protect the agricultural soil preventing speculative activities or activities that have little to do with agriculture/livestock.
- Given the climate crisis, increasing transport costs, and uncertainty, city councils should actively promote and enhance urban and peri-urban land for local production.



Naples, Italy

Naples, Troisi Park

The pilot is located in Troisi Park, which was opened in 1981 to allow locals to engage with nature and to provide an area for exercise, leisure, and recreational activities to the local community. The park extends over an area of 12 hectares and accounts for built infrastructures and open fields, currently hosting Mediterranean plant species, some greenhouses and an artificial pond collecting rainwater. The overall objective of the pilot was the establishment of an on-farm demonstration centre in an agricultural area of about 0.5 hectares, including a renovated pre-existing greenhouse, to illustrate the use of new or significantly improved production systems, technologies, and crops. The pilot is managed by the Municipality of Naples with the support of the Department of Agricultural Sciences of the University of Naples Federico II.



Naples, Italy

Main challenges and goals

One of the main issues addressed by the pilot was the requalification of an agricultural area within Troisi Park by a collaborative approach between public institutions.

In the FoodE project, a greenhouse has been renovated for educational and demonstration activities by the University of Naples Federico II, promoting social, environmental, and educational functions. The project aims to actively engage local inhabitants to mitigate the risk of vandalism. The pilot development focuses on:

- Testing hydroponic technologies for greenhouse vegetable and microgreen production.
- Demonstration of an aquaponic system.
- Technical support for creating urban horticultural enterprises in Naples.
- Testing hydroponic methods for greenhouse cultivation, focusing on leafy vegetables and microgreens.

- Demonstration of an aquaponic system.
- Technical support to the local community for creating urban horticultural enterprises to manage agricultural areas within the city of Naples.
- Training activities on sustainable cultivation for growing horticultural products involving local organisations and citizens.
- Educational programs on sustainable agriculture and food for local residents and the broader community to promote awareness and knowledge.

Project innovations

The project innovates in three main aspects:

The pilot's primary social innovation involves repurposing the agricultural area for social inclusion, training, and educational events. The greenhouse, utilizing hydroponics and aquaponics, serves as a demonstration and training centre. Upcoming plans include transforming adjacent open spaces for a farmer's market and workshops and enhancing community engagement.

The pilot is in a densely populated suburban area with high unemployment among young people and many low-income families who could benefit from engaging in economic and social activities.

The local inhabitants are also be targeted by awareness-creation and training activities, fostering the development of a healthy food culture.



Naples, Italy

Citizen engagement is crucial for the pilot's future, facilitated through surveys and events to ensure ongoing development and sustainability.

The pilot aims to test innovative sustainable food production technologies with active university involvement and inclusivity.

Replication of the project

The main actors to work with for replication purposes can be divided into the following groups:

- Stakeholders, who create synergies.
- Potential local producers (i.e., urban farmers).
- Potential local and consumers (e.g., for the restaurant).
- Technicians and experts in the technologies (e.g., for aquaponics).
- University and Research Centres
- Community (in a broad sense, including inhabitants, workers, visitors, etc.).

Resources needed

The activity needs initial investment and ongoing funding, technical skills, professional and volunteer time.



A business model, a civil society initiative, a public service innovation...?

This activity is a public service innovation, as the project leader is the Municipality of Naples supported by the Department of Agricultural Sciences of the University of Naples Federico II. The pilot is community-based since it involves the local community and provides educational and demonstration services.

Advice for potential replicators

So far, the pilot implementation shows that the experience produces a social impact but is not self-sustainable. Firstly, it requires an adequate initial investment that can be provided by the public administration, but it is necessary to develop an effective business plan and to involve private actors as potential investors. Secondly, it requires a scientific partner. Thirdly, it must be strongly connected to the local social environment, engaging inhabitants from the very beginning to generate a collaborative ecosystem.



Naples, Italy

Naples, Orti dei vesuviani

The cooperative “Litografi Vesuviani” was created in the province of Naples, in 2000, from a project funded by the European Commission based on training users of the local Mental Health Unit. In this regard, “Orto dei Vesuviani” was created in 2016 in Portici, a densely populated Municipality within the Metropolitan area of Napoli and covers about 1,100 m². It is a concrete example of a “social garden”, dedicated to the cultivation of vegetables and plants typical of the Vesuvian landscape, under organic production and circularity principles. The garden is a space open to all, where the main beneficiaries are people dealing with mental illnesses. The Department of Agricultural Sciences of the University of Naples Federico II has long-term experience in the cultivation of numerous local varieties of horticultural products (leafy and fruity vegetables, microgreens) and edible flowers, as well as in carrying out research, training, and dissemination activities. The role of the University was to support the cooperative on these aspects, as well as to define and establish robust production systems and sustainable cultivation protocols involving local organisations, stakeholders, consumers, and citizens.



Naples, Italy

Main challenges and goals

"Orto dei Vesuviani" is one of the satellite projects of the Cooperative Litografi Vesuviani, whose main object is "to offer opportunities" for social inclusion to psychiatric patients through training and job placement. Today, the cooperative, carries out different activities, including the training of workers in the field of social agriculture. The training is planned and carried out in collaboration with different experts from agronomists of the Department of Agricultural Sciences to professional workers/farmers who teach not only the cultivation technique, but also the love of the land and the respect for the environment, and this is certainly a fundamental aspect of the project.

In particular, the pilot development focuses on the following areas of work:

- Training activities on sustainable cultivation for growing horticultural products involving local organisations and citizens.

- Training of workers belonging to groups of disadvantaged people (mainly psychiatric patients) in the field of social agriculture.
- Didactic activities on sustainable food production and consumption addressed to the local inhabitants and to the broader population of the district/city to raise awareness of sustainable agriculture, food safety and food security.

Project innovations

The initiative's main innovation is related to the social value of agricultural practices as the main driver of social inclusion. The pilot is a site where the cultivation of local vegetables produced following the principles of organic cultivation serves both as a training centre and as a hub to involve local mental health patients in the cultivation and selling of products.

Furthermore, since the social garden is open to all citizens, it promotes direct contact between disadvantaged workers and other stakeholders.

The pilot is very active in the engagement of young people through direct activities with the primary and secondary schools of the area.



Naples, Italy

A recent collaboration with Slow Food, namely the “Slow Food Comunità Agricoltura Sociale del Vesuvio” has as its main interest the valorisation of social inclusion practices related to agricultural activities. The general aim is to increase citizens’ awareness of healthy food, correct nutrition and the potentiality of a transition to a circular economy through the cultivation of local products, the safeguarding of biodiversity and the protection of the environmental and cultural heritage of the Vesuvian area.

The workers of the pilot have also organised an ethical purchasing group that directly sells the products of the cultivation to citizens.

Replication of the project

The project has already developed a management model that can be replicated and exported to other urban parks in the City of Naples or in other Italian and European cities.

The involvement of patients of the Mental Health Unit in the activities of the pilot through the creation of the Cooperative has been a successful model from the beginning and now it has reached a stable organisation. It represents a consolidated system that can be replicated at local and wider levels.

Resources needed

Despite the pilot being advanced in its own management organisation, ongoing and further investments are needed to allow further development. For example, the Cooperative has recently applied in collaboration with the Department of Agricultural Sciences to a private foundation call with the aim to develop a canteen in the pilot to cook and serve food from on-site produced fruit and vegetables.



A business model, a civil society initiative, a public service innovation...?

The pilot activities represent a public service innovation from several points of view: firstly, because of the job creation opportunities for the Mental Health Unit patients, secondly, for the strong education activity conducted with the local schools' students.

Advice for potential replicators

The implemented pilot represents a self-sustainable system with a high social impact, despite the development of similar activities that need to be sped up by public or private investments.



Ljubljana, Slovenia

Ljubljana, Prison honey

The pilot is a unique project of the Urban Beekeeper's Association of Slovenia. The objectives of the association, which has been in existence since 2014, go beyond business opportunities and food production as such, as they also include social activation at its core. In fact, the Prison Honey project offers a way to rehabilitate and empower underprivileged groups (it is aimed at inmates) primarily in the Slovenian city of Ljubljana, with the possibility of spreading the business model broader, also to other institutions as day-care centres for physically impaired or elderly. The pilot is an example of good practice and shows the therapeutic potential of beekeeping as a craft, vocation or occupation.

Beehives were installed firstly in one prison in Ljubljana and training was offered to the inmates, with the aim of providing the prison with its own honey and other bee products, creating more human and socially inclusive conditions within the penalty system and making it an example of good practice for other prison facilities in Slovenia as well as beyond.



Ljubljana, Slovenia

Main challenges and goals

The Prison Honey project focuses on social inclusion and rehabilitation of prisoners through beekeeping. This activity promotes responsibility, environmental sensitivity, and organic practices, emphasizing the value of healthy, chemical-free food.

Within the FoodE project, the pilot development focused on the following areas of work:

- Introducing a modern way of beekeeping with LR-hives (which are not predominant in Slovenia) and showing the benefits of digital support (electronic scales);
- Showing the urban beekeeping benefits;
- Introducing an ecological approach to beekeeping and agriculture in general (only 1% of Slovenian beekeepers are registered as ecological beekeepers);

- Creating a sense of community and acceptance within the closed group of inmates;
- Teaching a new skill to the inmates;
- Instilling the value of organic farming/beekeeping and producing one's food;
- Preparing inmates for post-release life, guiding them toward meaningful and constructive use of their leisure time.
- Collaborating with designers to enhance the overall space – custom-designed and painted beehive stands were created for this purpose.

Project innovations

The primary social innovation in the project repurposes a prison area for social inclusion, learning, and training. Innovatively designed beehives not only enhance the space but also create a semi-public area.

The project, situated in an area with high unemployment, provides inmates with valuable knowledge and training for better career decisions. It stands as an innovative initiative in Slovenia and the broader European region.

The pilot project also provides policy innovation through an agreement between the Urban Beekeepers. The pilot involves collaboration between the Association and the Office of the Republic of Slovenia for the Enforcement of Penal Sanctions, employing a participatory planning process for the beekeeping program and semi-public events. This agreement fosters a governance model promoting social, environmental, and economic functionality.



Ljubljana, Slovenia

Replication of the project

The Prison Honey pilot project aims to create a management model that can be replicated and exported to other prisons (except to the maximum-security ones - because of the use of sharp objects, fire accessories and strong organic acids within the beekeeping process) or day-care institutions in Slovenia or abroad.

The main actors to work with for replication purposes can be divided into the following groups:

- Interested institutions with the support of supervising stakeholders (ministries, municipalities);
- Beekeepers and beekeeping experts;
- Local beekeeping associations;
- Potential local consumers;
- Local communities in a broad sense (inhabitants, visitors, employees).

Resources needed

This activity needs an initial investment in beekeeping equipment, hives and bees, and protective equipment for the trainees. Adequate storage space for spare beekeeping equipment is also necessary, as well as a separate room for food management and storing of the harvested bee products according to HACCP standards - some adaptation of the facility may be needed for this purpose.

Additional funds should be provided for technically and pedagogically qualified trainers, possibly combining professional beekeepers with volunteers.



A business model, a civil society initiative, a public service innovation...?

This activity is a civil society initiative, as the project leader is an NGO, the Urban Beekeepers' Association of Slovenia. The Association tried to involve the local community as well, and provided educational and demonstration services. Several inmates involved in the pilot project became beekeepers after their release and their hobby later contributing positively towards their income; in this regard, the pilot project can be considered also as a business model.

Advice for potential replicators

The pilot implementation shows that the experience produces a social impact with positive results but is not completely self-sustainable or economically viable. It requires an adequate initial investment that can be provided by an institution or the public administration, but it is challenging to develop an adequate business plan to cover all costs with a modest number of beehives. Engaging in small-scale beekeeping within similar institutions not only allows trainees to enjoy a season's worth of honey and pollen for personal use but also offers the potential to earn extra income by selling these products. Furthermore, this activity seamlessly integrates with the local social environment, fostering community involvement from the outset and fostering a collaborative ecosystem that often yields positive outcomes.



A sustainability scoring system to assess food initiatives in city regions

The City Region Food Systems approach has been proposed to achieve food system resilience and nutrition security while promoting the urgent ecological transition within urban and peri-urban areas, especially after the COVID-19 pandemic. However, the great diversity of the initiatives composing City Region Food Systems in Europe poses barriers to the assessment of their integrated sustainability. Hence, the present work has been developed within the EU-H2020 project Food System in European Cities (FoodE), to build a consistent sustainability scoring system that allows comparative evaluation of City Region Food System Initiatives. Adopting a Life Cycle Thinking approach, it advances existing knowledge and past projects, taking advantage of a participatory process, with stakeholders from multidisciplinary expertise. Consequently, the research involved the development and testing of a simplified, user-friendly scoring system derived from a qualitative and quantitative appraisal survey tool, with the capability to assign a final sustainability score on a 1–5 point scale. This scoring mechanism serves as a valuable tool for gaining insights into the social, economic, and environmental impacts of the case studies. In line with the needs of the UN Sustainable Development Goals, the outcome represents a step forward for the sustainable development and social innovation of food communities in cities and regions, providing a practical and empirical lens for improved planning and governance.



Vision 2050



What will the future sustainable CRFS look like?

What does this chapter do? The vision chapter gives an overview of the sustainable CRFS as being the “new normal” in the year 2050. Here, we will name different elements of the future CRFS that we then refer to in the innovation chapters as end points of the various pathways we describe there.

“History class. A college, somewhere in Europe. Year 2050. “... and this is when it all started, dear students. It was the beginning of the 21st century, and European citizens were struggling with an evolving climate change, social exclusion, and unfair food access. Grassroots initiatives were sprouting across countries, addressing the sustainability of regional food systems and combining state-of-the-art technologies with innovative social and management systems, resulting in the creation of innovative business models, where consumers engaged in food production and distribution, overall became active “prosumers”. It was the case of the Mai Bine bistro, in Romania, where the most socially disadvantaged prepared meals from locally produced food, similar to the Polar restaurant in the Svalbard Islands, which implemented a circular economy system for introducing local vegetable production and supporting small-scale fishery. Those days, the life of fishermen was becoming harder also in remote islands, where they struggled against

large-scale commercial fishing and the apparently unstoppable decline of the fish population.

Following the successful example of the small-scale fishing cooperatives of the Canary Islands that were also supplying your colleagues at school with fresh locally harvested seafood, fishermen in Norway and Italy managed to actively engage the local population in preserving fishing techniques that better preserved our sea. At the same time, agriculture was fighting with the growing pressure on land availability, water scarcity, production costs and market instability. Innovative plant cultivation systems and farm business models started to emerge, also thanks to the improved exchange of information and tools for sustainability assessment that are today so common in your FoodE app. Beekeepers spread across cities, vertical and rooftop farms, urban agricultural parks, but also community gardens were then connected and shared experiences during the MyLocalFoodE festivals (the same that we will host in our city this year for the 30th edition). And the book we will start reading today was edited by students like you, who participated, together with their community in designing, monitoring, and assessing the food systems that you see today in all coastal, rural and urban regions of Europe...”



Oslo, Norway

Policy innovations

Policy innovations in various areas were able to create a coherent set of supporting tools that reinforced each other to reach the same policy objectives, thus changing the policy environment from one where regional food production and consumption were severely disadvantaged to a more favourable one.

This chapter explores policy innovations crucial for sustainable CRFS development. Essential changes span EU, national, regional, and local levels, covering diverse themes. Actions involve removing hindering policies, introducing supportive ones, and co-creating regionally and locally relevant strategies with stakeholders.

Policy vision

In 2050, the transformation of the food system to sustainable CRFS is well underway. In many city regions, the greater part of fresh food provision reaches citizens through short chains. Farmers are remunerated for providing fresh, healthy, and varied food and also for the ecosystem services and social and cultural value they create in the process, through a mix of transparent prices and targeted subsidies. The importance of fresh, accessible, locally produced food is widely acknowledged in society.



Romainville, France

From the policy research in the FoodE project, two key themes emerged: access and integration/connection. These themes present numerous opportunities for policy innovations, offering high potential for synergy when implemented collectively across sectors and government levels. These include:

- Access to regionally produced, sustainable food for all, irrespective of socioeconomic status, education, or mobility;
- Access to education and information: food education for children and adults, academic and vocational programmes that include the kinds of knowledge and skills needed to operate a small farm or other food-related business focused on sustainable production and short-chain marketing;

- Enabling active individual participation in the food system beyond the consumer role, fostering "prosumers" in collaborative production and marketing models. Emphasizing citizens' involvement in governance through food democracy and food citizenship approaches.
- Access to spaces for food production and processing: land and buildings, including roof spaces, both for commercial operators and for self-provision and educational activities.
- Implementing integrated policies is crucial for governing food effectively, recognizing it as a cross-cutting issue requires comprehensive transformation rather than incremental improvements.
- Reintegrate food into urban spaces and people's lives, placing food activities at the core of society and cities.
- Promote circular economy; re-integration of food into material cycles (e.g. water, nutrients, energy);
- Building strong networks; connecting all stakeholders.



Food access for all

One of the major challenges in achieving sustainable CRFS is bringing local and regional food value chains (production, processing, marketing and consumption) out of the niche and into the mainstream. Crucial to this is ensuring access to regionally produced, sustainable food for everyone (read more in Chapter Social Innovation). At the moment, the great majority of food that is everywhere, cheap, and available almost around the clock originates from industrial production and processing, with long value chains and distances between the producers and consumers. Sustainable local food tends to be not only more expensive but also less easily available, being marketed through “alternative” modes, e.g., farmers’ markets, food assemblies or CSAs that cannot match the convenient opening times of supermarket chains and often struggle to find spaces for their marketing activities in urban centres. Some key policy actions need to be taken at the EU and national level, such as:

- Alter urban and regional planning rules to incorporate food-related activities into the urban environment, such as adjusting building height calculations to include rooftop greenhouses in Germany and requiring new buildings to use roofs for energy, food production, or green space.
- Removing fuel subsidies that make long-distance transport cheaper, and supporting local and sustainable logistics instead.
- Ensure sustainable, healthy food is affordable for low-income citizens, tackling the current scenario where the most industrial and least sustainable food is often the cheapest. This involves strategies like socially differentiated pricing, implementing “food social security,” and broader interventions like ensuring living wages, and basic income, or introducing housing rent caps to disproportionately benefit poorer households.
- Redirect agricultural subsidies to incentivize sustainable production, eliminating or reducing the premium currently borne by end consumers.
- Granting cities more authority to regulate local food environments, such as permitting specific types of food businesses, can reduce the prevalence of ultra-processed foods near schools. Regional and municipal governments play a crucial role in supporting food production and marketing initiatives by providing access to public spaces. While some cities have long been engaged in such efforts, this policy tool remains largely underutilized in certain locations.

Access to education and information

Sustainable food education spans various settings and beneficiaries, including activities like gardening and cooking with children in schools, teaching sustainable practices in agricultural training, and fostering adult learning in workplace canteens. Participation in transformative projects like community gardens or CSA farms is emphasized as part of this multifaceted education approach.

Strict hygiene regulations create hurdles for hands-on food education in schools. It's essential to revisit these regulations to align with the benefits of practical learning. A harmonized approach to food education policies across EU nations is necessary to address existing disparities, such as:

- In some countries, the provision of school meals for all pupils has a long tradition (e.g., France, Italy), in others, such as Germany, it is a relatively recent trend, and in others (e.g., the Netherlands) it is largely absent. Differences in infrastructure, such as kitchens and canteens, exist among schools.
- Food education in German schools, including activities like gardening and local market visits, is currently extra-curricular. This reliance on individual teachers' skills and extra time for organization leads to inconsistent implementation.
- Integrating these activities into the curriculum and providing the required resources ensures a systematic and comprehensive approach to food education. This allows students to gradually develop skills and insights, applying theoretical knowledge in real-world contexts.
- Traditional academic courses in agriculture and food fields often prioritize large-scale operations, neglecting crucial knowledge for managing small farms and food businesses within cohesive regional food systems like CRFS. This gap requires a more balanced approach to agricultural education.
- Government levels responsible for curricular changes in schools, universities, and vocational education vary across countries. Some municipalities have taken the lead in developing training courses focused on local, sustainable food production and marketing, exemplified by initiatives like the gardeners' school in Paris (École du Breuil).
- Most relevant education on sustainable food systems is currently provided informally through professional associations and activist networks. Integrating their guidelines into public education would expand these innovative approaches to a wider audience.



Sabadell, Spain

Citizens' participation in the food system and re-integration of food into the urban fabric and people's lives

The current food system largely disconnects consumers from the entire food process, hindering food citizenship. Limited sustainable food education reduces individuals to passive consumers, making choices based on affordability. Reintegration and participation can vary:

- Community gardens, allotments, and edible public green spaces offer self-sufficiency and informal education on food cultivation. They promote sustainable living, community engagement, and learning.

- Seasonality: "forgotten" foods are now marginalised by the dominant marketing structures and foods and preparations from other cultures.
- Farmers' markets, food assemblies, and innovative models like CSA create direct connections between consumers and producers. CSA and similar models empower urban citizens to participate in farming and distribution, fostering understanding and solidarity.
- Urban and peri-urban farms and processing facilities, whether community-based or individual businesses, are the foundation of a sustainable City Region Food System, offering both food production and opportunities for citizens to experience it firsthand.
- Participatory governance in food partnerships involves stakeholders from the food economy, civil society, and government bodies collaborating to create a sustainable food system for their city or region.
- Consumer engagement may decrease due to selective product choices in supermarkets. Sustainability indicators like regionality or farming conditions assume consumers thoroughly assess the product range for informed choices.

The key barrier to successful CRFS is insufficient access to land and production spaces near urban centers, driven by high costs and zoning regulations.

Policy changes

EU and national policies hinder urban food production and marketing, with indirect effects. Changing these policies can empower regional and municipal governments to actively build CRFS. Key hindrances, as identified in the FoodE project, include:

- Urban and regional planning regulations, including building height limits, hinder commercial agriculture within cities and limit the viability of rooftop agriculture.
- Inadequate protection of agricultural land leads to rising rents. Prioritize access to land through proposed EU soil health legislation and enforce existing measures. The debate on prioritizing the common good over profit from publicly owned agricultural land is ongoing.
- Urban farmers face exclusion from agricultural subsidies, either explicitly or de facto, as bureaucratic hurdles and minimal benefits, often tied to acreage, make the process impractical.
- The absence of "regionality" as a recognized criterion in public purchasing decisions hinders the realization of its potential as a powerful policy tool for fostering sustainable City Region Food Systems. If regionality were incorporated into these decisions, it could substantially boost the development of sustainable CRFS.

- Some countries limit the ability of food producers to market directly to consumers by requiring them to set up a separate business for each activity.
- Subsidies on diesel fuel are a de facto subsidy for long-distance transport, skewing the market conditions for local produce.
- Bureaucracy, especially in complying with food hygiene regulations, hampers small farms and food businesses, hindering their operations and deterring new entrants.

At the level of regions, federal states, and municipalities the most important changes should be:

- Integrate CRFS activities into regional and urban development, planning, and policies governing public land use. This includes supporting small producers and direct marketing through low or zero rent for public spaces and considering municipal involvement in food production.
- Commitment to giving preference to local, sustainable food in all public purchasing for canteens in schools, hospitals, retirement homes, and other public institutions.
- Supporting and participating in multi-stakeholder platforms for local food systems governance, like food partnerships and policy councils, requires political will and financial backing to unlock synergy effects and citizen participation.



Circular (food) economy: re-integration of food into material cycles

City Region Food Systems have a very high potential to function as a more circular system than the current globalised food system, closing nutrient-, water- and energy-loops or at least, significantly reducing waste. There are many innovations in the fields of resource management and technology but certain regulations or the lack of such regulations at the EU and national level prevent their application:

- Food hygiene regulations, including the EU feed and fodder law, are currently standing in the way of making use of post-consumer food waste (i.e., from private households, canteens and restaurants) to feed insects such as soldier flies that make very high-quality animal feed and also valuable fertiliser.
- Approximately 30% of global food leaving farms or fisheries is wasted. EU regulations on "food waste" aim for safety but limit reuse options. Innovations like incorporating insects into animal feed enhance quality and value. This not only transforms waste into a high-value product but also mitigates environmental concerns associated with imports like soybean meal and overfishing for fishmeal in aquaculture.
- Water quality directives put a break on re-using both the nutrients and water in black and grey water in food production.
- Global food chains contribute to ecological harm and environmental issues due to spatial separation, causing deforestation and eutrophication. Locally, human settlements waste heat and nutrient-rich wastewater. Implementing circular systems requires policy changes to legally recycle resources, making it economically competitive with fossil-based alternatives.

Integrated policy

For a genuine transformation of the food system, it must be managed comprehensively. This involves establishing government capacity at all levels to formulate and implement food policy. This can be achieved through a food-in-all-policies approach or by creating a dedicated food department with sufficient staffing and resources. Developing inclusive food system visions and strategies through participatory processes helps break out of policy silos. Measures like creating multi-stakeholder platforms also contribute to a more coordinated approach.





Tenerife, Spain

Social innovations

To transform our food systems, citizens play a crucial role. The FoodE project, based on scenario workshops and initiatives, envisions sustainable City Region Food Systems with three key social changes.

General access to local, healthy and sustainable food products

Today, not everyone has the opportunity to buy and consume healthy and sustainable food products, such as fresh fruit and vegetables. Rising food prices put pressure on many families that might end up consuming more ultra-processed foods (i.e., mass-produced bread, sausages, or instant soups) and products with unknown origins, which do not necessarily guarantee nutritional, social, and environmental quality. In addition, there are many food deserts, areas where most low-income residents do not have access to a grocery store or local market selling fresh produce within walking distance.

Social vision

In our vision, all consumers will access local, healthy, and sustainable food due to increased demand, better promotion of local initiatives, and improved producer-consumer connections. Local food initiatives will serve as hubs for community building and personal development, with certifications recognizing their social, environmental, and economic contributions. Schools will integrate food and agriculture into curricula, fostering a deeper understanding of food production. Diverse educational activities will cater to various demographics, empowering everyone to make informed food choices.



Tenerife, Spain

New socioeconomic and environmental trends are reshaping consumer demand:

- Our populations will require more healthy food products to meet their nutritional needs and reduce the rising risk of metabolic diseases related to eating behaviour, such as diabetes and hypertension.
- Consumers may also experience a lack of accessible fresh food because of disruptions in the supply chains in times of pandemics and international conflicts.
- Climate change has disrupted traditional seasonal patterns, leading to severe climate events such as droughts, floods, and heatwaves. Consequently, food suppliers may struggle to consistently provide adequate quantities of food.

Reduced food availability and rising prices prompt increased consumer awareness of sustainable options. Citizens demand local, sustainable food, advocating for shorter supply chains through direct or political action. Community engagement in identifying food sources fosters solidarity. Connecting consumers and producers is crucial, achieved through activities like citizen science and tools like the FoodE App developed in collaboration with local initiatives.



The FoodE App: empowering sustainable local food



The FoodE App is a free interactive mobile application that connects people with local food initiatives across Europe. Its purpose is to promote sustainable, healthy, and local food practices while empowering conscious consumers. By bringing together a diverse range of initiatives and consumers, the FoodE

App creates a platform for collaboration and knowledge exchange. There are two types of app users: (1) local food initiatives, and (2) consumers. Local food initiatives such as urban gardens, local animal farms and fisheries, restaurants, local food stores, vertical farms, and many more can join the FoodE app community by registering online as an initiative at <https://foode.sostenipra.cat/>.

When an initiative joins the platform, it is asked to complete a sustainability survey. This survey assesses the extent to which its activities align with the principles of sustainability across all three pillars (environment, society and economy). The FoodE App empowers initiatives to embark on a deeper sustainability journey. Initiatives can calculate key performance indicators, enabling them to track their progress and identify areas for improvement. This data-driven approach fosters constant learning and innovation, encouraging initiatives to continuously improve their sustainability practices. For consumers, the FoodE App offers a wealth of opportunities. It allows them to discover a wide range of local food initiatives across Europe, each with its benefits. Consumers can review the quality and sustainability of the initiatives they visit based on their perceptions. Their visits and reviews are rewarded with “Terrix” loyalty points, the FoodE project’s mascot superhero. This empowers consumers to make informed choices that align with their values and support the development of sustainable, healthy, and local food systems.





Recognition of the benefits of local food systems

Traditionally, agriculture's labour-intensive nature and reliance on unpredictable yields led to its decline. Urbanization drew people seeking better opportunities. Yet, the resurgence of local food systems in cities has brought positive impacts to various social groups.

Urban agriculture offers more than just fresh produce—it becomes a space for personal well-being. Engaging in activities like sowing, caring, and harvesting contributes to both physical and mental health. Growing and consuming one's produce fosters a connection to food, encouraging healthier eating habits. Spending time in urban gardens provides a nature-infused escape, reducing stress and offering various mental health benefits.

Providing these safe spaces can also be a way to promote social cohesion and inclusiveness. For instance, growing food can bring people together by exchanging knowledge on gardening and cooking. People lacking access to fresh produce will not only benefit from new sources of food but also from new connections with different kinds of people.

Community gardens offer additional assistance to underprivileged communities, providing services like cooking workshops, shared resources, and childcare.

These activities enhance the sense of belonging, fostering resilient and trust-based community bonds.

Many local food initiatives in Europe actively involve disadvantaged groups, providing opportunities for income generation through activities such as processing and selling products at local markets or involving them in running farms, fisheries, restaurants, and canteens.

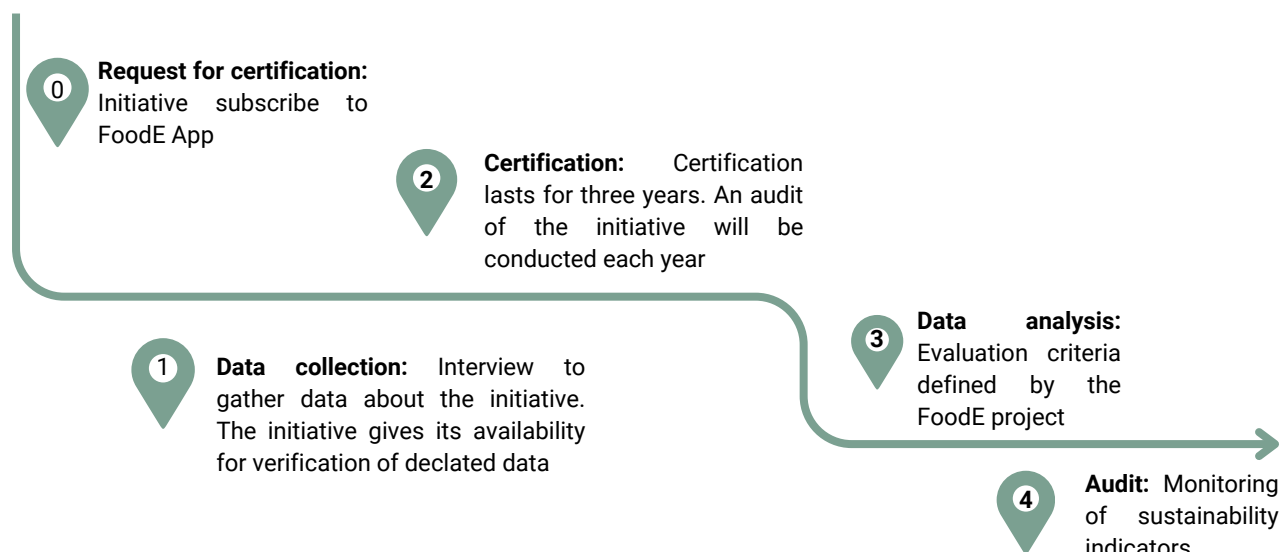
Recognizing the benefits of local food initiatives is crucial for raising awareness among users and local administrations. Community gardens provide social services, while local farms and restaurants focus on job creation and income. Each initiative may vary in its approach to sustainable resource use and its relationship with nature.

While some gardens connect with rural spaces, others focus on sustainability within buildings, contributing to regional circular economies. Recognizing these benefits, despite challenges, is crucial for showcasing the value that these initiatives bring to communities. The FoodE App is a unique tool to rate the sustainability of an initiative, but we also propose the creation of a certification scheme that can show the efforts and benefits of local food initiatives.





Certifying local food initiatives



In recent years, the market has seen a significant increase in food labels. With a growing variety of food products, consumers are now exposed to large amounts of information, each focusing on different aspects of the product such as nutrition, carbon footprint, allergies and many more. Existing labels can thus lead to confusion among consumers of local and sustainable food, as not all the relevant parameters are displayed or recognised. The FoodE certification aims to solve this issue. It seeks to help consumers make informed decisions about the products they purchase and to support the implementation of policies to develop local food systems. The uniqueness of the FoodE certification lies in its evaluation approach. It takes into account the social, environmental, and economic impacts of a single or a group of initiatives operating within a specific food product or sector in a region. Therefore, this certification recognises and encourages collaboration within the supply chain (that is, from producers to retailers or service-oriented activities) and is accessible to all kinds of initiatives (for instance, small, large, commercial, or non-profit initiatives). To initiate the certification process, an initiative must be registered in the FoodE App and participate in an exploratory interview with the competent body to collect the necessary data. To obtain and maintain the certification, an initiative must provide current data to ensure the accuracy and reliability of the information throughout the certification period. By promoting a certification system that values transparency within the food system, the FoodE certification offers consumers valuable insights into the products they buy and empowers them to make informed choices that align with their values and preferences.





More food awareness and education

Youth involvement in environmental causes underscores the need for improved education. Despite awareness, school curricula often fall short. To transform food systems, schools, teachers, and students must take a lead role by creating materials and activities for classroom integration, as outlined in the Policy Innovation chapter.

Revamping school food initiatives needs community and expert input. Urban gardening, linking kids with nature and food production, thrives through collaboration among students, teachers, family members, and local farmers. Boosting food awareness includes using local produce in school canteens, and reducing waste with support from the local administration through public procurement. A community-wide effort is crucial to sustain and improve school food projects, enhancing knowledge and awareness among children and families.

In the information age, securing reliable sources for consumers is crucial. "Food influencers" on social media can educate on agriculture, but they must use credible sources or have expertise. Hands-on learning, like the FoodE project's "KidScience" activities, complements media, fostering understanding of food systems and prompting questions about eating habits.

Playing and reading to produce food



During the FoodE project, several kids' science activities took place in each country, whether during special events (MyLocalFoodE initiatives) or year-long with preschool to high school students. Educating kids has been seen as especially important for the acquisition of STEM (Science, Technology, Engineering and Mathematics) knowledge using both theoretical and hands-on activities. By inspiring both younger and older children to explore sustainability challenges related to food and the environment, these activities also influence the entire family by instilling this knowledge within the household. The FoodE activities can be categorised as hands-on activities developed at school, in the pilots or at home (such as workshops for all ages on different themes); real and virtual visits, games and contests (such as drawing, quizzes and food blind tests), as well as conferences and exchange events (such as plant swapping and informative meetings) for the eldest. The FoodE project has also put in place new ways of dissemination using comics, animations, interactive e-books and an online article collection in *Frontiers for Young Minds*, which can then be translated through Creative Commons so that it is free for all to use.



Bologna, Italy

Economic innovations

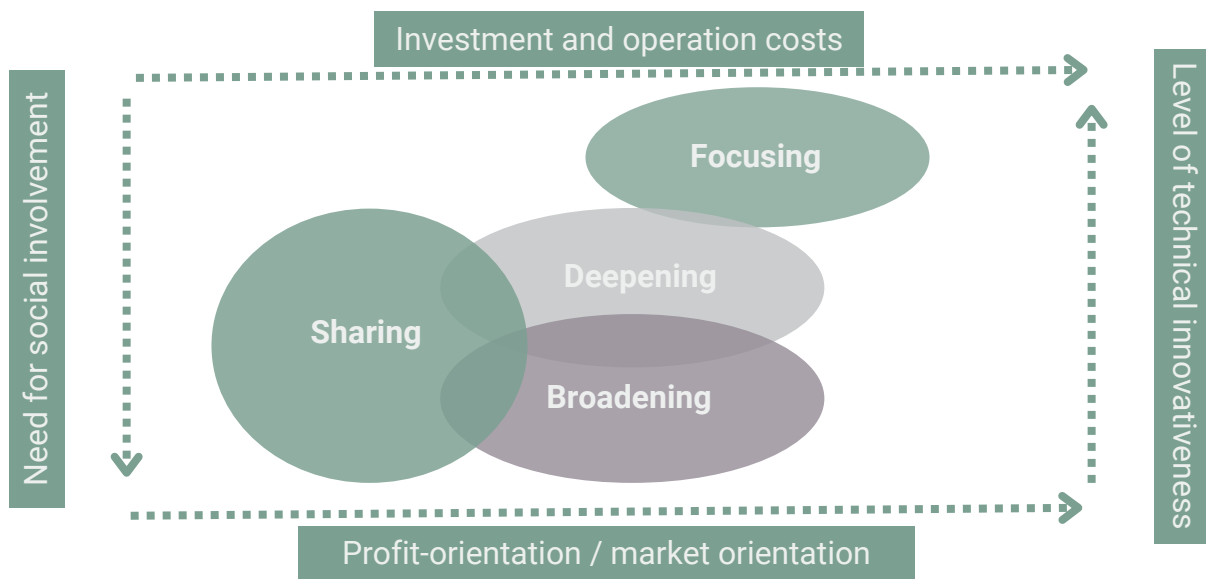
The food industry needed a reinvention to address challenges across the value chain, including concerns about product prices and profit distribution. Prices often didn't cover producers' costs, making it difficult for family farms to sustain themselves amidst the necessary changes for production process sustainability.

Affordable, sustainable high-quality products are often out of reach for lower-income households. Creating a resilient food system with fair prices for producers and affordable, local food for all households poses a key challenge. Various approaches, outlined in the following chart on Business Model Classification, formed different business models, contributing to a more resilient and sustainable food system. The models differ in investment costs, technical innovation, social involvement, and market orientation.

Economical vision

In 2050, food production takes place in short supply chains within city limits or in the surrounding countryside. The way food is produced is as diverse as the food itself. From long-established family farms in the countryside that have adapted their production to meet the needs of nearby urban dwellers, to high-tech solutions that allow year-round production within buildings or other controlled environments in an urban context.

Business model classification



The "**sharing**" business model relies on civic engagement, compensating for limited capital access. It prioritizes member needs over market orientation, emphasizing traditional growing practices, old plant species, and citizen participation. The focus is on social innovation for environmental benefits, community building, and health.

The "**focusing**" business model takes a distinct approach with high investment and maintenance costs. It aims to overcome natural restrictions and threats by providing year-round food in cities. Techniques involve strong research, development, and tech specialists, with production shielded from environmental influences. Examples include indoor and vertical farms, and aquaponics.

The "**deepening**" business model empowers farmers to strengthen their market position by establishing direct relationships with customers, avoiding being price-takers in long, anonymous supply chains. To succeed, farmers must provide favourable product qualities or specialities, taking on the responsibility of processing goods and managing sales channels themselves.

The "**broadening**" business model includes activities that aim to set up an enterprise beyond primary food production by addressing the different needs of the city. Common examples are care farming, educational services, gastronomy or accommodations on the farm.

Business Models in the Spotlight

The four business models described offer different solutions as well as advantages and disadvantages for regional food production in 2050.

			SWOT-Analysis for each Business Model								
high	medium	low	Focusing	Sharing		Deepening	Broadening	low	medium	high	
			economic feasibility price sensitivity entrepreneurial skills employees scalability consumer support environmental impact	W E A K N E S S		S T R E N G T H	product quality				
			little market power economic perspective consumer acceptance prices labour city environment	T H R E A T H		O P P O R T U N I T Y	market prospects				
high	medium	low							low	medium	high
high	medium	low							low	medium	high

Table 1



Strengthen the food system

All four business models have characteristics in common but use resources differently or respond to social challenges by different means. The described qualities of each business model are collected in the Table 1. The level of compliance is presented in three classes; "low", "medium", and "high" highlighting to what extent a certain strength is embodied in a business model.

Business models aim to attract customers through product quality, focusing on freshness, innovation, food safety, and regional production. The "focusing" model, addressing concerns about pesticides, utilizes controlled environment agriculture like indoor farms or aquaponics to shield production from environmental uncertainties. Consequently, it is limited to the physical value proposition of high-value crops.


The "sharing" model lets members participate in production, fostering community and shared values. In the "broadening" model, the value proposition often extends beyond agriculture to include non-agricultural activities, such as events and cooking courses, creating memories and leisure experiences as part of their distinctive value proposition.

Transparency in business models varies. "Sharing" achieves the highest level as members actively participate in production and decision-making. In "deepening" and "broadening," transparency is crucial as a sales criterion and justification for higher prices.

All four business models offer an escape from the long, anonymous food industry value chains. In the saturated Global North market, dominated by cost reduction and efficiency pressures, adopting one of these models enables companies to break away from global competition. Direct selling, emphasizing proximity and tailored production, fosters long-lasting customer relationships, allowing producers to retain more sales revenue by eliminating intermediaries. Direct sales are a survival strategy for both the "deepening" and "focusing" business models. In "focusing," with low vegetable margins, direct sales highlight qualities for higher prices and financial stability, but the main unique selling points are technical innovations attracting specific customer groups. Entrepreneurs in "deepening" must identify and communicate a unique selling proposition: environmentally friendly production, artisanal methods, or promoting food-related cultural identity like regional specialities.

"Sharing," less market-oriented, includes examples like Community Supported Agriculture (CSA) and self-harvesting plots in Alternative Food Networks (AFN). Production is for the members, and shared financial responsibility shields the initiative from common risks like low yields, ensuring income stability.

Business models offer benefits to the local economy, including job creation and diversification. "Focusing" is a technology-driven model requiring technical expertise, often involving partnerships with



education or research centres for knowledge growth and funding. Integration in buildings or on roofs allows for production in densely populated areas, with circular resources and energy flow.

"Deepening" and "broadening" create green job opportunities. "Deepening" increases the workload, requiring more employees, while "broadening" activities, especially in the care sector, contribute to job creation in areas like elderly care, rehabilitation, and education, requiring specialized workers beyond traditional agriculture.

The positive social impacts of civic engagement and community building are prominent in the business models "sharing," "deepening," and "broadening." "Sharing" aims to reconnect producers and consumers, creating prosumers and fostering trusting relationships. Collaborative production enhances social embeddedness, linking physical work to well-being and mental health. Engagement is driven by social and environmental concerns, emphasizing knowledge transfer. "Deepening" and "broadening" rely on reliable networks for success, serving as anchors in society, and promoting social interactions, civic engagement, and well-being. Regional roots aid in adapting to changing needs and circumstances.

In terms of environmental impact, the benefits of the "focusing" strategy come mainly from the creation of a growing method that can potentially reduce pressure on fertile agricultural land.

The artificial environment in the buildings not only allows year-round production without pesticides but also has the potential to make more efficient use of resources such as greywater.

Diversifying agricultural production in terms of crop rotation or animal-friendly husbandry practices is beneficial to the "deepening" business model. "Broadening" activities, such as agro-tourism and education, have the potential to increase interest in and knowledge of nature and food production. Especially in scenic areas (e.g., mountain regions), agriculture is associated with comparatively high expenditures but often rather low yields. Nevertheless, these semi-natural landscapes depend on land uses that need to be maintained. Additional income streams from agro-tourism can improve the economic stability of farms and food system actors.

Putting light to the shadow side

Up to now the transformation of the food system sounds promising. But if there is light there will always be shadow as well. The four business models described are endangered by weaknesses that arise from the business design and could not be wiped out yet. Economic feasibility is a major challenge when addressing various issues like fair prices, cleaner production, and local economic strength. Implementing business models such as "focusing" or "sharing" involves high investment costs, while "deepening" lacks long-term contracts, making business

planning and borrowing challenging. This insecurity also hinders investment in "broadening" business models.

Consumers' price sensitivity poses a challenge, leading to competition with retail prices despite higher product quality. Additionally, the short shelf life of many food products is a weakness, particularly in the early stages.

Each business model requires entrepreneurial skills beyond technical expertise, involving tasks like communication management, networking, marketing, and adapting concepts for key customer groups. Finding and retaining suitable employees is challenging due to low wages and demanding working conditions in primary production. BM "sharing" relies on unpaid voluntary work, supervised by paid experts, but faces the issue of short-term availability. BM "focusing" requires tailored training for novel techniques.

The principle of reducing costs through business expansion faces challenges in urban settings due to limited scalability and barriers like restricted distribution channels and land capacity. The "sharing" model's complexity in coordinating social interactions limits membership, while "broadening" relies on attractive landscapes and tailored services to meet local demand. Market success relies on customer support, crucial for overcoming consumer scepticism, especially with soilless media. In the "sharing" model, a lack of organizational support or member motivation may lead to a free-ride problem

risking the model's failure. "Deepening" and "broadening" models face challenges in meeting ever-changing customer needs, requiring frequent product range adaptations, which can be costly. New techniques like aquaponics and controlled environment systems are energy-intensive, especially with LED lights, posing challenges with heat and downstream nutrient impact.

Research aims to enhance energy efficiency and address environmental concerns, promoting circularity and sustainability. In the "sharing" model, urban pollution requires soil analysis to ensure safe production. "Deepening" impacts vary, and environmental considerations depend on individual cases. "Broadening" activities also require case-specific assessment for their environmental impact.



Romanville, France



Riding the wave

Staying ahead involves identifying trends and adapting to new requirements, allowing businesses to ride the wave of success. Entrepreneurs in City Region Food Systems must actively pursue opportunities aligned with their strengths.

A positive trend for all models is the growing market for regional food, especially advantageous for "broadening" near cities. Concerns about pesticides and environmental issues boost interest in alternative production methods, benefiting "focusing" and "sharing." The desire to reconnect with nature supports environmentally friendly practices, a starting point for "sharing." Desirable food qualities, like organic, are beneficial for direct selling and "deepening", often highlighted through labels.

Viewing food as a lifestyle expression goes beyond nutrition, prompting companies to align products with specific customer lifestyles. This can be achieved by associating products with nature or incorporating modern, high-tech production methods.


Each BM contributes to community support. "Focusing" creates urban employment, "sharing" enhances social coherence through shared responsibility. "Deepening" and "broadening" reconnect city and countryside, addressing the needs of urbanites and demographic changes. Farmers can adapt to provide housing, education and rehabilitation, addressing social challenges.

Escaping the Dangerzone

Various threats, such as urban challenges, customer willingness to pay, market dynamics, and political restrictions, pose risks for companies. Navigating through these challenges is akin to a pilot navigating a plane through a thunderstorm. But what are the threats to each business model, and how easily can each of them be managed?

All business models face limited market power in the dominance of grocery chains. Local food infrastructure is often marginal, and establishing strategic partnerships requires labor-intensive and costly network building.

Economically, there's a serious problem, especially during business establishment. Access to credit is crucial, presenting challenges for the "focusing" model due to high financing demand and limited case studies for new technologies. Calculating costs becomes risky for investors. The "sharing" model may face financial viability issues with higher costs than revenues. "Deepening" and "broadening" encounter problems with farmers' high workload and lack of extension services, hindering entrepreneurial thinking in the agri-food sector. Historically, farmers have been price takers and market followers. Customer-related threats abound, especially regarding acceptance of new foods and production methods, like soilless media or novel foods like insects. "Focusing" should focus on reducing prejudice and promoting knowledge. Ever-changing consumer demands make business challenging for all BMs,



impeding long-term customer loyalty. Additionally, customers' willingness to pay higher prices and their affordability pose significant obstacles. The labor market demands qualified personnel, especially in "focusing," where specialized knowledge is essential, requiring companies to organize their own training. A changing work environment, with longer hours and multiple jobs, limits time and skills for voluntary work, impacting "sharing." In agriculture, less attractive working conditions, low wages, and limited holidays pose challenges for recruiting employees in "deepening" and "broadening."

Urban markets offer opportunities but pose challenges with scarce land, rising prices, and heavy metal pollution impacting the "sharing" model.

Rooftop and indoor production for "focusing" faces competition from solar panels, limited suitable roofs, high building reinforcement costs, and regulatory constraints. Energy costs, crucial for energy-intensive models like "focusing," are anticipated to increase.

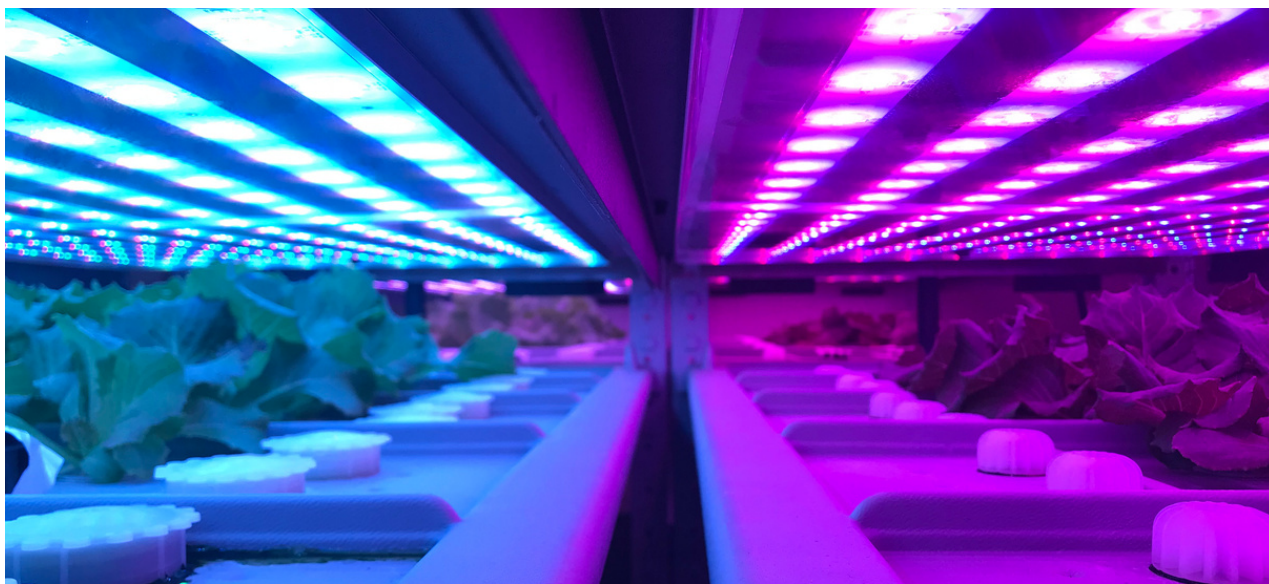
The mixture makes the difference

The four presented business models - "deepening", "broadening", "focusing", and "sharing" - offer different business options and solutions to strengthen the regional food system. In practice, it has been observed that pure business models rarely exist. Instead, hybrid forms emerge, allowing for the combination of the advantages of various approaches and the mitigation of potential risks.

Pilot Decision Support Tool to Assess Food Initiatives in City Regions

The Pilot Decision Support Tool is a comprehensive simplified informatics tool developed using spreadsheets. The tool aims to support decision-making in business models and to be used by relevant stakeholders and pilot owners from the City Region Food System. The tool is composed of different modules that let the user modify selected parameters and evaluate sustainability criteria divided among economic, social and environmental dimensions. The Pilot Decision Support Tool is divided into 5 sheets: introduction, general information, economic, social, and environmental.

The Pilot Decision Support Tool, developed in Microsoft Excel(R), is available on the FoodE App's back-office web for CRFSI. Users can download and register to better monitor tool usage. The tool is mostly automatic, with users entering values and receiving instant responses for specific indicators. However, some indicators require expert processing due to license agreements with data providers.



Bologna, Italy

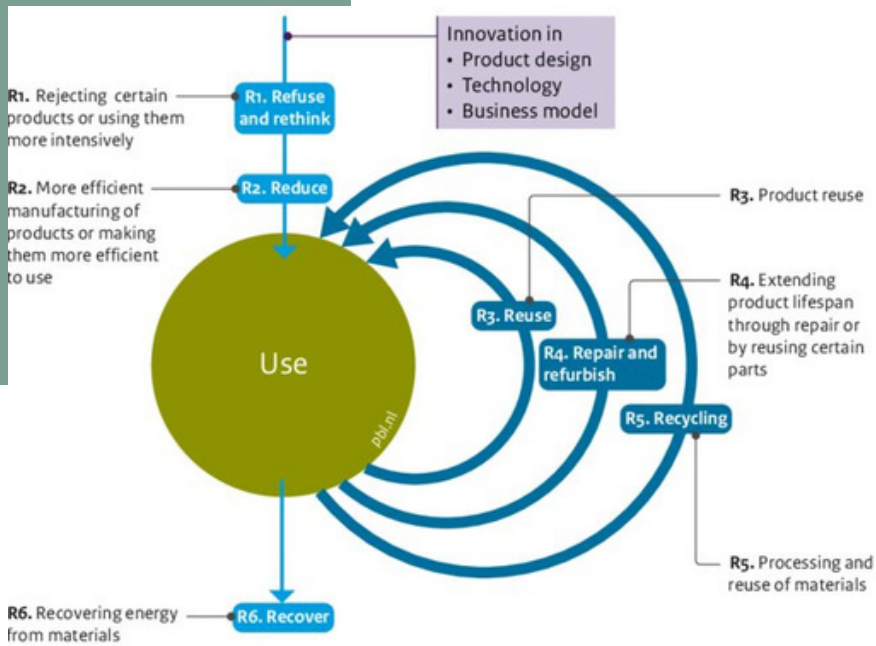
Technical Innovations

Technological innovation is taking place throughout the food system. In order to achieve sustainable and resource-efficient food production at all stages of the supply chain, innovative processes need to be developed and researched.

This chapter explores technological innovations that are crucial for the sustainable development of the CRFS. In particular, it describes new ways of growing and producing food, new ways of consumption, the reuse of resources and the integration of sustainable and resource-efficient food systems in urban areas.

Technical Vision

In 2050, the EU achieved to be the first climate-neutral continent – based on an economy with net-zero greenhouse gas emissions. The vision of a circular food supply chain has become a reality, representing a sustainable and regenerative approach to food production, distribution, consumption, and waste management. The fundamental principles driving this system have evolved to address the pressing challenges of the time. Several technical innovations have played a substantial role in this transition.



Lucas et al. (2022)

Circular economy

The circular economy aims to minimize new resource use, emphasizing prolonged preservation of materials. It contrasts with the linear model of take-make-consume-throw away. The R-ladder, indicating circularity levels, includes strategies like "Refuse and Rethink" (R1) to avoid or optimize product use, "Reduce" (R2) for efficient manufacturing, and "Recycle" (R5) for resource processing and reuse.



Berlin, Germany

Resource efficiency

Optimal utilisation of resources, such as water, energy or nutrients – remains at the forefront, as the focus on maximising resource use has intensified. Waste reduction, energy optimization, water use efficiency, and increased production efficiencies have become integral to the circular food supply chain. Organic farming practices have flourished, as well as controlled-environment agriculture and advanced irrigation techniques.

Renewable energy sources have become the norm, powering the various aspects of the food system.



Iasi, Romania

Closed-loop material cycling

Closed-loop material cycling has become a cornerstone of the circular food supply chain. Strategies and practices have been implemented to ensure the continuous circulation and reuse of materials, significantly reducing waste generation and maximising resource efficiency. The system has successfully transformed the concept of waste, keeping valuable materials like nutrients, packaging, and by-products within the production, consumption, and disposal cycle. For example, composting, nutrient cycling, and utilising organic waste for soil enrichment have become widespread practices, significantly minimising reliance on synthetic fertilisers.

Distribution

Distribution has transformed, blending efficiency and sustainability. Local and global distribution networks have been optimised to ensure cost-effective and environmentally friendly transportation systems. These systems work hand in hand with sustainable farming practices and conscious consumer choices. Regional food networks, farmers' markets, community-supported agriculture (CSA), and urban farming initiatives have thrived, fostering stronger connections between producers and consumers.



Iasi, Romania



Sabadell, Spain

Food waste reduction and valorisation

Food waste reduction and valorisation have reached new heights in the circular food supply chain. Every stage of the food process, from production to consumption, is characterised by a relentless drive to minimise food waste. Innovative strategies such as food waste prevention, surplus redistribution, composting, and anaerobic digestion have become standard practices. Organic waste is efficiently converted into energy or nutrient-rich by-products, further contributing to the regenerative nature of the system.

Biodiversity and ecosystem preservation

Biodiversity and ecosystem preservation have become deeply ingrained in the circular food supply chain. The vital role of biodiversity and ecosystem services in ensuring long-term food security is universally recognised. Sustainable farming practices, agroforestry, the preservation of natural habitats, and the adoption of agroecological approaches have become the norm.

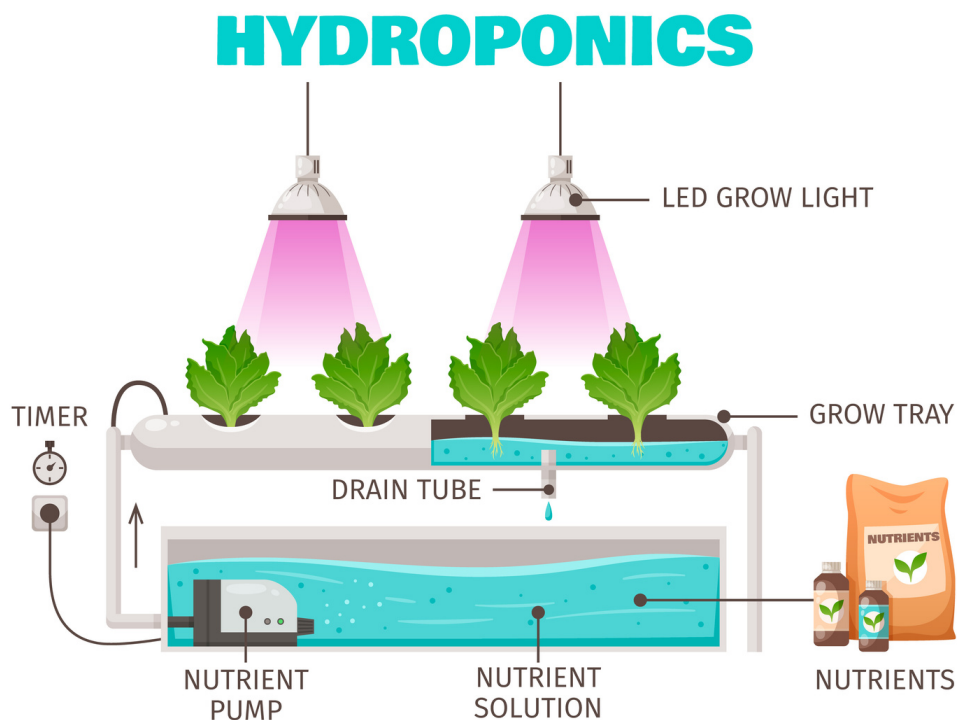
Consumer awareness and engagement

Consumer awareness and engagement have taken central stage. Circular food supply chains have successfully educated and empowered consumers to make sustainable choices. Environmental impact awareness, healthier diets, and support for sustainable food producers have become widespread. Consumers actively participate in shaping the food system, making informed decisions that positively impact the environment and their well-being.

A New Value Chain

New food production

The increasing density of urban areas, alongside global population growth and climate change, poses a key challenge for agricultural systems. As urbanization trends make agricultural land scarcer, traditional systems may struggle to feed the growing metropolitan population. To adapt, innovative indoor production systems, like hydroponics and aeroponics, offer climate-independent food cultivation. Hydroponics involves soilless cultivation in a nutrient-rich watery solution, while aeroponics atomizes the solution for root delivery as vapor, both using less water and space. Plant towers, often lit with LEDs, can be set up in various indoor spaces. Aquaponics combines fish farming and hydroponic plant production, utilizing processed water for dual purposes in vertical farming.



Macrovector on Freepik (2023)

People will buy fresh and healthy food that has not travelled around the world but is produced close to home and embedded in local resource flows. Circular technologies can encourage consumers to become more involved in the food production process. This promotes circular thinking in society so that we can move away from linear production processes and enable agriculture within planetary boundaries.



Tenerife, Spain

New consumption options

How can the world's growing population feed itself in the long term without harming the environment? How can you help? Is it worth changing your diet? There are many new approaches - from seaweed dishes to fried grasshoppers to cultivated meat.

To realise the vision of a fully circular food system, consumption patterns will need to evolve to gain efficiency (get more out of food) and reduce the environmental impacts of food production. There are already emerging trends in terms of consumption options, some have seen significant development in the last few years. By 2050, these consumption trends may become ubiquitous thanks to continuous technical improvements and yield new 'everyday' food options. These include, in addition to plant-based meat, cultivated meat, insect-based foods, algae-based food, functional ingredients, and personalised nutritional products.

Plant-based meat alternatives

Plant-based meat substitutes are already expanding in terms of market share and variety of production options thanks to the increased popularity of low-meat and vegetarian diets. By 2050, we can expect even more advanced and diverse options. Improved plant-based burgers, sausages, chicken, seafood, and other meat analogues may become widely available, mimicking the taste, texture, and nutritional profile of traditional animal-based products.

Cultivated or lab-grown meat

Cultivated meat, also known as lab-grown or cell-based meat, involves producing meat by culturing animal cells in a lab without the need for traditional animal farming. By 2050, cultivated meat products could become commercially viable and accessible, offering a more sustainable and ethical alternative to conventional meat. However, the potential of lab-grown meat can also be confirmed through significant development in terms of social acceptance by consumers. The lab-grown meat industry would imply a new type of workforce in the biotechnology sector, focused on cellular food production.



Insect-based foods

Insects are highly sustainable and nutrient-rich food sources. They are currently present in many diets across the world. However, by 2050, we may see an increased utilisation of insects as ingredients in various food products. The social acceptance of insect-based food, especially by consumers located in the Global North, steadily increased. Insect-based protein bars, snacks, and insect flour for baking or cooking could become more prevalent. The job market for insect food and feed production, currently small, would greatly increase in size.

Algae and seaweed products

Algae and seaweed are nutrient-dense and sustainable food sources. Similarly, to fish aquaculture over the last three decades, algae production could boom soon, driven by its use in both food products and cosmetics.

By 2050, we might see an expansion in the use of algae and seaweed in food products. These could include algae-based oils, protein powders, seaweed snacks, and even algae-derived ingredients for food fortification.

Functional and nutrient-dense foods

With advancements in food science and technology, there could be a broader range of functional and nutrient-dense foods on the market. Functional foods are food containing bioactive compounds (e.g., dietary fiber) that have positive health properties. These might be included in beverages, snacks, and convenience foods designed to provide specific health benefits or meet the nutritional needs of certain populations. These functional ingredients could be derived from food components that are traditionally considered as 'residues', such as meat and seafood trimmings, spent grains, spent coffee and tea grounds, vegetables and fruit peels and pulps. These new products could therefore play a significant role in increasing the circularity of food processing activities by valorising all waste streams into new functional food products.



Berlin, Germany

New Waste (Water) Management

In the future, the goal in the water sector is to minimise groundwater extraction without compromising convenience, increasing costs, or posing hygiene risks. To achieve this, wastewater will no longer be seen as something to be disposed of quickly, but as a resource for new water, energy and nutrients. Practices such as using drinking water to flush toilets, and rainwater will no longer be treated as wastewater, but as high-quality (drinking) water.

Similar to the existing waste management cycle, where paper, plastics and food are segregated into different bins - wastewater can be separated into different material streams, making it easier to reuse and recycle:

- **Black water** - domestic wastewater containing faecal matter: originating from toilets. Potential for recycling: nutrients
- **Grey water** - wastewater free of faecal matter: originating from baths, showers, washing machines or kitchen. Potential for recycling: (service) water, heat
- **Rain water** - water from rainfall. Potential for recycling: drinking water, service water
- **Service water** - water used in the household for various purposes but not of drinking water quality. Potential sources: black water, grey water, rain water, service water

In most European countries, a single pipe supplies drinking water into households, regardless of whether the intended use requires drinking water quality. High-quality drinking water is used for flushing toilets, cleaning floors or watering plants. Only 4% of water is used for drinking or cooking. Table 2 shows the percentage of daily water consumption in Germany by type of use. The blue bars indicate areas where drinking water quality is recommended, while the green bars show where service water quality is perfectly adequate.



Table 2

In 2020, the EU took a significant step towards sustainable water useage by setting quality and safety standards for reusing wastewater in irrigation (2020/741). Recycled water extends beyond agricultural use and finds applications in households and communities. While drinking water must maintain high safety standards from natural sources, recycled "service water" can be used without the same safety requirements. This approach offers environmental benefits, helps urban fauna, contributes to city cooling, and is economically advantageous. Achieving these advantages involves challenging centralised water systems and influential players in the sector.

Grey water recycling

Among the decentralised options, using purified greywater for service water seems most suitable for multi-storey buildings and complexes. While the rain collection area per person is relatively small, each person produces the same

amount of grey water every day of the year. Greywater treatment is relatively simple.

The recycling process at the place of origin not only simplifies the direct reuse of water but also allows for heat recovery. Using simple heat exchangers or heat pumps, households' drinking water can be preheated to save gas or electricity.

Grey water treatment

Pollutants and foreign substances are filtered out of the water through various filtering processes. Finally, the water passes through a sand filter to make it clear, and UV disinfection eliminates any hygiene risk. After this process, it exceeds the quality requirements of the EU Bathing Water Directive, making it suitable for various household uses where drinking water quality is not essential.



Berlin, Germany



Rainwater harvesting

The retention of rainwater in urban planning has become integral. In addition to infiltration and evaporation, there are many benefits to using rainwater in households. For example, collected rainwater can be used for irrigation or flushing toilets.

Unlike wastewater, rainwater does not contain undesirable substances such as pharmaceutical residues or hormones and therefore does not need to be removed in a complex and energy-intensive fourth purification stage in wastewater treatment plants.

Second pipe system

Whether rainwater or recycled grey water is used, a second pipe system is required to transport the water to the point of use while maintaining a hygienically safe system. With a separate wastewater system, hygiene is assured because there is no connection between the drinking water pipes and the wastewater pipes.

Separating toilets - recovering nutrients

To produce our food, nitrogen is artificially produced using a lot of energy, and the finite resource of phosphorus is mined. Around 80% of nutrients are found in our wastewater or black water. The nutrients nitrogen, phosphorus and potassium in wastewater are essential for plant production.

While legislation for phosphorus recovery in regular wastewater treatment plants is slowly being introduced, there are already technological innovations that do this in a decentralised way - dry separation or vacuum toilets.

Urine and faeces are collected and stored separately. The urine is filtered to remove most pollutants and can be used directly as fertiliser or processed into dry fertiliser. Solids from dry toilets are processed into humus through thermal processes and an aerobic humification process. Changes to fertiliser legislation to allow these safe and resource-efficient products to enter the market are imminent.



This new value chain influences the surrounding system

Future cities will transform into food production hubs with buildings employing both high-tech and low-tech processes to provide local, healthy food. These structures will use innovative and natural materials, following eco-design principles, and incorporate on-site water recycling for food production.

Underutilized areas like derelict land, empty warehouses, and rooftops will be chosen for new food production sites. Multi-storey farms can integrate into new buildings. This urban production shortens delivery routes, reduces greenhouse gas emissions, and promotes transparency in the food supply chain, enhancing consumer awareness of food origins.

Urban planning and development offices are now integrated into planning specifications, making them mandatory. In addition, decision-support systems (DSS) will be used for logistics and as a decision-support tool for the selection of systems/plants and locations for the

sustainable use of urban open spaces. This transformation will turn cities into edible cities, strengthening social cohesion and providing healthy, local food for the population.

New job opportunities

Environmental benefits aside, technological innovations in areas like vertical crop production and water recycling create new jobs. Research and science drive these developments, involving consumers as producers in the circular economy.

Marketing new foods requires extensive communication and education, as discussed in the social innovation chapter. In the circular economy, collecting nutrient-rich waste for high-quality fertilizer and developing separate toilet systems offer new job opportunities, especially in multi-storey buildings.

These innovations mark initial steps toward a circular economy in wastewater management, with varied water qualities for different applications and increased use of decentralized systems. The urgency of climate change may accelerate re-evaluations of water management strategies in water-rich countries.



Conclusion



Only through collective efforts Vision 2050 can become a reality



Thirteen European pilot projects in the Guidebook showcase transformative food system initiatives with diverse goals and innovations, all aimed at urban food system transformation.

These initiatives, with distinct orientations, contribute to a framework for future CRFS efforts, fostering sustainability across social, ecological, and economic dimensions. They align with Vision 2050's call for fundamental innovations in political, social, economic, and technical aspects of CRFS.

To achieve Vision 2050, European cities need cross-level coordination and consensus, as seen in collaborative pilot projects across disciplines, surpassing individual initiatives.

Adapting policies is crucial for Vision 2050 addressing obstructive regulations.

Social innovations are needed for equal access to healthy food, considering disparities in prices and income.

Reintegrating food production into urban areas and robust educational initiatives are vital for Vision 2050. The Guidebook highlights the importance of technical innovations.

Sustainable resource use, following circular economy principles, is crucial for Vision 2050. While progress is seen in waste management, further adjustments like separate wastewater collection are necessary. Achieving Vision 2050 requires changes in every area, and collaborative efforts, as exemplified by the FoodE project, are essential at all levels and with all stakeholders in Europe.



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