

HOW TO BRING INNOVATION IN CITY / REGION FOOD SYSTEMS?

YOUR PHD CONCEPT IN 3 MINUTES

2 September 2020



ENVIRONMENTAL ASSESSMENT
VOLATILE ORGANIC COMPOUNDS
AQUAPONICS
URBAN FARMING
ROOFTOP FARM
FOODE
SUSTAINABILITY
VERTICAL FARMING
COMMUNITY SUPPORTED AGRICULTURE
FARM-TO-FORK
BUILDING INTEGRATED GREENHOUSE
PROSUMERS
BUSINESS MODELS

QUALITY FOOD ZERO-MILES
LED LIGHTING
WATER NUTRITION FARMERS MARKET ENERGY

Host: *Dr. Giuseppina Pennisi*
University of Bologna Alma Mater Studiorum

SPPSPHD2020.FI/
PROGRAM



The activity is realised within the MyLocalFoodE initiative of EU project Food Systems in European Cities (FoodE). This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 862663.



© 2020 Alma Mater Studiorum, University of Bologna

Text and Editing: Giuseppina Pennisi
Design: Chantal van Wessel, Manon Dees,
Quentin Galland, Aleksandar-Mihail Atanasov
Editor: Alma Mater Studiorum - University of Bologna
License: Creative Commons Attribution Non-commercial No Derivatives
(CC BY-NC-ND 4.0)
DOI: 10.6092/unibo/amsacta/6455
ISBN: 9788854970281
Book Series: UrbanFarm
ISSN: 2612-7660
Volume: 4
Curator: Francesco Orsini



The activity is realised within the MyLocalFoodE initiative of EU project Food Systems in European Cities (FoodE). This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 862663.



“... we are facing today a grave threat, not one solely based on the fact that we don't answers to burning problems in society, but even more to the point that we don't pose a clear apprehension of what the main problems are and clear understanding of their real dimensions ...”.

Slavoj Žižek



Table of Contents

Forewords	6
Jury Members	8
FoodE	9
Agenda	12
Improving Food Production	13
<i>Rooftop cultivation as a response to new urban exigencies: an inventory of worldwide cases.</i>	14
<i>Potential volatile organic compounds emission in indoor urban farming: impact assessment in building integrated-Rooftop Greenhouses (i-RTG).</i>	15
<i>Quantifying resources-to-food conversion efficiency in urban horticultural systems, under diversified climate conditions.</i>	16
<i>Teresina Urban community gardens. The producers perception of natural resources management.</i>	17
<i>Natural wax from arctic berries as our treasure.</i>	18
<i>Toward the understanding of the role of aquaponics toward circularity and more liveable cities.</i>	19
<i>Homegrown microgreen - from light-recipes to taste.</i>	20
Reducing Food Waste	21
<i>Food waste in the school food service sector: elaboration and assessment of tailored mitigation strategies.</i>	22
<i>Theoretically and Practically avoidable food waste: trade-off analysis in determining priorities to reduce food waste at City/Region Food System level.</i>	23
<i>Urban agriculture and organic waste management: a case study from Florianopolis, Brazil.</i>	24
Creating Sustainable Cities	25
<i>The City/Region Food System adaptations in the post Covid-19 era: evidences to design a more sustainable future.</i>	26
<i>Innovative digital solution approaches to enhance sustainable behaviors in City Region Food Systems.</i>	27
<i>Territorializing food system sustainability assessment: Life Cycle Thinking contribution to shared value chains.</i>	28

Forewords





The International Workshop & How to bring innovation in City/Region Food Systems” has been organized within the framework of the EU- H2020 project Food Systems in European Cities (FoodE, www.foode.eu), in collaboration with the 11th SPPS PhD Student Conference (<https://sppsphd2020.fi/>), held in Turku (Finland) and online in September 2-4, 2020.

In recent years, our planet has been experiencing a convergence of natural and man-made crises that are unprecedented in our lifetime. We are facing the consequences of accelerating and rapid urbanization, the scarcity of natural resources and their mismanagement and the impact of major errors in our responses to disasters. Recent pandemic outbreak has posed at serious risk food access and security, especially in larger cities, enabling the environment for a constructive debate on how to rethink our food systems. While cities cover less than 2 percent of the Earth’s surface, they consume 78 percent of world energy and release over 60 percent of all carbon dioxide and a significant amount of other greenhouse gases. Among EU citizens, major environmental impact are associated with food systems, with all the related economic and social consequences.

This workshop represents a place where young minds and early stage researchers are called to discuss about innovation and sustainability of City/Region Food Systems (CRFS), ranging from where food is produced, to where it is processed and distributed. Talks range among all aspects of CRFS, including innovative plant production systems, sustainability assessment, short food chain, food waste management, urban agriculture, business models and the water-food-energy nexus within cities.

Speakers were asked to resume their innovative ideas and PhD research projects in three minutes, fulfilling the key questions:

- *What is the innovation of your research project?*
- *How can this innovation contribute to sustainability of City/Region Food Systems?*

Within 1 h 30’, the workshop brought together 15 contributions (combining two plenary lectures and 13 short presentations from PhD candidates) from 9 World countries. All participants have got the opportunity to follow excellent presentations on topics that sometimes were far from their field of expertise, but though so much integrated and relevant to it.

Welcome!

Dr. Giuseppina Pennisi

Department of Agricultural and Food Sciences, University of Bologna Workshop host

Jury Members



Bernd Poelling, PhD

South Westphalia University of Applied Sciences
(Soest, Germany)

Teaching business models for agriculture in metropolitan areas, contributing to the definition of entrepreneurial opportunities and business models in urban agriculture within EU projects Newbie (New Entrant netWork: Business models for Innovation, entrepreneurship and resilience in European agriculture, <http://www.newbie-academy.eu/>) and FoodE (Food Systems in European Cities, <https://www.foode.eu>).



Esther Sanyé-Mengual, PhD

Scientific officer at the Joint Research Centre of the European Commission (EC-JRC) within the Bio-economy unit.

Working on the use of life cycle assessment for policy advice, the assessment of the environmental impacts of EU consumption and the evaluation of marine litter from a life cycle perspective.

Former MSCA fellow at Bologna University, within the project SustUrbanFoods (<https://site.unibo.it/susturbanfoods/en>).

FoodE

Food Systems in European Cities

Led by the University of Bologna, FoodE brings together a highly qualified consortium of 24 organisations. It comprises universities, research institutes, SMEs, NGOs, as well as city councils spread across 8 EU countries. FoodE is financed under Horizon 2020 (grant agreement number 862663) - the European Union Research and Innovation Framework Programme (2014-2020) - and will run for four years. FoodE aims to accelerate the growth of sustainable and resilient City/Region Food Systems (CRFS) by bringing together citizen-led local food initiatives across Europe. The project will build a “Think global, eat local” mindset with a view to addressing pressing global challenges that threaten food security, while boosting the local economy. FoodE will act as an exchange platform where public authorities, citizens, SMEs and non-profit organisations share ideas, best practices and tools to support cities and regions in their transition towards innovative, sustainable food systems. At its core, FoodE will nurture social and technological innovation with the active role of citizens, who are involved in the food production, distribution and consumption.

Specifically, FoodE and its partners will implement the following activities:

- Building a database of existing citizen-led food systems initiatives in the EU and their integration within CRFS;
- Developing a methodological framework for assessing these existing CRFS and emerging initiatives;
- Assessing the social, environmental and economic dimensions of the selected initiatives;
- Creating and improving an online app for the reviewal and monitoring of CRFS;
- Launching hands-on initiatives in 18 schools throughout Europe, resulting in the preparation and publication of an e-book on CRFS, edited by and for young minds;
- Holding an open challenge/competition for the design of innovative CRFS pilot projects;
- Implementing and scaling-up 15 CRFS pilot projects in 12 EU cities/regions, involving coastal, rural and urban areas;
- Classifying innovative business models in CRFS and reviewing existing certification labels;
- Creating a CRFS ecolabel;
- Producing fact sheets on EU and national policies on CRFS;
- Preparing and publishing a European guidebook to sustainable CRFS;
- Developing an app that will allow European citizens to identify, monitor and assess CRFS initiatives.

The outputs of FoodE will pave the way for job creation, enhance local economies, and enable local communities to contribute to the United Nations Sustainable Development Goals, whilst increasing the relationships and interlinkages between the different actors of the food chains.

Stay tuned on www.foode.eu!



Agenda

Time	Title	Speaker
15.30-15.35	Welcome and Opening of the workshop.	Giuseppina Pennisi
15.35-15.45	How to make smart and sustainable CRFS economically viable?	Bernd Pölling
15.45-15.55	The environmental impacts of EU food consumption and innovative urban agriculture experiences.	Esther Sanyé-Mengual
Session 1. Improving Food Production		
15.55-16.00	Rooftop cultivation as a response to new urban exigencies: an inventory of worldwide cases.	Elisa Appolloni
16.00-16.05	Potential volatile organic compounds emission in indoor urban farming: impact assessment in building integrated-Rooftop Greenhouses (i-RTG).	Gaia Stringari
16.05-16.10	Quantifying resources-to-food conversion efficiency in urban horticultural systems, under diversified climate conditions.	Isabella Righini
16.10-16.15	Teresina Urban community gardens. The producers' perception of natural resources management.	Nicola Michelin
16.15-16.20	Natural wax from arctic berries as our treasure.	Priyanka Trivedi
16.20-16.25	Toward the understanding of the role of aquaponics toward circularity and more liveable cities.	Roberta Calone
16.25-16.30	Homegrown microgreen - from light-recipes to taste.	Martina Angeleri
Session 2: Reducing Food Waste		
16.30-16.35	Food waste in the school food service sector: elaboration and assessment of tailored mitigation strategies.	Zhuang Qian
16.35-16.40	Theoretically and Practically avoidable food waste: trade-off analysis in determining priorities to reduce food waste at City/Region Food System level.	Pietro Tonini
16.40-16.45	Urban agriculture and organic waste management: a case study from Florianopolis, Brazil.	Gianluca Di Fiore
Session 3. Creating Sustainable Cities		
16.45-16.50	The City/Region Food System adaptations in the post Covid-19 era: evidences to design a more sustainable future.	Mara Petruzzelli
16.50-16.55	Innovative digital solution approaches to enhance sustainable behaviors in City Region Food Systems.	Francesca Monticone
16.55-17.00	Territorializing food system sustainability assessment: Life Cycle Thinking contribution to shared value chains.	Francesco Cirone
17.00-17.10	Closure of the meeting and award ceremony	Giuseppina Pennisi

Improving Food Production



Rooftop cultivation as a response to new urban exigencies: an inventory of worldwide cases.

Elisa Appolloni^{1*}, Xavier Gabarrell Durany², Francesco Orsini¹

¹ *University of Bologna Alma Mater Studiorum, Department of Agricultural and Food Sciences, Bologna, Italy.*

² *Universitat Autònoma de Barcelona, Institut de Ciència i Tecnologia Ambientals (ICTA), Chemical Engineering Department, Barcelona, Spain*

*elisa.appolloni3@unibo.it

As urbanization is rapidly growing in both developed and developing countries of the globe, new urban exigencies emerge. Issues associated with increasing urbanization may relate to different aspects of urban living quality, including fresh food accessibility, social interactions, economic opportunities, health implications and educational aspects. The equilibrium and interactions between the built environment and the surrounding environment also represent key points to ensure urban well-living, particularly with reference to cities microclimate management (e.g., storm water, heat island effect) and biodiversity preservation. Green infrastructures within the urban context represent a fundamental tool to counteract thermal fluctuations across seasons, as well as favoring cities resilience to unexpected events. These events, which could also be represented by sanitary issues as recently demonstrated during Covid-19 pandemic, can also affect urban residents more dramatically than rural ones, especially for what concerns food purchasing and supply. Therefore, the development of urban food systems that also incorporate inner food production may represent an actual solution to overcome these obstacles. Still, high costs for urban lands may put a strain on this objective, pointing out the necessity of urban farming systems not based on soil occupation. The use of underexplored urban spaces such as flat rooftops of different building typologies (e.g., hospitals, residential, offices, retailers), cultivated with both low or high-tech solutions, can be a viable way to enable food production within cities, contemporarily contributing to social, economic and environmental sustainability. This form of building-based farming, often referred to as Rooftop Agriculture (RA), has been gaining great interest in the last decade, spreading worldwide following aims that range from business oriented to household production. In order to have a better understanding of the global spread and state-of-the-art of RA, the present research targeted the implementation of a global inventory of worldwide cases of RA projects, particularly focusing on their main objectives, building typologies and agronomic solutions applied. The inventory, which accounts for 185 cases, represents a viable monitoring tool to better understand future trends, challenges and potentialities of this developing form of urban agriculture.



Potential volatile organic compounds emission in indoor urban farming: impact assessment in building integrated-Rooftop Greenhouses (i-RTG).

Gaia Stringari^{1*}, Antoni Rosell-Melé^{2,1}, Francesco Orsini³, Joan Rieradevall Pons^{4,1}, Xavier Gabarrell Durany^{4,1}

¹ *Sostenipra Research Group (SGR 01412), Institute of Environmental Sciences and Technology (ICTA), Universitat Autònoma de Barcelona (UAB), Edifici ICTA-ICP, Carrer de les Columnes, 08193 Bellaterra, Barcelona, Spain*

² *Catalan Institution for Research and Advanced Studies (ICREA), Barcelona, Spain*

³ *University of Bologna Alma Mater Studiorum, Department of Agricultural and Food Sciences, Bologna, Italy.*

⁴ *Department of Chemical, Biological and Environmental Engineering, (Catalan Biotechnology Reference Network -XRB-), Universitat Autònoma de Barcelona (UAB), Campus UAB, 08193 Bellaterra, Barcelona, Spain*

*gaia.stringari@uab.cat

While support toward cities greening and urban agriculture take place through modern installations such as building vertical farming, it is then important to give a complete assessment of potential issues related with these systems. Promising solutions for sustainable food production and urban resilience are represented by integrated-Rooftop Greenhouses (i-RTGs) where plant farming is carried out on buildings top in a protected greenhouse environment. In i-RTG quality of air becomes relevant for professionals and people that spend most of time inside this space due to low air turnover and potential accumulation of indoor Volatile Organic Compounds (VOCs) emitted not only by building furnishings but also by cultivated plants. Outdoor annual plant emission has been estimated between 1000 - 1200 Tg y⁻¹ versus only 110 - 186 Tg y⁻¹ released by anthropogenic activity, having therefore a high impact on total budget of atmospheric emissions. Up to now plant volatiles have been mainly studied in open environments and on forest species, while very few studies focused on emissions associated to crop species and on their effect on surrounding air. Considering increasing tendency toward the implementation of urban and indoor farms, there is a call for life quality improvement in the city. On the perspective of giving an introductory overview on VOCs released by horticultural species in a protected urban environment, a preliminary assessment on volatiles composition emitted by common green bean (*Phaseolus vulgaris* L.) and on sampling methodology was conducted in the soilless i-RTG of ICTA-ICP building of the Universitat Autònoma de Barcelona. For VOCs collection, both an active and a passive methods were performed and facilitated by an open chamber built around two plant rows during all crop season, plus parallel control samplings taken outside the i-RTG. Plant volatiles were almost undetectable, instead compound mixes were found in both chamber and control samples in chromatographic results, suggesting setup improvements were needed. Building on these findings, the experiment was repeated using only active sampling in a smaller chamber divided in two sections, one planted and one empty. This time the chamber was closed at sampling to minimize disturbance effect of surrounding environment in order to achieve clear qualitative results and quantitative information on detected VOCs.



Quantifying resources-to-food conversion efficiency in urban horticultural systems, under diversified climate conditions.

Isabella Righini¹, Leo F.M. Marcelis², Luuk Graamans¹, Silke Hemming¹, Cecilia Stanghellini¹

¹ Wageningen UR Greenhouse Horticulture, Wageningen, The Netherlands

² Horticulture & Product Physiology Group, Wageningen University, Wageningen, The Netherlands

[*isabella.righini@wur.nl](mailto:isabella.righini@wur.nl)

Increasing global urbanization relies on food supply chains that may not be entirely robust. Therefore, urban horticultural production is gaining more and more attention, ranging from small-scale urban gardens to more industrial high-tech soilless greenhouses and closed high-productive systems such as vertical farms. Although urban horticulture cannot replace traditional dominant food systems in feeding the world, it may cover the growing demands of nutrients, sustainable and fresh produce in urban areas and grow to become a key element of future food systems. Given the high value of urban land and increasing pressure on finite natural resources, such dietary requirements should be fulfilled in the most efficient, sustainable and robust way possible. This implies that the decisions of what, where and how to grow should be based on 1) a quantitative assessment of the resource requirement of each basic component constituting healthy diet and 2) on the robustness of crop production systems to climate conditions (both in the natural and controlled environment as well as those caused by climate change). However, from a preliminary literature search it is difficult to obtain a direct feedback on the resource efficiency in the production of the plant-based fraction of a standard given diet. The available evidence is relatively large but scattered and heterogeneous, often being limited to small amount and specific types of crops and/or nutritional compound (especially for fruits and vegetables), or being focused to yield as the only output parameter. This research aims to fill gaps in our knowledge about resource use efficiency of selected crops and robustness of urban cultivation systems under diversified climate conditions. In the first place, the study will develop a methodological framework to orient the design and planning of crops in urban cultivation systems, in view of maximizing the "dietary benefit" vs "resource requirement".



Teresina Urban community gardens. The producers perception of natural resources management.

Nicola Michelin^{1*}, Giuseppina Pennisi¹, Stefano Bona², Lucrecia Pacheco Batista³, Francesco Orsini^{*1}, Giorgio Gianquinto¹

¹ Research Centre in Urban Environment for Agriculture and Biodiversity (ResCUE-AB), Department of Agricultural and Food Sciences (DISTAL), Alma Mater Studiorum University of Bologna, Viale Fanin, 44, 40127, Bologna, Italy.

² Department of Agronomy, Food, Natural resources, Animals and Environment (DAFNAE), University of Padova, Viale dell'Università, 16, 35020, Legnaro (PD), Italy.

³ Department of Agriculture Sciences, State University of Piauì (CCA-UESPI), 64001-030 - Teresina - Piauì, -Brazil;

*nicola.michelon@unibo.it

The urban and peri-urban areas of main cities of developing countries are characterized by spread poverty and a high rate of unemployment. The promotion of urban community gardens allows to produce fresh vegetables, to contribute improving people's diet and creating job opportunities. This study was conducted to characterize the urban and peri-urban community gardens of Teresina city (Piauì State, in the north-east region of Brazil), determine their role in peri-urban agriculture production, and assess potential risks in terms of natural resources management. The research builds on the results of a survey conducted during 2019, where users of five urban community gardens of the city of Teresina were interviewed. The questionnaire included 25 open and closed questions and was structured into two sections, including both general information (e.g., age, gender, level of education) and technical and production information (e.g., cropping system adopted, yields, irrigation water consumption). Multiple variable analysis was used to analyze the survey results. It was detected that most horticulturists are female above 45 years of age. Most of farmers have incomplete primary education, and a weak agricultural background. About 95% of horticulturists do not have information on either soil or water quality. Main crops produced include coriander, chive, and lettuce. Significant differences in terms of yield (kg m^{-2}) were observed among the urban community gardens under assessment. While lettuce yield reached up to $2.7 \pm 0.22 \text{ kg m}^{-2}$ in some gardens, values of water use efficiency (WUE) were very low (average of $6.9 \pm 0.4 \text{ g FW L}^{-1} \text{ H}_2\text{O}$). The highest WUE values were found in the urban gardens where an irrigation system was adopted. The survey points out that a tailored training for the horticulturist on more efficient use of natural resources is needed to contribute a better and more sustainable management of urban and peri-urban gardens in the city of Teresina.



Natural wax from arctic berries as our treasure.

Priyanka Trivedi^{1*}, Nga Nguyen¹, Katja Karppinen⁵, Linards Klavins², Petri Sundqvist³, Esa Heinonen³, Maris Klavins², Juha Väänänen³, Janne Remes³, Laura Jaakola^{4,5}, Hely Häggman¹

¹ Department of Ecology and Genetics, University of Oulu, FI-90014 Oulu, Finland

² Department of Environmental Science, University of Latvia, LV-1586, Riga, Latvia

³ Centre of Microscopy and Nanotechnology, University of Oulu, FI-90014 Oulu, Finland

⁴ Norwegian Institute of Bioeconomy Research, NIBIO, Norway

⁵ Department of Arctic and Marine Biology, UiT The Arctic University of Norway, Tromsø, Norway

*priyanka.priyanka@oulu.fi

In Scandinavia, there are about 50 species of wild berries and 37 of them are edible. Only 5% of berries are picked and remaining is left to rot in the forests. Bilberry and lingonberry are most important industrially utilized berries. They are being used increasingly by the food industry due to their reported health and probiotic effects. Only 3% of the industrial demand for waxes is met by natural waxes, while the remaining 97% is produced from non-renewable energy. The outer surface of berries is covered by cuticular wax, which plays a role in non-stomatal water loss, protection from UV rays and plant defense. Therefore, the industry side streams of berry industry can be used to extract wax. We have studied the chemical composition of cuticular wax in bilberry (*Vaccinium myrtillus*), lingonberry (*Vaccinium vitis-idaea*), bog bilberry (*Vaccinium uliginosum*) and crowberry (*Empetrum nigrum*) fruits using GC-MS. Triterpenoids, known for their health beneficial properties were found to be dominant compounds in bilberry and lingonberry cuticular wax. Therefore, the industrial leftover of berry (bilberry and lingonberry) juice industry, berry press cakes were utilized to extract wax using clean and environmentally friendly technique, Supercritical Fluid Extraction (SFE). Linoleic acid and γ -linolenic acid were found to be the dominant compounds. Berry waxes show good *in vitro* Sun Protection Factors (SPFs) depicting high UV-B absorbing capacities. Further studies on the bioactivity; antimicrobial, antioxidant and cytotoxicity of bilberry and lingonberry waxes are ongoing. The aim of our work is to develop methods for exploiting the raw material present in the side stream of berry juice industry for value added high value products. Our study brings new information on composition of berry cuticular wax of as well as utilization of residue of berry juice industry for potential applications in food and cosmetics. The work aims at enhancing bioeconomy and circular economy, while exploiting potential of side streams of Nordic berry based industry for value added products.



Toward the understanding of the role of aquaponics toward circularity and more liveable cities.

Roberta Calone^{1*}, Luca Settanni^{1,2}, Francesco Lombardo², Gian Marco Tamborra², Giuseppina Pennisi¹, Francesco Orsini¹

¹ *University of Bologna Alma Mater Studiorum, Department of Agricultural and Food Sciences, Bologna, Italy*

² *Aquaponic Design, Bologna, Italy*

*roberta.calone3@unibo.it

The fast global population growth and the increasing urbanization result in a strong reduction of the available lands for agriculture, today accounting for about 7 ha pro-capita. In this alarming context, urban agriculture may play a crucial role in supporting food production and ensuring food safety. In accordance with the green new deal goals, aquaponics, a soilless productive system that integrates into a circular way fish and vegetable production, may offer an important contribution to the achievement of zero climatic impact. Besides its multiple economic and environmental advantages (reduction in water, soil, pesticides, and fertilizers use, as compared with traditional agriculture), aquaponics may favour the recovery and requalification of urban green spaces and abandoned areas and boost the diffusion and adoption of good practices for a more sustainable food production. A study was conducted during the productive season of 2020 at the aquaponic plant located at the Serre dei Giardini Margherita (Bologna, Italy). This system was composed by a 10 cubic meters artificial pond, hosting more than 200 fishes, including red-fishes and koi carps, and 21 NTF hydroponic towers, occupying a 4 square meters surface and hosting 231 plant of leafy vegetables. This plant was built with the main objective of furnishing fresh leafy vegetables and aromatic essences to the annex restaurant. In the first place, an evaluation of the effective restaurant requirements in terms of fresh vegetables achievable in the described tower system was executed. Then, an experimental plan was fixed to evaluate the quali-quantitative yield of the vertical hydroponic system compared to the traditional soil cultivation, when watered with fresh tap water or with water coming from the fish-pond. Furthermore, a social analysis was carried out to evaluate the degree of customer satisfaction, concerning the ornamental and recreational benefits linked to use of the space where the ornamental aquaponic unit is located.



Homegrown microgreen - from light-recipes to taste.

Martina Angeleri^{1,2*}, Iiris Kuusisto², Saijaliisa Kangasjärvi¹ and Kari Vuorinen²

1 University of Turku, Turku Finland;

2 Plantui Oy, Turku, Finland

[*marang@utu.fi](mailto:marang@utu.fi) or martina@plantui.fi

“Microgreens”, i.e. young plants at the stage of cotyledons, are an emerging “super-food” whose demand has largely increased in recent years. They are rich source of minerals and phytonutrient (e.g. vitamins, ascorbic acid, tocopherol, carotenoids) and a concentrate of flavors for soups and salads. One of the limitation in consumption of microgreens is their short shelf life, thus the need to access to freshly harvested product. Indoor gardens are an ideal solution for self-cultivation of microgreen. For this research, the “smart garden 6” produced by the local company Plantui (patent WO 2015/144815 A1) was used for microgreen growth. This indoor garden for hydroponic cultivation consist of a water pump, a tray specifically designed for cotyledons growth and a light unit emitting photosynthetically active radiation (PAR). The light unit uses light emitting diodes (LED) technology and comprises LEDs emitting radiation within the blue, green and red fractions of the spectrum. The aim of the research is to modify the taste and the nutritional value of microgreens grown in the indoor-garden, by modifying the spectrum of light emitted by the light unit. Changing the intensity of the light emitted by each LED, different illumination conditions were created for plants. Preliminary results showed that the different illumination affect plant growth both in term of biomass produced and colour of the cotyledons. The nutritional composition and panel tests of broccoli and red cabbage microgreens grown in the different conditions are currently under evaluation. Design specific light recipe(s) to achieve a peculiar taste will be the next step. To obtain this result different light-colours will be used during the plant growth (i.e. light used in germination and length of the lighting period) taking advantages of the growing phases of the Plantui’s smart garden 6. The final goal will be to create (and share) a catalogue of different light recipes, each for a specific taste, for the home-gardener to choose.



Reducing Food Waste



Food waste in the school food service sector: elaboration and assessment of tailored mitigation strategies.

Zhuang Qian^{1*}, Matteo Masotti¹, Matteo Vittuari¹

1 Department of Agricultural and Food Sciences, University of Bologna, 40127 Bologna, Italy

* zhuang.qian2@unibo.it

Given the interrelated economic, environmental and social impacts, food losses and waste (FLW) represents a major challenge for the sustainability of the food supply chain. In this context, a key target for international organisations and national governments consists in the identification of mitigation interventions addressing food waste (FW) at the consumption stage, where the largest share of FLW occurs. Moreover, particular attention needs to be placed on the food service sector, which is relatively unexplored compared to household, especially in terms of potential interventions targeting FW reduction. Building on the understanding of the causes of FW and more specifically on consumer's attitudes and behaviours, this work wants to identify and test FW reduction measures tailored for school canteens. To achieve this goal the work will: 1) quantify FW; 2) identify FW determinants and students' eating behaviour patterns; 3) identify and design FW reduction interventions building on the aforementioned drivers and behaviour patterns; 4) test the selected interventions. To be clear, a mix of integrated methodological tools will be employed within the context of a selected elementary school. FW quantification will be based on the visual estimation method. FW causes and eating behaviour patterns will be detected employing a questionnaire survey under the theory of planned behaviour. An initial set of interventions will be identified through a systematic literature review. Selected measures will be then revised by analysing the logic of intervention to ensure their coherence with the most important drivers of FW. Measures will be then tested comparing the level of FW before and after their implementation. This research contributes to the literature on FW mitigation strategies in the food service sector by providing advancements in the understanding of the effectiveness of alternative interventions nudging consumer behavioural change targeting FW prevention and reduction.



Theoretically and Practically avoidable food waste: trade-off analysis in determining priorities to reduce food waste at City/Region Food System level.

Pietro Tonini^{1,2*}, Pere Muñoz¹, Francesco Orsini², Xavier Gabarrell Durani¹

¹ *Universitat Autònoma de Barcelona, Institut de Ciència i Tecnologia Ambientals (ICTA), Chemical Engineering Department, Barcelona, Spain.*

² *University of Bologna Alma Mater Studiorum, Department of Agricultural and Food Sciences, Bologna, Italy*

*pietro.tonini@uab.cat

It was recently reported that within EU citizen lifestyle, food consumption accounts as the main driver of environmental impact generated. Although vegetables are perceived to have lower environmental impacts than meat and dairy products their burden depends on various factors, including the type of transport, process and food waste generation in the value chain. Food waste is defined as any food, and inedible parts of food, removed from the food supply chain. It affects the EU society at economic level, since its management accounts for almost 2000 euro per ton of product. Moreover, it has an environmental impact mainly associated to the inefficient use of the resources. Finally, it also has social impacts, mainly associated to food poverty, a growing phenomenon also in European cities. The research builds on a trade-off analysis based on LCA approach, developed applying the European hierarchy process in determining priorities to reduce food waste. The indicator of Degree of recoverability provided by Garrone et al. is applied in the city-region food system context of Barcelona identifying tailored opportunities to quantify *theoretically avoidable food waste* giving the input for the scenario analysis. Within the municipal area of Barcelona, 80% of the organic fraction of municipal solid waste is composed by horticulture products that are mainly thrown entirely (i.e. error in the purchase forecast) and in lower percentage as leftover. The scenario analysis will be used to derive *potential practically avoidable food waste* based on the political context (i.e. introduction of food waste regulation), emerging technologies, and businesses to support the decision-maker toward the achievement of sustainability goals. The analysis will be created starting from quantitative data to create a baseline and then several scenarios will be established in collaboration with a stakeholder advisory board composed by farmers, university, public entities, and finally the consumer.



Urban agriculture and organic waste management: a case study from Florianopolis, Brazil.

Gianluca Di Fiore¹, Kathrin Specht²⁻³, Oscar José Rover⁴, Cesare Zanasi¹

¹ Alma Mater Studiorum - University of Bologna, DISTAL-Department of Agri-food Science and Technology. Viale Giuseppe Fanin 50 Bologna, IT 40127

² ILS-Research Institute for Regional and Urban Development Brüderweg 22-24, 44135 Dortmund, Germany, Dortmund, DE 44135

³ Faculty of Life Sciences, Humboldt-Universität zu Berlin, 10099 Berlin, Germany

⁴ Federal University of Santa Catarina (UFSC) – Department of Agri-food Science (CCA), Rod. Admar Gonzaga, 1346 - Itacorubi, Florianópolis - SC, 88034-000, Brazil

[*gianluca.difiore@unibo.it](mailto:gianluca.difiore@unibo.it)

The urban settlements' over population will be one of the main challenges that local government and international institutions will have to cope with. The negative externalities deriving from the urban overpopulation are involving all the dimensions of the urban metabolism including food security and municipal solid waste (MSW) management. This is particularly affecting marginal communities in Global South countries. In countries like Brazil a large percentage (40%) of MSW is still inappropriately dumped in peripheral areas and 35% of this waste derives from organic waste (OW). The first Brazilian capital to ever approve a law on organic waste treatment is the Santa Catarina's capital Florianopolis. The law supports a model based on community composting initiatives aiming at reuse of the generated compost for community Urban Agriculture (UA). UA, thanks to its ability to promote environmental education, can be an effective tool to raise awareness among citizens, support food security in marginal communities and operatively improve the municipal OW management system. To this end an analysis of the waste management habits (reuse, recycle and reduce) has been conducted with the aim of assessing the differences between urban farmers and other citizens. The results show that the urban farmers are more likely to self-compost their household OW rather than use public or private waste management services. UA participation seems to have a lower impact on the waste reduction habits. Furthermore, a stakeholders' analysis has been conducted trying to evaluate the benefits and risks related to the law. The interviews showed that the main benefit related to the composting law are represented by the possibility to provide fertilizer for UA and support the existing OW management initiatives. The main risks are represented by a lack of infrastructure that could result in health issues associated with inappropriate waste management. Possible policies aiming at support UA activities could be derived from the study results, toward the aims of *i*) an improvement of the waste management systems thanks to a reduction of the workload of the public system and *ii*) an improvement in terms of food security in marginal communities.



Creating Sustainable Cities



The City/Region Food System adaptations in the post Covid-19 era: evidences to design a more sustainable future

Mara Petruzzelli^{1*}, Francesco Cirone¹, Fabio De Menna¹, Matteo Vittuari¹

¹ *University of Bologna Alma Mater Studiorum, Department of Agricultural and Food Sciences, Bologna, Italy.*

*mara.petruzzelli@unibo.it

The Covid-19 pandemic has deeply modified our food paradigm, favouring formalised food channels and limiting the relational sphere of the food chain. During the lockdown period, local food initiatives and alternative food networks have faced several structural and logistical challenges, with the small local producers being the most affected ones. In this respect the City/Region Food System (CRFS) approach offers a unique lens to identify more extensively the multiple values of each food activity and to streamline its local linkages. Building on this scenario, the present work aims at analysing responses from CRFS initiatives around Europe, to identify both strengths and weaknesses of informal food chains during the crisis and understand their role within their territory of origin. A set of initiatives that best reflect the CRFS definition and are relevant in sustainability terms, were selected. All stages of the CRFS - including agriculture and fishing, processing, distribution, consumption, waste management, and education - in more than 15 European countries, were included to assure both a broad sectorial and geographical coverage. Several Covid-19 related questions investigating how these activities reacted to the different restrictions and how their perception of the future changed were submitted through a survey. Responses were then clustered into food supply chain categories and analysed to identify successful strategies and features allowing CRFS resilience during the pandemic. By identifying the most relevant CRFS challenges and potential opportunities in time of crisis, results from this research provides local and national authorities with scientific-sounding ground for action. Following the current trend, stakeholders will be more and more interested in exploring the most urgent hotspots of interventions enabling to design tailored policies. Given the broad CRFS initiatives database used and the extensive food supply stages inclusion, this study helps filling the gap in ad hoc data elaboration and clear summaries of the Covid-19 consequences. As such, the research project places itself in a unique position to contribute to the future food systems sustainability debate.



Innovative digital solution approaches to enhance sustainable behaviors in City Region Food Systems.

Francesca Monticone^{1*}, Antonella Samoggia¹

¹ Department of Agricultural and Food Sciences, Viale Fanin 50, Bologna, Italy

*francesca.monticone2@unibo.it

Given the evidence that digitalization can be part of the solution to many challenges faced by the agri-food sector, in 2020 the FAO launched a new International Digital Council for Food and Agriculture. Similarly, numerous initiatives at urban level have recently been implemented to address the same set of challenges: since 2010 – and particularly after the 2015 Milan Food Policy Pact – hundreds of cities have implemented food policies to increase the sustainability of local City Region Food Systems. The present research aims at linking these two approaches in order to understand whether policies at urban level can help creating an enabling environment for digitalization in City Region Food Systems. In particular, the first step of this project focuses on the analysis of the current panorama in terms of digital solutions in the agri-food sector, with specific attention to the use of mobile applications. As a matter of fact, the number of app downloads is growing worldwide, and the Food and Drink category represents a relevant segment of such growth.

The first step of the research explores which apps encouraging urban and regional agro-food purchasing and consumption and sustainable behaviours are currently available, as well as their characteristics and features. Data collection was performed on several platforms, where apps were selected according to inclusion and exclusion criteria. The resulting apps were then analysed according to Michie et al. (2013) hierarchical taxonomy of Behaviour Change Techniques (BCTs). Preliminary results show that “Knowledge enhancement” is the most common feature among the apps, followed by “Community creation”. Instead, “Reward” for sustainable behaviours is not a popular feature. Data collection and elaboration were also performed through a literature review of papers about digital solutions in the agro-food sector. Around 60 papers were included in the qualitative analysis, which explored a set of themes, including digital solutions targets and aims. As for the former, the main targets are consumers and farmers, and as for the latter, the two principal aims are marketing and information of agro-food products. Apps can be a valuable instrument to strengthen agro-food chain actor relations, and to promote a digital transformation to enhance sustainable behaviors in City Region Food Systems.



Territorializing food system sustainability assessment: Life Cycle Thinking contribution to shared value chains.

Francesco Cirone¹, Fabio De Menna¹, Matteo Vittuari¹

¹ *University of Bologna Alma Mater Studiorum, Department of Agricultural and Food Sciences, Bologna, Italy.*

*francesco.cirone2@unibo.it

The global food supply chain is facing unprecedented challenges placed by communities demanding food security while meeting emerging societal and environmental needs. Indeed, food companies are progressively accounting for their sustainable responsibility. Nevertheless, profit maximization remains the main driver of value creation. It emerges that, until food firms will not target societal and environmental dimensions in their business models, they will still be stranded in an incomplete approach to sustainability, thereby, losing an opportunity to generate a distinctive sustainable shared value creation, taking advantage of the territorial resources. Food chains require territorial features of production-consumption patterns for increasing the sustainability of their systems. This allows a peremptory identification of specific impacts and hotspots on different territorial scales. In literature, there are several theoretical frameworks for the analysis of different territorialized sustainability dimensions. Life Cycle Assessment (LCA) has stood out as a recognized method for quantifying the environmental pillar. Recent studies have been focusing on territorializing LCA for evaluating the geographically-defined environmental impacts of the food chain. However, a holistic integrated theoretical and methodological framework for territorialized Life Cycle Thinking (LCT) is still missing. Based on integrating current theories, the research aims to build a theoretical and methodological framework for territorialize the food system sustainability assessment through the LCT approach for quantifying the shared value chain of food businesses. A critical literature review of the shared value chain, the territorial capital, and LCT applied to the topic of food businesses, was conducted to identify key elements for the theoretical framework. Then, it was turned into the methodological framework by customizing the Impact Assessment and the Characterization Factors phases of LCA. The Key Performance Indicators were used as shared value parameters of company strategies and they were selected by using SMART CRITERIA. Social-economic-environmental impacts were territorialized through the eight dimensions of Territorial Capital. The relevant territorial indicators were selected by the Region-Specific Nested Model (RSNM). By the Normalization phase, it was possible to estimate and compare impacts on different territorial dimension. The elaborated framework allows food companies to measure the sustainability trade-off of their shared value chain by reporting their performances in terms of territorial impacts.

