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Creative Food Cycles: A Cultural Approach to the Food Life-Cycles in Cities

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Abstract: The new contemporary multi-city needs the landscape as a proactive eco-systemic infrastructure in order to rethink the whole food system, from the design of public spaces to domestic spaces. In this direction, Creative Food Cycles (CFC) is an EU project that, according to the Sustainable Development Goals (SDGs), addresses the topic of food as a cross-cutting factor and powerful accelerator toward the co-design of sustainability in cities. Design culture today has begun to question and innovate production, distribution, and recycling models of food cycles. In the post-consumption and disposal phase illustrated herein, making the most of food means conceiving waste as a resource for the creation of new sustainable materials or prototypes. The concept of food waste and food losses has been shown to be not only a topic at the center of the debate but also a powerful tool for raising awareness of sustainable development at the community level. The CFC actions shown here were developed with the objective of persuading consumers to change their behaviors, while at the same time exploring cultural and social perceptions. With the aim of making cities more sustainable, this paper describes tools to engage different stakeholders, such as architects, product designers, and citizens, from a cultural point of view. The ongoing research has turned in the end into an educational campaign and an open platform where prototypes, new materials, and products are developed as inspiration for change.

Keywords: resilient and sustainable cities; food waste; design culture; food cycles

1. Introduction

1.1. Land Links: Fractal Multi-Cities, Meshed Territories, and Operational Landscapes

During recent decades, increasing anthropization and the competitive positioning of cities and territories in a global economic framework [1], associated with the growing increase in mobility and internationalization of the soil market and the appearance of a new cultural and environmental sensitivity, have led to the need to think about new urban reformulation processes and initiate significant, innovative, and qualitative operations within these global "circuits of flow and exchange." The definitions of possible "multi-inter" strategies—multi-level and inter-network, but also multi-urban and inter-territorial [2]—for the great challenges that arise in this exchange scenario oblige us to contemplate some of the great transversal themes associated with the "re" factor (re-naturalization, re-cycling, re-structuring, re-activation, and re-information) that today mark the goals of the new urban–territorial agendas in the beginning of this century [3–5].

The new urban and territorial approach today appeals to a new mutable, dynamic, complex, evolutionary, and networked "systematiCity," which is more relational (transversal), intelligent (holistic), and imaginative (creative) and leans toward a new conceptual logic (more strategic and informational), a logic in which the ancient "urban swing" or "urban needlework" would be based not only on the

continuity of building plots but on the capacity of new integrated network models [6]. These models are associated with the more active importance of a natural and, above all, semi-natural (agro-productive) landscape capable of promoting an interlaced linkage of large "meta-politan" development areas [7], coordinated synergistically with different territorial mobility links. This type of new multi-urban governance [8] obviously requires a reinforcement, an enhancement, and a qualitative (re)definition of its main nodal tissues and centers, and therefore the reuse and recycling of pre-existing urban structures, through strategies aimed at favoring programmatic and social diversity, but also a more effective relationship with the landscape and between landscapes.

We have used, on several occasions, the terms "land links," "land grids," and "recycling" [9] associated with these new dynamics, which are open to define possible integrated strategies intended to ensure local and global development, coordinated qualitatively at the large (territorial) scale and the intermediate (urban) scale—developments in which the new multi-city [10] would no longer interpret itself as a large "building extension" linked to a single mono-central reality, but as a possible polycentric structure [11]. Today, it is a question of interpreting landscapes as infrastructures (and even infrastructures as landscapes) or infra-structures such as eco-structures [12,13].

1.2. Agro-Cultures, Agro-Cities: Potential for New "Rurban" Proactive Development

In this sense, the evolution of these new urban territorial cities and the mutation of our environments has produced in recent decades in Europe (particularly in the Mediterranean area) a complex set of questions and research topics going beyond the traditional relationships—city–landscape, landscape–nature, and nature–city. Consistent parts of the work in urban disciplines and territorial sciences have been dedicated to reinterpreting the role of open spaces (free, semi-natural, and in-between spaces) closely related to agricultural production and how they can become (re)generative elements for defining new paradigms in the construction of the urban forms [3].

The transfer from an oppositional reading between city and countryside to an integrated and intertwined reading, in which the peri-urban territory can assume a vital and active role, with new productive functions associated with creative and complex added value, supposes a new kind of holistic approach to land-use governance in this new geo-urban definition [2]. Challenges that require new types of structural land spaces, or "rurban" spaces [14], call for combining primary and tertiary activities: agricultural and technological production, environmental sensitivity and tourist attractions, private spaces and public spaces, etc.

The role of agriculture in this interpretative framework is hence fundamental as one of the most decisive and transcendent uses of the soil, linked to the concept of landscape and basic for its conservation and the efficiency of the new urban territorial dynamics [15]. In the most paradigmatic zones of the Mediterranean Latin Arch, agriculture generally represents an average of 35% to 65% of the geographical area, occupied by only 1% to 5% of the working country's active population [16]. It is important to understand agricultural spaces as being no longer conceived solely as primary spaces but as complex spaces (green infrastructure, ecological corridors, natural matrices, wellness environments, innovative production scenarios, agro-touristic attractions, etc.), spaces that can foster an understanding of the landscape as a "system of ecosystems" [17].

A condition linked to the basic agricultural food component [18], but also connected to social well-being, economic development, the environmental and resilient urban quality, and a new technological and operational dimension, is smart landscapes [19] or advanced landscapes [20]. The smart planning concept alludes to a set of integrated systems and subsystems (safety, resilience, water, health, infrastructure, economy, environment, food, etc.) calling for orienting and managing the development and sustainable growth of these new scenarios [21]. In this "smart" framework, urban and interurban agriculture can not only contribute to ensuring healthier and more efficient nutrition processes related to algorithmic data optimization of environmental and economic parameters, but also promote new energy and waste cycles, reduce water consumption, and improve and manage resilient answers for the environment.

In this sense, some basic research questions can be formulated around this new prospect linked with agricultural spaces, their local traditions, and their ability to survive and adapt their role and characteristics according to the current transformational trends of this "glocal" and "rurban" scenario in which rural and urban are no longer strictly separated, as it is possible to see in the proposed schemes in Figure 1, as follows:

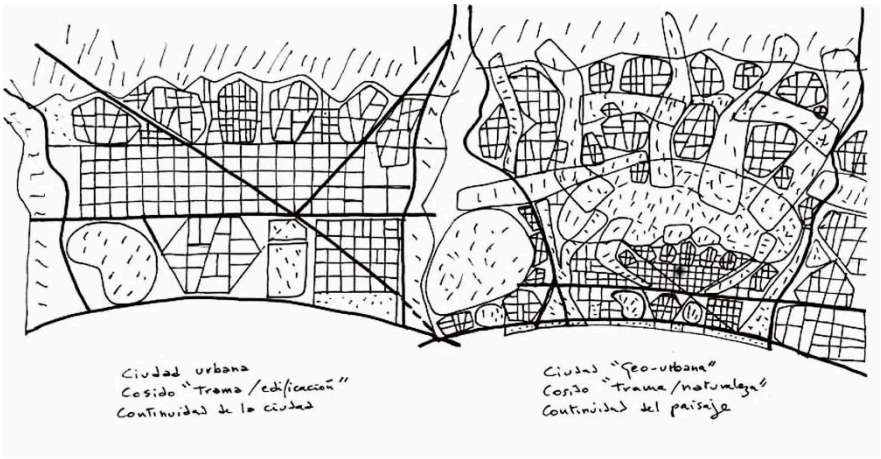

Figure 1. Patchworks of urban building plots and geo-urban landscape grids. By building continuity, old connections of the old urban fabric are replaced by a natural–artificial interlacement in the networked city where buildings and the landscapes in between are meshed. Image: M. Gausa.

1. To what extent can urban agriculture become a form and structure of the city, considering the new technological possibilities linked to production and distribution systems as well as the interest in a quality food chain and the processes of urban renaturalization by citizens?

2. How can diverse neighboring zones (functional, residential, commercial, eco-recreational, and industrial) that exist today along the edges of these areas be rethought to encourage new positive interactions among agriculture, social activities, leisure and innovative production, new mixed operations, and users?

3. How can we reformulate and reinterpret the old notion of food as a primary product, combining it with secondary and tertiary levels of definitions related to the recycling of waste but also with its reuse oriented toward innovating research in pharmaceutical applications, cosmetics, chemistry, and new bio-materials?

The research units and partners in the Creative Food Cycles (CFC) project have tried to answer these questions, starting from the ideas of previous studies associated with the prospective planning and social design laboratories of the University of Genoa, for example, AC+, Agri-culture, and Agro-cities [15]; Albenga GlassCity [22] and MedCoast AgroCities [23]; and in 2018 innovative actions linked to the CFC framing a set of urban perspective projects on the contemporary multi-city and its relationship with equations of city–territory–landscape–architecture and resilience in the Mediterranean coastal territory.

The main actions presented in these pages related to new approaches to food and its creative transformation and reinterpretation call for a recognition of the current context of these potentially hyper-agricultural scenarios in new polycentric and meta-metropolitan contexts and their strategic repercussions from the point of view of the high territorial and environmental value, a value connected to our "living–working–resting … enjoying and visiting" our own habitats [24]. New urban and territorial systems need to be stimulated to propose holistic solutions to multi-level problems related to society, the environment, health, food, and cities. This new agricultural transformation of the city, not bucolic but functional, renews the whole system, from the design of public spaces to domestic ones, with new needs and new opportunities.

In this direction, the CFC project, particularly with the work of the University of Genoa (UNIGE) team on reducing waste generation through recycling and reuse in everyday life, aims, on one hand, to

test within the academic design community new products and materials derived from food waste, and, on the other hand, to organize creative events to raise awareness of the impact of food cycles in our cities. The CFC research starts by detecting good practices from the urban to the productive scale and goes on to analyze and experiment with the social impact of this paradigm shift. The experimentation related to the agricultural supply chain is a vessel and a stage that can show how much the scientific and creative communities are already working hard on these issues.

The project focuses on identifying those tools and methods related to the production and recycling of food waste that are innovative and can be either combined or simplified for non-industrial use. To do this, the project mainly targets training and education as capacity-building tools for architects and product and event designers in order to widen the interfaces between creativity, places, and public awareness through active engagement and co-creation events. In this framework, this paper presents the structure of the CFC research, illustrating the different phases and events and describing the materials and methods of the network and its possible implementations but also opening a possible discussion on awareness campaigns for issues related to food cycles and their impact in our cities.

2. Methodology

2.1. Urban Cultural Revolution in the CFC

As early as the late 1990s, Pothukuchi and Kaufman argued that food systems need a place in planners' concerns so that planning can be oriented toward the future and the public interest in an effort to improve the livability of the community through community systems and their interconnections [25]. The next step means understanding how holistic agro-cultural and social systems intercept the spaces, actors, resources, and dynamics present in a city, moving from the food system—understood as a chain of activities related to production, processing, distribution, consumption, and post-consumption, including related institutions and regulatory activities—to a new kind of integrated agro-urban system where innovative food and multi-scalar approaches are combined. The same CFC project follows this sequence by addressing the theme of food in 360 degrees, from production to disposal, structuring the project into three main phases.

The production phase is demonstrated in the city in the experiences of urban and peri-urban agriculture (producing in or around the city) and in the approach of commercial farms and agricultural parks, the heterogeneous set of horticultural experiences (social gardens, vegetable garden collectives, private gardens, school gardens, regulated or abusive gardens, guerrilla gardening practices, etc.). With a view of the food system at the city–region scale, it is equally important to know the characteristics of production, analyzing the agricultural sector in terms of quality and quantity. Specifically, the CFC project in this first phase aims to demonstrate how the use of technology can help produce food in urban environments or in close proximity and enhance city resilience. Urban agriculture can contribute to enhancing the resilience of cities, making available inexpensive healthy food for citizens. With the use of digital fabrication and control interfaces, the aim is to create hydroponic and aquaponic systems in a closed loop, teaching citizens, architects, and product and event designers how to manage self-sufficient cultivation. The use of digital fabrication allows custom-designed gardens to be built, and the use of sensors helps in controlling the performance. If soil cultivation is not practicable in many urban conditions, especially in dense city cores, hydroponic cultivation can represent a practical solution where the main limitations are lack of space or farming knowledge.

The distribution phase (large-scale food distribution, retail stores, markets, alternative food networks, online commerce) is the service activity aimed at transferring food products from producers and processors to consumers. In general, food distribution intercepts urban dynamics in spatial (affecting the way in which space is lived, designed, and consumed), social (in the relationships between actors), and environmental (generating impacts in terms of air and soil pollution, energy consumption, etc.) aspects. In the CFC project, the concept of this phase is to focus on new models of distributing, marketing, and processing, as well as cooking, displaying, and sharing food and regional products

from a collective aggregation point (place-making effect). This can be an "urban food hotspot" characterized by a multipurpose stage connecting different places to a single manifestation of material and nonmaterial open public activities, trends, and movements. The aim is to collect into movable pieces of urban furniture different sensory experiences, augmented reality data processing, and art installations, offering interactive ways for audiences to participate in products or services and address extended audiences to ensure that the goods and commodities are difficult for customers to resist. A sense of originality and unparalleled creativity is a critical aspect that buyers take into consideration when shopping, consuming, and interacting in the urban foodscape.

The phase of urban consumption, combined with the last disposal phase, is complex and difficult to analyze since it includes a multiplicity of issues, ranging from the spaces in which items are consumed (public and private collective catering, domestic catering) to the social and cultural implications related to habits, traditions, consumer choices, ways and times of consumption, food accessibility, the relationship between food and health, etc. The last phase of disposal addresses the issue of waste and scraps, which the Food and Agriculture Organization of the United Nations (FAO) distinguishes between food loss (in the production, collection, distribution, and transformation phases) and food waste (produced in the final stages of sale and consumption), and it is becoming increasingly important in relation to issues such as global climate change, social justice, and food education. In particular, within the CFC project, this phase explores the process that brings food from consumption to disposal by not only offering options for new uses of discarded products (from waste to resources) but also defining new potential meanings and spatial combinations in an art–design reinterpretation (from scrap to art). It proposes a series of actions and performances based on a combination of projects and research that explore a new way of rethinking and reinterpreting food after consumption or discarded products for art, material, or reuse; the creation of ephemeral and flexible installations to define new configurations of public spaces (urban and artistic scenography) in order to attract the attention of target groups and stakeholders in the framework of public events; and the reuse of abandoned heritage buildings in order to promote civic participation and a convivial dimension in urban settings.

It is therefore these elements and their integration that the analysis of qualitative and quantitative aspects and local relationships and those with higher levels are concentrated on in a multiscale approach, with the aim of constituting an effective support tool for future territorial policies. An important challenge for the future will be to strengthen collaboration and knowledge sharing between users in the food sector (groups, organizations, businesses, individuals, etc.), research, and companies by combining the technological capacity of companies and their practical, operational, and market visions with conceptual capacity, or the experimental and creative role of research, in order to launch proactive exchange platforms on the theme of food and its expressive capacity as a cultural vehicle of identity, innovation, and social integration.

2.2. Tools

The CFC research is thus configured in three steps with different methods and tools.

The first step, food interactions, was a call for the creation of a database of good practices, already existing at a global level, of innovative food production processes and the exploitation of food waste. The idea to start from best practices came from the academic field in order to involve the research units in the three cities in the first two phases and to spread the outputs to architecture and design schools.

The second step, food crossovers, follows the research activity by proposing three creative workshops, one for each partner city, meant as open co-creation labs to empower thematic skills and engage diverse audiences. It was intended both to test some of the catalog experiences and interview some of the subjects who had made them, but above all, within the didactic university laboratories, to also experiment with new combinations, productions, and materials. This phase did not stop there but went further by designing new containers for food production and new objects produced from food waste. We consider this the most important phase for two reasons: on one hand, it is experimental

and innovative for the results achieved, and on other hand, everything that has been prototyped from the point of view of both manufacturing and chemical processes is easily replicable in a fabrication laboratory and often simply at home.

This has been very important for us because the third step, Food Cycles in action, is the step of dissemination, and as mentioned, since this is a creative project, it is linked to dissemination targeted to wide audiences. This part included the following kinds of activities:

- The development of three art installations in Hannover, Barcelona, and Genoa aimed at connecting professionals and citizens with creatives through the co-production of art installations and place-making laboratories;
- Itinerant exhibitions on best practices and learned experiences held in Barcelona, Ljubljana, and Genoa;
- An international symposium to present the project's results to selected international representatives (experts and creatives); and
- An international festival, aimed to explore, through prototypes, art installations, and art performances, the process that brings food from consumption to disposal, by offering new potential meanings and spatial combinations in design reinterpretation.

Festivals, shows, performances, or even playful activities become the output of the project because all of these activities should not only provide information about production processes but also be real activities involving people in order to have an effective impact so that the processes are then replicable by the participants autonomously. This was very important because we believe that understanding the ease of the process and its replicability allows us to increase interest in a whole chain of food cycle processes and greater awareness.

Food Cycles in action displayed co-produced art installations and place-making events in the three cities and an itinerant exhibition traveling to other places, ending up with the final festival and symposium that will be held in 2020 to present prototypes and proofs of concept to target groups and stakeholders.

For this reason, the three units involved divided the phases of the main cycle of the food chain for research and experimentation, always maintaining cross-over on objectives, content, and methods. Figure 2 represents the exchanges set up by the three city partners, each one taking care of a food cycle phase. The Institute for Advanced Architecture of Catalonia (IAAC) developed the food production phase through the use of new technologies or new production processes, but also by experimenting on new foods and containers mainly for domestic food production. The UNIGE with the Department Architecture and Design instead developed the phase in relation to the reuse of food waste and the prototyping of new products from the materials obtained but also decided to go further, especially with the popular model for the use of methods of food consumption, and the idea was to organize real banquets to consume experimental food with supplies produced by food waste in an atmosphere of conviviality. The Leibniz Universitat Hannover (LUH) worked on the intermediate phase, distribution, imagining pop-up markets that could allow small or spontaneous producers to easily commercialize or exchange their products but at the same time create spaces and multi-level objects to be both new vessels and new platforms for exchange and generation of new sociality.

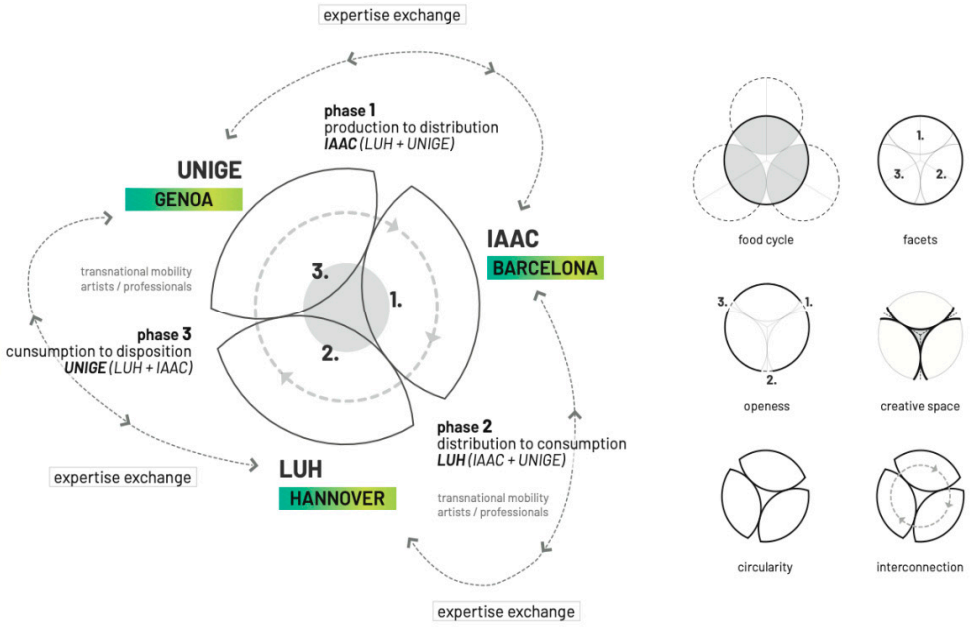

Figure 2. Food cycle phases and partners: international exchanges. Image: LUH Regionales Bauen und Siedlungsplanung.

Every action of the project is conducted by extending open calls for action and for projects in order to allow wider participation by professionals and encourage local organizations to deepen their audiences and experience international exchange at the same time. Calls for projects are meant as essential tools to collect ideas on the topic of food but also to allow the creation of a network of proposals [26] with a high innovation level that can be spread at a bigger scale.

The collaboration is evident, as every partner worked with the same tools. Calls for projects/papers/actions helped to reach a wider audience. These calls represent a wide-reaching dissemination program aimed at increasing the visibility of the research through social channels and a dedicated website.

During the pandemic period in spring 2020, other tools were tested, such as webinars, where participants were asked to take an active role and to experiment with materials derived from food waste in the domestic environment.

2.3. CFC Activities, Impact, and Network Dissemination

The CFC approach merges new ways of design and digital interaction in a transdisciplinary way, exploring cultural, social, and economic innovations through the activities. The research structure was inspired by a previous two-year Creative Europe project developed by IAAC in 2017, a current CFC research partner, entitled Active Public Space (APS). The purpose of APS is to develop knowledge of public spaces, fostering people's interaction with flows of energy, materials, services, and finances to catalyze sustainable economic development, resilience, and high quality of life. Thanks to the use of smart urban technologies, the project was able to demonstrate how they were essential for the change of public city space, allowing real-time data capture, energy generation, storage and reuse, material adaptability, management of time use, and citizen–space interaction.

Similar to the structure of APS, the CFC research has been structured through a series of activities to bring research closer to the social context and encourage the cultural dissemination of project results. Activities have been organized by the three international partners, LUH, UNIGE, and IAAC, with an open and inclusive approach and targeted communication, deepening the interconnection

among architects, designers, cultural operators, institutional stakeholders, and active urban society, and combining the concept of food resilience with the cultural sphere.

Institutions, local experts, artists, cultural operators, and stakeholders of the three partner cities were involved in an open co-creation work program.

The workshops, exhibitions, and festival strongly address target groups such as cultural operators and local stakeholders, as well as active urban society in the three partner cities, while the symposium is aimed at dissemination among academic and institutional stakeholders.

These target groups are considered integral parts of the project work and are incorporated into a specific audience development strategy based on creative workshop experiences and open co-creation moments for building art installations and international biennial festival exhibitions in order to extend the audience. Thanks to the intense digital presence of the project (website, streaming and social channels) and major publications (CFC catalogue, international festival experiences, and symposium proceedings), the project's results have also been transferred to other cities and available online to everyone.

The main results obtained in terms of impact and dissemination are assessed on the basis of the number of participants (citizens, creatives, stakeholders, etc.) involved in the activities detailed in Table 1.

Table 1. Activities carried out in the period 2018–2020 involving the three partners, LUH, IAAC, and UNIGE.

Activity ID	Type of Activity	Activity Description
A	Call for the Food Interactions Catalogue	The Call for the Food Interactions Catalogue was spread via social networks and mailing lists and asked the participants to send realized projects related to three types of classification: typological, readiness, and performance categories. *https://creativefoodcycles.org/food-interactions-catalogue/*
B1	Creative Urban Farming Workshop, Barcelona, IAAC	The Creative Urban Farming Workshop, Barcelona, 4–6 May 2019, was aimed at developing innovative urban food production system prototypes. Each participant group made one 1:1 scale prototype for food production in the urban environment. The event involved 59 participants/creatives. *https://creativefoodcycles.org/workshops/workshop-barcelona/*
B2	Food Cycles Pop-Up Workshop, Hannover, LUH	The Food Cycles Pop-Up Workshop, Hannover, 23–25 May 2019, was about new models of distributing, marketing, and consuming food, as well as cooking, displaying, crafting, and sharing, in a collective "urban food hotspot." Workshop participants learned about how to conceive and effectively communicate innovative concepts for pop-up market prototypes based on instant urban design principles. The workshop involved 66 participants/creatives. *https://creativefoodcycles.org/workshops/workshop-hannover/*
B3	Food Shakers | Food Remakers Workshop, Genoa, UNIGE	Food Shakers | Food Remakers Workshop, Genoa, 17–21 June 2019, was about food waste as new material, from organic food waste to the creation of new industrial materials, or food waste and packaging for new products, from organic food waste to real products for consumers. Workshop participants had the opportunity to showcase the designed prototypes at the 2019 SUQ Intercultural Food, Art and Craft, and Music Festival. The event involved 49 participants/creatives, and about 5000 citizens on the closing day, and was open to the public, within the SUQ Festival. *https://creativefoodcycles.org/workshops/workshop-genova/*
C1	Myco-scape Installation, Barcelona, IAAC	The CFC myco-scape installation, Barcelona, 27–29 June 2019, staged a modular system supporting the growth of edible mushrooms in the urban environment, producing both food and construction materials. The installation involved citizens of different education levels and ages. More than 1200 people participated. https://creativefoodcycles.org/installations/installation-barcelona
C2	PorTable Installation, Hannover, LUH	The CFC "PorTable" pop-up installation, Hannover, 15–17 October 2019, staged a modular and movable unfolding table covered by a raised cultivating bed in which culinary or wild herbs were grown. The Installation involved 63 participants/creatives and about 220 citizens. *https://creativefoodcycles.org/installations/installation-hannover/*

Table 1. *Cont.*

Activity ID	Type of Activity	Activity Description
C3	Food (re)makers Installation, Genoa, UNIGE	At the food (re)makers installation, Genoa 29–31 October 2019, the prototypes designed during the Food Shakers | Food Remakers workshop were implemented through educational laboratories organized as open days during the Festival della Scienza 2019 program. The event involved 30 participants/creatives and more than 70 middle and high school students, who conducted some workshops with the creatives. *https://creativefoodcycles.org/installations/installation-genova/*
D1	Responsive Cities Expo, Barcelona, IAAC	The CFC itinerant exhibition was hosted on 15–27 November 2019 in Barcelona at the IAAC main exhibition hall in parallel with the work of Responsive Cities 2019 Symposium. It involved about 680 citizens. *https://creativefoodcycles.org/exhibitions/cfc-exhibition-barcelona/*
D2	Future Architecture Fair, Ljubljana, LUH	The CFC itinerant exhibition was hosted on 12–13 March 2020 in Ljubljana during the Future Architecture Fair, part of the Creative Exchange 2020 event, an international gathering organized by the Future Architecture Platform, involving more than 550 citizens. *https://creativefoodcycles.org/exhibitions/cfc-exhibition-ljubljana/*
E1	International Online Symposium, Hannover, LUH	The CFC International Online Symposium will be organized online by LUH on 17–18 September 2020. *https://creativefoodcycles.org/symposium/*
F1	International Festival Food interAction!, Genoa, UNIGE	The International Festival Food interAction! will be hosted on 9–11 December 2020 in an abandoned heritage building, Albergo dei Poveri, in Genoa. The aim is to explore the process that brings food from consumption to disposal by offering new potential meanings and spatial combinations in design reinterpretation.

3. Results

3.1. The Consumption to Disposal Phase

The UNIGE team explored the consumption to disposal phase and proposed new ways of recycling and reusing food waste as a resource for the creation of new environmentally friendly materials or prototypes, as can be seen in Figure 3. The question that emerges at this point is how to evaluate this approach, which uses food as an accelerator of disruptive change toward the co-design of sustainability in our cities and implement it in everyday life. Food is certainly a powerful medium because it is related to our emotional processes [27], even if it has become a product for mass consumption and a true industrial product linked to profit. Food can be combined with creativity as a lever of innovation, redesigning its entire life-cycle from production to disposal, in an attempt to anticipate what will happen in the short term but also to subvert what we are used to and broadly raise awareness.

Table 2. Some of the prototypes and new materials developed by the designers within the CFC project.

Reused Food	Type of Processing	Product Description
Coffee grounds	Compression material	1. Mooka is a circular product, it is a pot for planting that becomes fertilizer. Presented in a setting that offers visitors a visual and olfactory experience.
Coffee grounds	Bioplastic combination	2. DishBratta line is made by mixing coffee ground and a biological resin. It consists of a set of two dishes, a dinner plate and a deep dish, a fork, a spoon, and chopsticks.
Chamomile infusion	Bioplastic combination	3. BioPlastic was born from the desire to create a line of packaging for chamomiles and infusions starting from the classic internal waste of the bags once used.
Fennel and walnut waste	Bioplastic combination	4. Fennut light is a lamp that combines two materials borne from food waste.
Eggshell, pasta, lentils, etc.	Bioplastic combination	5. Bis Bioresina and Bis Compostable, are tableware with different uses: the first can be re-used, and the other one is single-use and biodegradable.

Table 2. *Cont.*

Reused Food	Type of Processing	Product Description
Rice husk	Bioplastic combination	6. V.pot is a dish made from the waste of rice husk compressed in a mold with the addition of bio-resins.
Fish bones	Bioplastic combination	7. BOFISH is an innovative material obtained from bone and cartilaginous waste from fish sourced locally.
Peanut shell	Cooking chemistry	8. Hanging Plates from peanut shells into bowls.
Honey	Cooking chemistry	9. Miellow is a honey-based bioplastic with a high resistance to water. The semi-transparency given by honey gives it a glass-like appearance.
Milk	Cooking chemistry	10. Galalith is a natural plastic material manufactured by the interaction of casein and formaldehyde. It is odorless, insoluble in water, biodegradable, non-allergenic, antistatic, and inflammable.
Soybean	Drying and weaving	11. S.D.S. The skin made of soybean, combined with the weaving process, makes healthy and environmentally friendly coasters and placemats.
Loofah	Drying and weaving	12. The mission of the Loofah fiber is to completely reuse decayed and inedible loofah and combine the good physical properties of the loofah.

Figure 3. Some of the products and materials designed by University of Genoa (UNIGE) students on the Creative Food Cycles (CFC) project, which follow the list in Table 2.

This becomes even more evident if we talk about food waste. While consumers' awareness of the issue is growing, it remains a significant barrier to achieving a sustainable food system. Even if

technologies are ready to make a new sustainable lifestyle possible with new products and techniques, the disappearance of unsustainable practices is not yet on the agenda. The goal for food waste, followed in the CFC project, is to halve per capita global food waste at the retail and consumer levels by 2030 (SDG 12.3). This cannot be achieved without raising awareness of the topic at the community level. Currently, a third of all food produced globally is thrown away each year. Food loss and waste represents one of the most significant environmental and economic issues, and it is generally recognized that if it were a country, it would be the third-largest greenhouse gas emitter behind China and the United States [28]. It is a well-known issue that also fully involves European and Italian cities, which have to take an active role by making the most of food by redistributing surplus edible food while turning inedible byproducts into new products, ranging from food products to organic fertilizers and biomaterials [29]. Rather than being seen as final destinations for food, cities and communities have to be seen as places and environments where food byproducts are transformed by emerging technologies and innovations into a broad array of valuable materials. This is a philosophy that is contextualized within the circular economy, using the material energy of food, but it is also conceptual, for better safeguarding of resources.

Communities are at the center of these experiences and in a way also drive the food industry and large-scale distribution. Creative communities, accustomed to social innovation practices in cities, can design and make visible new ways of recycling and reusing food waste, as a resource for the creation of new environmentally friendly materials or prototypes. These projects are developed as actions aiming to persuade people to change their behaviors around food waste, at the same time exploring cultural, social, and economic perceptions. The experiences proposed in the following section are intended to answer the question of how to configure new design and creative activities related to food and food waste, engaging the public to design by and for themselves [30] and making sustainable habits and behaviors more compelling and attractive [31]. In Genoa, product designers, researchers, students, and local urban activists presented and implemented activities in which design played a role as a form of culture and a major driving force for envisioning and realizing processes of social innovation toward resilience, where people change their behavior and act collaboratively [32]. This educational campaign targeted to this group of stakeholders in the food system can make these projects effective and successful, because consumers' knowledge is integral to reducing food waste and recycling in similar activities [33].

The main output of the UNIGE activities, previously described, was to create real products and prototypes derived from food waste that were displayed in a way that implied an active role for visitors through artistic performances and co-creation workshops.

These prototypes were useful for fully understanding the relationship between ethical elements and the way we produce, consume, and recycle in our cities, and even more because this topic represents an interesting field of investigation for design that has a "reparative role" [34] with respect to these kinds of environmental and social issues in which the system at a general level and the choices of individual consumers are intimately intertwined.

"Designers and artists are able to formulate, through artifacts and concepts, urgent political questions that cannot rely solely on regular processes to enter public discourse. In regards to the environment and all associated concerns, in particular, state policy is driven to make reformations by the priorities that researchers, designers, activists, scientists, architects, and citizens set forth" [34] (p. 18).

To do this, we must refer to the circular economy for food as a natural system of regeneration, in which waste again becomes food, transforming itself into a new resource. "Making the most of food" [35] means involving local communities, stakeholders, and active urban society, developing a cultural and holistic approach, and joining all aspects of food cycles, but also stimulating with an open and inclusive approach a deeper interconnection of all disciplines dealing with the urban environment to reduce food waste and co-design a new concept of waste.

3.2. Outputs

The first result of the CFC project is represented by the catalog available as an open-access digital publication, which gives access to information through social media, webpages, online videos, and interactive resources to increase the framework of knowledge. This database includes both industrial and start-up projects, as well as university and other research institutes. All this information has been incorporated in a catalog, showing how innovative production or processing of food waste can be done by showing the characteristics that make it possible, for example, to transform orange peels or pineapple leaves into fabric. This is interesting because it allows us to understand, for example, the logic and chemistry behind a transformation in order to make it accessible and replicable with different food waste but similar in substance. The catalog expresses sustainable food cycles that emerge from digitalization, advanced technological implementation, digital manufacturing, sharing and informal economies, innovative participatory processes, increased awareness of climate change, and advanced strategies for urban and territorial resilience.

Besides this, the other important research results include the development and prototyping of new materials deriving from food waste. In fact, thanks to the CFC project, the research unit of Genoa has developed numerous design products made with the use of new materials derived from food waste and recyclable together with students and designers. These projects always work with the main idea of making the population aware of recycling, looking for easy-to-reproduce procedures and daily use of the products made. There have been different ways of processing waste, but we can say that the three most recurrent macro-categories are the addition of bio-resins or homemade processes that we could define as "cooking chemistry" or situations of drying and weaving of food waste. An excerpt of the processes and products produced can be found in Table 2 and Figure 3.

The results of the research can be measured through the number of prototypes developed, the people physically involved in the activities and the knowledge produced and disseminated through the online channels; the real impact of these objects must in fact still be evaluated, because the project is still in progress, and it is believed that the prototypes can act as demonstrators of the principles that originated them.

The topic of food waste should involve each one, and it is actually at center stage, so the approach of CFC can become a guideline to create events open to the public to involve citizens in the production of prototypes and materials derived from food waste. Schools, universities, and municipalities with waste management companies are the main stakeholders of this process. From the project, a strategy could be extrapolated that brings together collections of best practices, co-creation workshops, and installations open to the public that involve different levels of education. This could be a format that allows schools to involve students in project activities. Putting together best practices with co-designing activities has proved to be very effective in raising people's awareness and involving them directly in the creative and realization phase, allowing them to come into contact with food waste as a material that takes on new meaning.

In addition, the many prototypes coming out of the project activities of the workshops also have value at the level of innovative proposals, which should be explored and evaluated separately. The involvement of young architects and designers in the design processes of food waste allowed the research teams to introduce new ideas and generate a high rate of innovation.

From a conceptual point of view, the research is aimed at defining where we can act with consumer awareness as a priority, but also, and above all, at the possibility of putting in place possible actions that make everyone's impact effective, in order to understand how to amplify this message that the project activities started from an analysis of best practices, followed by creative workshops to develop ideas and installations aimed at spreading and testing alternative practices in the three cities involved. This educational campaign has the ambition to build an open platform where everything is designed and developed in the research; i.e., prototypes and new materials and products are available as inspiration for change in different communities and in other contexts. Physically, the project has also become an exhibition that circulates, spreading its message in cities related to the CFC network, but at

a digital level, it is also a website (www.creativefoodcycles.org), conceived as an open platform where every single action that has been produced can be viewed and therefore replicated by using the tools, i.e., workshops, calls to action, calls for projects, and webinars. This modus operandi is particularly effective when referring to food waste, an issue for which mixing inspirational best practices with artistic installations and projects of new materials, products, and services can have a major impact on generating new ideas and approaches.

This can be illustrated as an output, as proposed in this paper, by analyzing the phases of the food life-cycle, starting from the one that is generally at the end of the process, the food waste phase. Putting food waste at the beginning of the life-cycle, as a new starting point in this case, takes on significance as a radical change of perspective.

The food life-cycles guide us backward on a journey through the activities carried out in CFC, in which the raw material is the waste to produce food and zero-mile items, to distribute and consume the surplus, up to food reuse processes and packaging made from the food itself. The scheme in Figure 4 provides a guide to descriptions of the project findings by the actions proposed in the activities with stakeholders in the three cities.

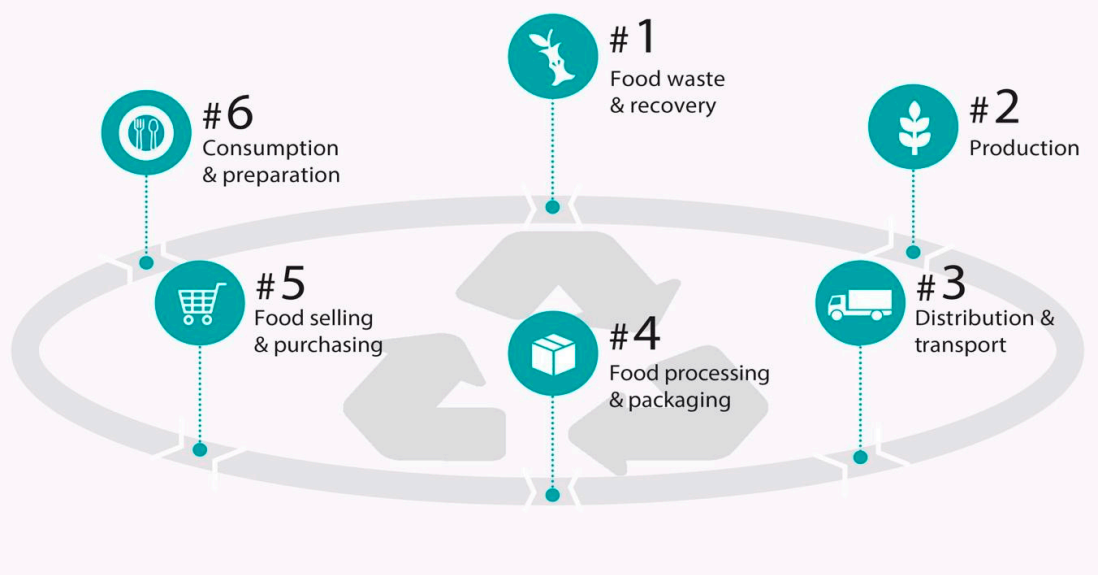

Figure 4. Food life-cycle phases starting from food waste.

Phases 1 and 2: From Food Waste to Production—Urban Environment

"Waste equals food." In nature, everything has a purpose: each organism's process contributes to the health of the whole ecosystem, and when it becomes waste, it is food for other organisms. Designers can optimize products and services, creating closed-loop material flows that are sustainable [36]. The Food Cycles in action installation presented in Barcelona in 2019 by the IAAC displayed a myco-scape, a modular wooden system with an external surface supporting the growth of edible mushrooms in the urban environment, producing both food and construction materials. After harvesting the mushrooms, the material contained in the cultivation area can be used as construction material. This prototype project acts as a real food life-cycle demonstrator, creating a culture of caring for locally sourced and produced food and raising awareness of sustainable development and lifestyles in harmony with nature according to the SDGs. It should be noted that the concept that a basic element of architecture, a wall, can function as a prototype of these possibilities brings interesting developments as a means of communicating to a wide audience.

Phases 1–4: From Food Waste to Food Processing and Packaging—Products

Climate change demands original and radical thinking, and if, as Papanek and Fry argue [37,38], design is a vital form of political action, designers play a major role as powerful agents of change

who can imagine long-term freedom. Freedom from plastic packaging, for instance, is a necessity for designs that not only can serve the market but also can realize alternative dreams. To spread this message, the CFC UNIGE team, in summer 2019, organized as a food crossovers workshop "Lay the Table," a performance that combined an exhibition of objects made from food waste conveying a message with a stage show to explore new ways of rethinking and reinterpreting post-consumer food as everyday objects and packaging. The workshop/performance took place at a summer festival in Genoa, an event that enhances mutual knowledge exchanges and artistic collaborations across the Mediterranean area, combining food, music, and other cultural activities.

Phases 1–6: From Food Waste to Food Selling—Services and Food

Services also have a major role in supporting communities of citizens as users and companies, by creating a virtuous circle in which everyone actively interacts for sustainability with a positive impact on the territory and the quality of life of all those involved. With proper service and interaction design strategies, companies can promote their sustainable actions and behaviors, while consumers can lead sustainable lives. The example of Too Good to Go pushes in this direction. Designed as a free app by a movement against food waste, it allows the purchase of unsold food to prevent it from becoming waste and ending up in a landfill. Following this strategy, as part of the CFC project, the Food Shakers | Food Remakers installation explores the topic of food surplus by experimenting with food to become new material as packaging, but also as real products for consumers. The installation was a part of the Festival della Scienza program, an annual science event in Genoa at an international level. In the installation, waste becomes a means for education but also a possible and desirable answer to problems we all face, in which the true essence of contemporary design is expressed not merely as an intellectual exercise. In this sense, the aesthetic and emotional dimension represents a fundamental theme that, together with the ethical emergency, can become leverage for persuading final consumers to change their habits. Based on the idea of experiencing beauty and related to the consumption of food, in the project, discarded food, such as dry bread and vegetable waste, was cooked according to the idea that ethics and aesthetics become one thing. Food thus becomes an artistic experience, in which art makes the invisible visible and generates a sense of responsibility, which in turn is a social act in the form of creativity.

4. Main Findings

The CFC project, funded by the European Commission within the Creative Program, started with the intent to combine research and dissemination through the use of tools that can reach citizens of different ages and cultural profiles. It is therefore a mixture of investigations into the current panorama of innovative techniques of production, distribution, consumption, and reuse of food; workshops with students from universities; and presentations of the various results at events suitable for citizens, integrated with artistic performances and open festivals.

This structure of the project, on the one hand, allows high scientific rigor in research and experimentation and, on the other hand, combines educational and creative playful aspects that help to pass on the message about the importance of food cycles and their potential within people's own houses and urban environments.

The research starts from refining and improving dissemination actions already addressed in another creative project carried out by the same network, APS, to improve and develop a new format based on the previous one, oriented to involving a wide audience, whose impact can be measured by the numbers of participants in the project activities.

In the CFC research, the wide topic of food and cities was divided and deepened in the activities of the three partners, allowing possible implementation of new research clusters.

The aim of this paper is to present the CFC research in its structure, illustrate the different phases and events, and describe the working methods of the network as a format that can be implemented in other contexts. As we have seen, the project with its phases is linked by moments of research and experimentation and moments of dual dissemination to the academic and scientific world and to

citizens, as foreseen by the European reference project. This openness to citizens through cultural events makes its effects on the territory easier, but it also opens a discussion on the importance of raising public awareness of issues related to food cycles in daily life. The CFC network is constituted today by the three research groups, UNIGE, LUH, and IAAC, and in addition to collaborating with each other, they have built a network of small businesses, start-ups, creative groups, and visualization activities, combining potential and developing new prototypes. The various actors involved had the opportunity to interact with each other, often working in direct contact with university students in a mutual exchange. The ensuing events allowed these interactions to be shown to citizens in a process where they were not only consumers but active participants.

The research, especially the part followed by UNIGE, moves toward the capacity of self-sufficiency, understood not as a survivalist scenario, but as the capacity of self-production and, above all, awareness of the potential and richness of food waste. The current situation has also led us to reflect further on how much the social capacity of food processing in all its cycles can be important within cities, to create better habitats and facilitate production in certain urban contexts [39] and within homes, in single or associated form, for new models of production in daily life.

Hannover, Genoa, and Barcelona are the three cities that have had a direct impact from CFC research, because these cities are where the research groups organized events and workshops for dissemination. However, today, with the website full of content and itinerant exhibitions, the research interest has expanded to other cities and stakeholders. The next step will be about better integrating local administrations, in terms of dissemination and practice, not only to develop or incentivize new materials generated by, e.g., second-life food waste but also to make them a real option.

Since the research is not linked to a precise geographic area and does not require close interaction with the administrative world for all its phases, even if this would allow great facilitation, the project, and above all the scenario presented, is replicable in other geographic contexts. Certainly those territories that already have a deep-rooted agricultural culture can be facilitated, although perhaps they are in decline and far from cities, but with an active and young entrepreneurial capacity, especially if there is interest in the rebirth of the territory and traditions related to innovation.

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