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Revisiting the Sustainability Concept of Urban Food Production from a Stakeholders' Perspective

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Abstract: Urban Food Production (UFP) initiatives are expanding worldwide to enhance urban food production while contributing to the development of sustainable cities in a three-bottom perspective (environment, society, economy). Although the sustainability aspects of UFS have been addressed in the literature, there is a need to set a sustainability framework for UFP based on the concepts and the understanding of the stakeholders as a basis for quantifying their sustainability and for developing effective policy-making. This paper evaluates the concepts of the UFP sustainability from a stakeholders' perspective through participatory methods and network analyses. Two different workshops were organized in the city of Bologna (Italy), where mind-mapping exercises to define the environmental, economic and social sustainability elements of UFP were performed. This bottom-up approach unveiled a comprehensive and complex vision of sustainable UFP, the relevance of certain sustainability elements and key aspects to take into consideration for the development of UFP and effective policy-making. The existence of bidimensional and tridimensional concepts indicated priorities, synergies and trade-offs among the dimensions of sustainability. The multi-scalar nature of UFP suggested that specific policies can be supported by global schemes (e.g., Sustainable Development Goals) and that UFP can be a local tool for democracy and equity at lower scales.

Keywords: urban food systems; urban agriculture; participatory research; sustainable development goals; sustainability; policy-making; network analysis

1. Introduction

The growing urban population and the environmental awareness of the globalized food system has led to the expansion of urban food production (UFP) through the reincorporation of agriculture in cities and the promotion of alternative supply-chains [1–4]. In particular, UFP has sprouted up around cities of developed countries seeking the enhancement of urban food security and social justice as well as the mitigation of the environmental burden associated with urbanization and globalized consumption [4–8]. More specifically, awareness of the entire food supply-chain has recently increased, with local food production gaining relevance in the sustainable development agenda of cities [9].

The multifunctionality of UFP has resulted in the diversification of initiatives, from commercial high-tech farms to community-led social initiatives, with substantial variant contribution to urban sustainability among them [10–12]. Palmer [4] indicated that urban agriculture is a priority in urban planning to address multiple issues, although the measurement of the overall contribution of UFP to sustainability is still a gap. With the aim of supporting policy-making around UFP, there is a need to provide quantitative information that can identify the overall contribution of diverse UFP typologies to sustainability, thereby identifying the most adequate developments for the specific urban needs to be addressed.

1.1. Quantifying the Sustainability of UFP

Diverse contributions of UFP to environmental, economic and social sustainability have already been identified in the literature [13,14]. However, only a small number of studies have assessed the sustainability of UFP from a quantitative perspective. With reference to the quantification of UFP's contribution to sustainability, a list of available literature has been compiled in Table 1, including quantitative studies dealing with the benefits and impacts to the three sustainability dimensions. To date, most of these studies have focused on the quantification of the environmental impact of urban agriculture case studies, whereas the literature on social and economic sustainability studies is still limited. The quantification of environmental sustainability has been performed for multiple studies, from the system to the national level, paying particular attention to the comparison with conventional food production [15–22]. Life cycle assessment (LCA) and carbon footprint methods have been employed most frequently in these studies. The environmental balance of UFP has also been upscaled at the city or national level, evaluating theoretical scenarios of UFP development [7,23,24]. These studies were aimed at answering whether UFP is more environmentally advantageous than imported foods as well as determining the city-scale impact of these new local products. Some studies have approached the contribution of UFP to society. The quantification of the social dimension of sustainability has mostly been approached from a food security perspective [25–28], e.g., quantifying the amount of local food that could be produced in UFP. Some authors have also evaluated the impact of urban agriculture in the food diets of citizens who are gardeners and thus, the positive impacts on their health [29,30]. Finally, the economic dimension of UFP has rarely been evaluated in the literature. Sanyé-Mengual et al. [16,17] and Dorr et al. [31] combined LCA with life cycle costing (LCC) to integrate the environmental and economic dimensions of sustainability for case studies of rooftop agriculture. The economic profitability of emerging types of UFP have also been evaluated for vertical farming [32].

Table 1. Quantitative studies on evaluating the sustainability of urban food production (UFP), type of urban food system (UFP), location, sustainability dimension and method employed.

Study	Scale	UFP Type	Location	Dimension	Method
[7]	National	-	United Kingdom	Environment	LCA
[23]	City	-	Lisbon, Portugal	Environment	LCA
[18]	City	Diverse	Boston, United Stated (USA)	Environment	LCA
[33]	City	Rooftop garden	Singapur, Singapur	Environment	Food production Carbon emissions
[28]	City	Community rooftop garden	Bologna, Italy	Society	Food self-supply
[25]	City	Diverse	Cleveland, USA	Society	Food self-supply
[34]	City	Vacant land gardens	Manila, the Philippines	Society	Food security
[35]	City	Rooftop greenhouses	Barcelona, Spain	Society Environment	Food self-supply LCA
[26]	City	Vacant land gardens	Oakland, USA	Society	Food security
[36]	City	Rooftop agriculture	New York, USA	Society	Food security
[27]	City	Vacant spaces	Boston, USA	Society	Food security
[37]	City	Community gardens	Philadelphia, USA	Society	Food security
[38]	City	Community gardens	Camden, USA	Society	Food security
[29]	Household	Community gardens	Michigan, USA	Society	Food diet Survey

Table 1. Cont.

Study	Scale	UFP Type	Location	Dimension	Method
[39]	Household	Community & Home gardens	Denver, USA	Society	Food diet Survey
[40]	Household	Community & Home gardens	San José, USA	Society	Food diet Survey
[41]	Household System	Home gardens	Padua, Italy	Environment Economy Society	LCA LCC Food security
[42]	Household	Home gardens	Chicago, USA	Environment	Agrobiodiversity
[43]	System	Rooftop garden	Barcelona, Spain	Environment	LCA
[19]	System	Suburban greenhouse	Beijing, China	Environment	LCA
[15]	System	Suburban farm	Sydney, Australia	Environment	LCA
[20]	System	Community supported agriculture	Sacramento, USA	Environment	LCA
[31]	System	Rooftop garden	Paris, France	Environment Economy	LCA LCC
[17]	System	Rooftop greenhouse	Barcelona, Spain	Environment Economy	LCA & LCC
[21]	System	Rooftop greenhouse	Barcelona, Spain	Environment	LCA
[44]	System	Aquaponics	Venice, Italy	Environment	LCA
[22]	System	Aquaponics	Padua, Italy	Environment	LCA
[45]	System	Peri-urban agriculture	Seville, Spain	Environment	LCA
[46]	System	Rooftop garden	Paris, France	Society	Food production
[47]	System	Rooftop garden	Paris, France	Environment Society	Ecosystem services Food production
[32]	System	Vertical farming	Quebec, Canada	Economy	Profitability
[48]	System	Aquaponics	United States	Society Economy	Food security Income Job creation

LCA: Life Cycle Assessment; LCC: Life Cycle Costing.

The environmental potential at the city-scale of UFP at the city-scale has been evaluated by different authors [7,23,24,33] who have reported contrasting results. Goldstein et al. [24] accounted for the potential production of urban food in Boston and the avoided carbon footprint, which would not represent a substantial reduction of the city-scale carbon footprint. These results suggested that UFP may not be a shifting point in the design of low-carbon cities, although UFP can support healthier lifestyles and the local economy. Kulak et al. [7] also found that the carbon emission reduction of UFP would be rather low for the United Kingdom, but insisted that UFP showed a greater potential than urban green spaces and thus, UFP would be a more carbon efficient planning element towards achieving low carbon cities. On the other hand, studies evaluating the avoided impact of promoting local food production through UFP at the city scale indicated a great contribution to climate change mitigation, such as for Singapore [33] or Lisbon [23]. When evaluating the contribution of UFP to the social sustainability of cities, studies have focused on the food production capacity and the resulting impact on food security and food self-sufficiency. Studies in Bologna (Italy) [49], Cleveland (United States) [25], Manila (The Philippines) [34], Boston (United States) [27], Oakland (United States) [26] and Barcelona (Spain) [35] agreed on the potential of vacant spaces for producing local food to have significant impact at the city scale in terms of self-sufficiency capacity. Other studies quantified the current contribution of UFP forms at the city scale (e.g., Philadelphia [37], Camden [38]).

At the household level, quantitative studies have focused on health improvement due to dietary changes when engaging in UFP activities. Alaimo et al. [29], Litt et al. [30] and Algert et al. [40]

quantified the changes in the vegetables and fruit uptake of household members, in terms of number of daily portions, before and after participating in community gardens or having their own home garden. Sanyé-Mengual et al. [41] assessed the sustainability potential of home gardens from a food security perspective, where the assessed home garden represented economic savings for the household and satisfied the annual vegetable requirements of between 1 and 2 people.

Several studies have quantified the environmental impact of UFP activities from a life cycle perspective, with the aim of quantifying the environmental burden of initiatives that may have a lower resource efficiency compared to large-scale conventional farming due to small-scale constraints. The results depended mostly on the type of UFP and the geographical location. Studies in warm climate areas highlighted the efficiency of UFP cases and the potential environmental benefits from minimizing the distance between producers and consumers (i.e., reduced transport, packaging and food losses) [16,17,21,45,50]. On the contrary, studies in mild climate cities found that the UFP typology and the productivity of the system would determine whether UFP has environmental benefits compared to conventional food systems [18,31]. Finally, Forchino et al. [44] and Maucieri et al. [22] investigated the environmental impacts of aquaponics, where the production of fish and vegetables are integrated, paying attention to different production techniques [44] as well as the potential use of aquaponics as an educational tool [22]. On the other hand, Grard et al. [47] quantified the ecosystem services provided by rooftop gardens that use organic waste flow from the city as a substrate, thereby improving urban metabolism and enhancing the local circular economy. While food production showed similar values compared to other productive systems in the study area, the study highlighted the potential of rooftop gardens to improve runoff water management in cities due to their high rainfall retention capacity. In previous studies, Grard et al. [46] have already ascertained the food safety of rooftop garden products.

The studies evaluating the life cycle costs of urban food mostly revealed that the cost of UFP falls into the market price range of local or organic products, although some crops can have higher costs due to low crop yield or the cost of the auxiliary equipment [17,31], or because the total cost at the consumption point is cheaper when considering the entire supply-chain [16]. Eaves and Eaves [32] simulated the profitability of a vertical farm in Quebec and obtained slightly more positive values compared to a conventional greenhouse production. Chang and Morel [51] modelled the economic viability of 192 strategic scenarios for micro-farms in London to identify best practices for maximizing economic viability without compromising socio-ecological aspirations, indicating that strategies involving short-cycle crops and crops with high added-value as well as marketing to restaurants are more viable. Love et al. [48] compiled data on the food production, income generation and job creation of commercial aquaponics in the United States.

1.2. The Need for a Bottom-Up Perspective

The topic of sustainable food systems has expanded from food production (issues in agriculture) to also include also topics regarding food consumption (global issues, diet, nutrition) [9], highlighting the role of dietary habits as drivers towards sustainable lifestyles [52]. Such a shift has led to society actively engaging in the definition and achievement of sustainability. Therefore, understanding the perceptions and values of stakeholders can support the identification of relevant aspects of sustainability [9,53]. Bottom-up processes can reinforce the development of policies and actions that are supported and shared by the community [54], thereby enhancing governance and integrating citizens as being co-responsible and co-creators of a “collaborative development” [9]. In the case of UFP, Gasperi et al. [55] unveiled the conflicting top-down and bottom-up implementation processes of urban agriculture in vacant areas in the city of Bologna (Italy), where top-down projects were not participatory and resulted in unsuccessful initiatives that did not respond to community expectations and needs.

In this sense, setting a sustainability framework for UFP, where robust scientific approaches are combined with the concepts and understanding of the stakeholders, could contribute to the current

approach for quantifying UFP sustainability. The creation of a participatory framework would enhance a deeper understanding in the investigation of UFP sustainability, where an agreement between the bottom-up and top-down perspectives can be set. Indeed, participatory processes have already been used as successful tools to create certification labels for sustainable foods [56–58]. For example, Mendonça et al. [57] highlighted the role of participatory certification of organic food to support local food systems, where stakeholders participate in the definition of the certification criteria resulting in the creation of networks and the exchange of knowledge. In the case of Brazil, such processes also led to a positive impact at the community level, as better access to healthy food was provided.

1.3. Goal and Objectives

The goal of this paper was to evaluate the conceptualization of UFP sustainability from a stakeholders' perspective. The specific objectives were (i) to examine the comprehensive definition of the environmental, economic and social sustainability of UFP; (ii) to evaluate the interactions among the three dimensions of sustainability and (iii) to assess the multi-scale nature of the sustainability of UFP. The discussion deepened by comparing the bottom-up (stakeholders' point of view) and top-down (scientific literature) definitions, the policy implications, the power relationships and the relationship to global sustainability frameworks, such as the Sustainable Development Goals of the United Nations. The outputs from this process contributed to the SustUrbanFoods project (MSCA-IF-708672) (<http://susturbanfoods.com>), which aims to develop an integrated sustainability method to assess UFP in a comprehensive way (i.e., three-bottom approach).

2. Materials and Methods

The stakeholders' definitions of the sustainability elements of UFP were assessed through a participatory process and were systematically evaluated by employing a network analysis.

2.1. Participatory Research Design

The participatory research design process was employed to identify the sustainability elements that stakeholders associate with UFP. The process was developed in the form of stakeholder workshops where the global project was presented, practitioners of the city illustrated different initiatives and exercises in groups were proposed.

During the workshops, three different exercises were conducted (Figure 1). As a first step, the participants identified the elements tied to the environmental, economic and social sustainability of UFP through mind-mapping. The participants were asked to differentiate between positive (benefits), neutral and negative (impacts). Three pieces of cardboard, one for each sustainability dimension, were provided for this purpose, as sustainability was divided into its three dimensions. As previous informal communications with some participants unveiled a potential misunderstanding between environmental sustainability and sustainability as a whole, the three dimensions of sustainability were differentiated to avoid the exclusive focus on aspects regarding environmental sustainability and to promote the consideration of the social and economic dimensions. As a second step, the participants proposed quantitative indicators to evaluate such elements and complemented their proposal by adding a set of indicators already used in the literature, provided by the organizers. Finally, the participants valued a list of environmental and socio-cultural ecosystem services and ranked their importance for the evaluation of UFP.

2.2. Participants

Two different meetings were organized in the city of Bologna (Italy) with 51 participants attending (Appendix A). The first meeting included UFP stakeholders in Bologna representing four groups: administration and associations; urban garden managers and practitioners; UFP-related companies and co-ops; and researchers on food systems. The second workshop was held within a course on urban agriculture from the ERASMUS+ Urban Green Train project with 31 students participating, including

university students, practitioners and representatives from local administrations from Germany, Italy, France, The Netherlands, Serbia and Brazil.

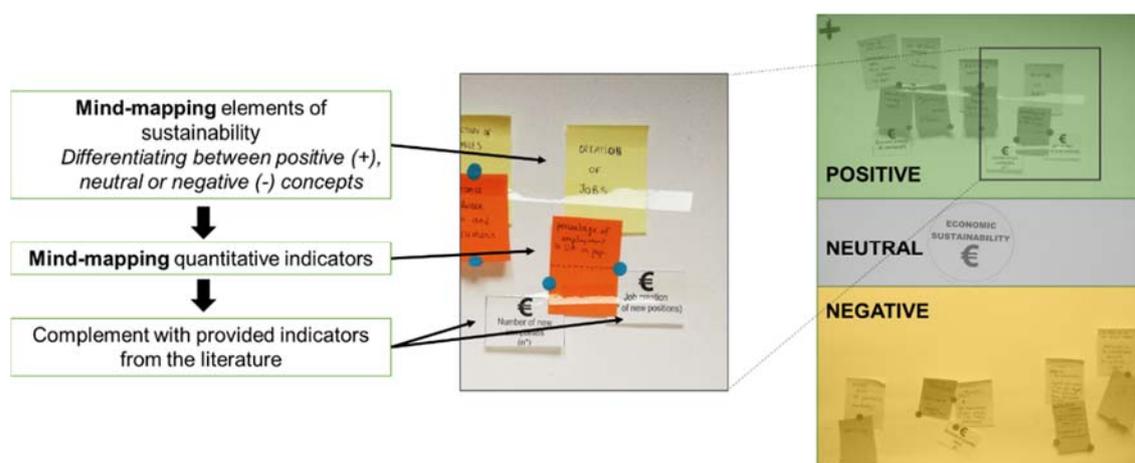


Figure 1. Workshop exercise to support the mind-mapping process, and examples of results in the participatory research design.

2.3. Data Analysis

This paper presents the analysis of the first stage of the participatory process by paying attention to the definitions of sustainability provided by the stakeholders (i.e., citizens involved in any stage of the design, development and implementation of UFP). The resulting materials from the workshops were digitalized and evaluated through network analysis. The resulting network of elements of sustainability and stakeholders' groups by dimension (i.e., environmental, economic, social) were the basis for exploring the patterns and relationships between the concepts and the stakeholder groups, as well as to create a global set of definitions. The employment of network analysis was essential for performing a systematic and visual assessment of the interactions between stakeholder groups and sustainability definitions, the existence of bidimensional and tridimensional concepts and the appearance of isolated discourses. Gephi 0.9.2 software [59] was used for the assessment by applying the ForceAtlas 2 algorithm [60].

Through network analysis, the centrality and the connectivity of the concepts (i.e., elements of sustainability) were observed:

- Centrality refers to the stakeholder groups. The centrality in the network highlights the concepts that are most used by the distinct groups involved in the workshops, thereby showing the most agreed upon concepts. Thus, the more central a concept is, the larger the number of groups that have named it.
- Connectivity refers to the sustainability concepts and the frequency of the connection sustainability element—the stakeholder groups. The connectivity shows how many times a sustainability element was mentioned in the network in total (i.e., by the different groups), outlining the most relevant concepts. Hence, the more connections a concept has with the different stakeholder groups, the more times it has been employed.

3. Results

The complexity of defining the sustainability of UFP was unveiled in the results. A total of 92 elements were employed to define global sustainability, including its three dimensions (environment, economy and society) (Figure 2a). The understanding of the sustainability of UFP was largely composed of benefits (62%). The diversity of these elements showed a slightly balanced distribution among the three dimensions (Figure 2b). However, when the focus was on the importance—i.e.,

how much a concept was employed by all the stakeholders—both the social (40%) and environmental (37%) dimensions gained relevance compared to economic elements (23%) (Figure 2b).

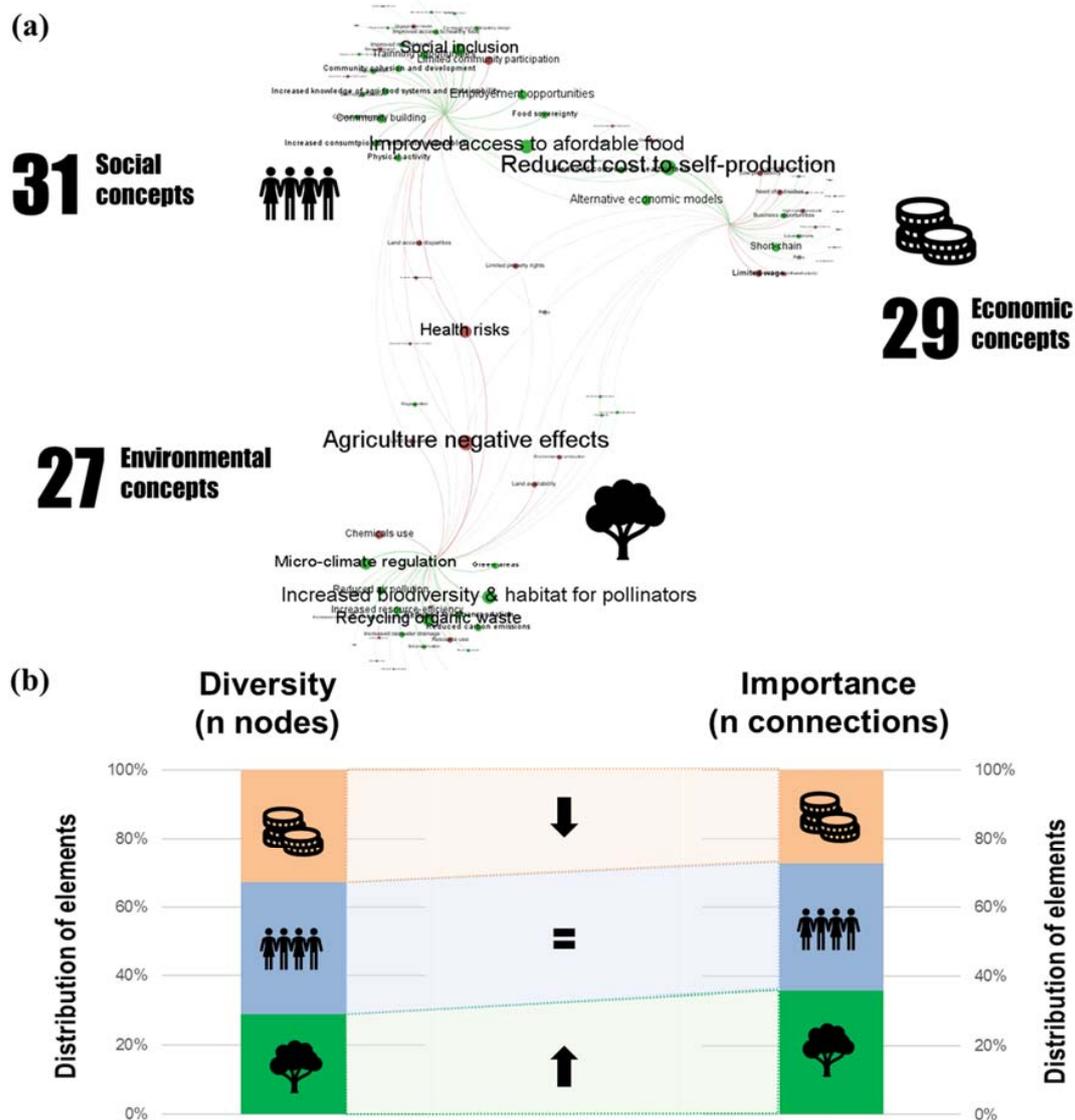


Figure 2. (a) Network of sustainability concepts associated with UFP from a stakeholder perspective; and (b) the diversity and importance of the three dimensions of sustainability in the global definition provided by stakeholders.

3.1. An Insight into the Elements of Sustainability

The elements that construct the sustainability of UFP from an environmental, social and economic perspectives are detailed in this section.

3.1.1. Environmental Sustainability

The global network of elements that comprise environmental sustainability (Figure 3) highlighted the positive role of UFP in the local ecosystems of cities, climate change mitigation and city design. The most relevant aspects were associated with the local ecosystem, where “improved biodiversity”, “micro-climate regulation” and “recycling organic waste” were the most central and connected elements. As an aspect affecting climate change mitigation, “increased resource-efficiency” was

the most highlighted benefit of UFP. Finally, the increase of “urban green” by implementing new UFP experiences was the most important aspect concerning the design of cities.

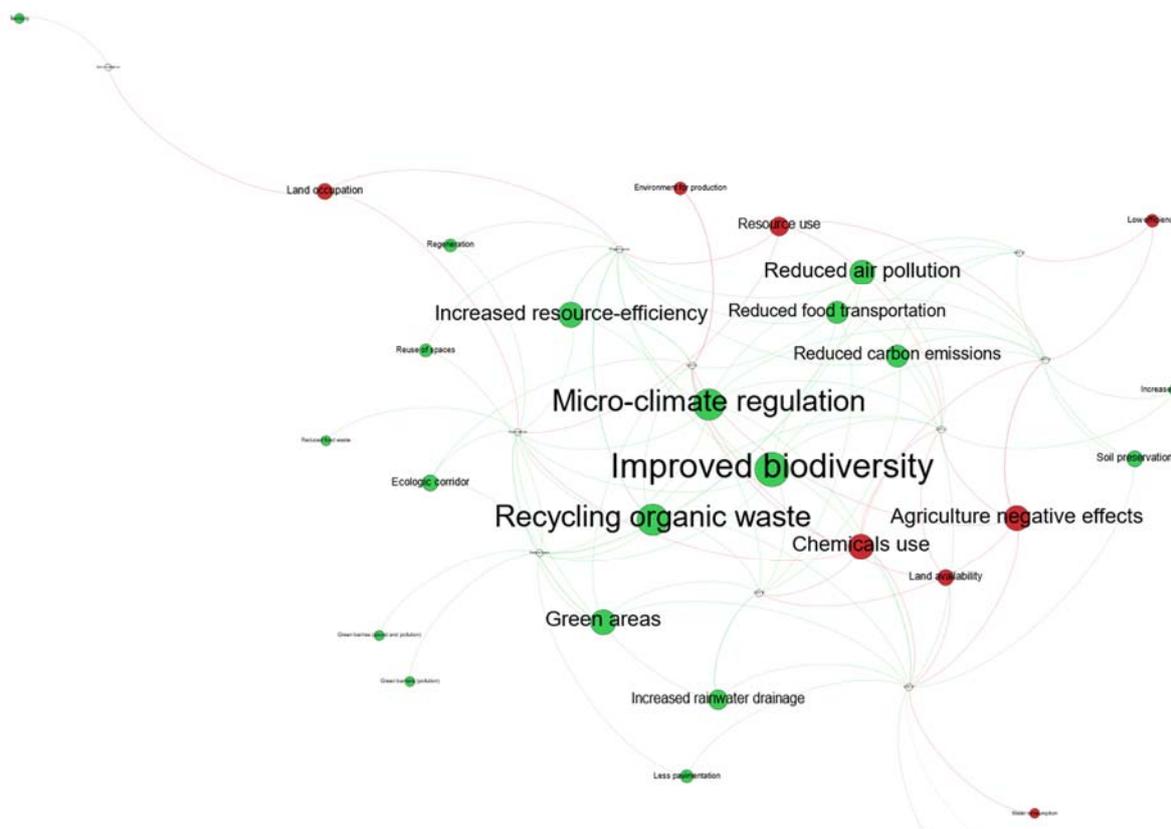


Figure 3. Network of elements comprising the environmental sustainability of UFP (green nodes represent positive elements, while red nodes represent negative elements).

The negative elements were related to the local ecosystem, climate change contribution and environmental limitations for agricultural activities. Among the diverse elements, the most mentioned by the stakeholders were “chemical use” and “agricultural negative effects” in general (which mostly included pollution of soil and water) (Figure 3).

3.1.2. Social Sustainability

The global network of elements that comprised social sustainability (Figure 4) included aspects concerning the community, culture, education, food access and security, health and empowerment. Enhanced “social inclusion” and “improved access to affordable food” were the most relevant benefits of UFP in the social sphere as contributions to culture and food access and security. The main valuable social aspects regarding the community, education and health were “community building”, “training opportunities”, “physical activity” and “increased consumption of fruit and vegetables”. The elements related to the empowerment of the society were the least mentioned ones.

The negative aspects related to the social dimension were less central and less common in discourses of the stakeholders. The social impacts related to UFP included aspects of community cohesion, cultural integration, education, health, local design and justice. “Limited community participation” and potential “health risks” were the most relevant social impacts of UFP as potential barriers to the settlement of UFP (Figure 4).

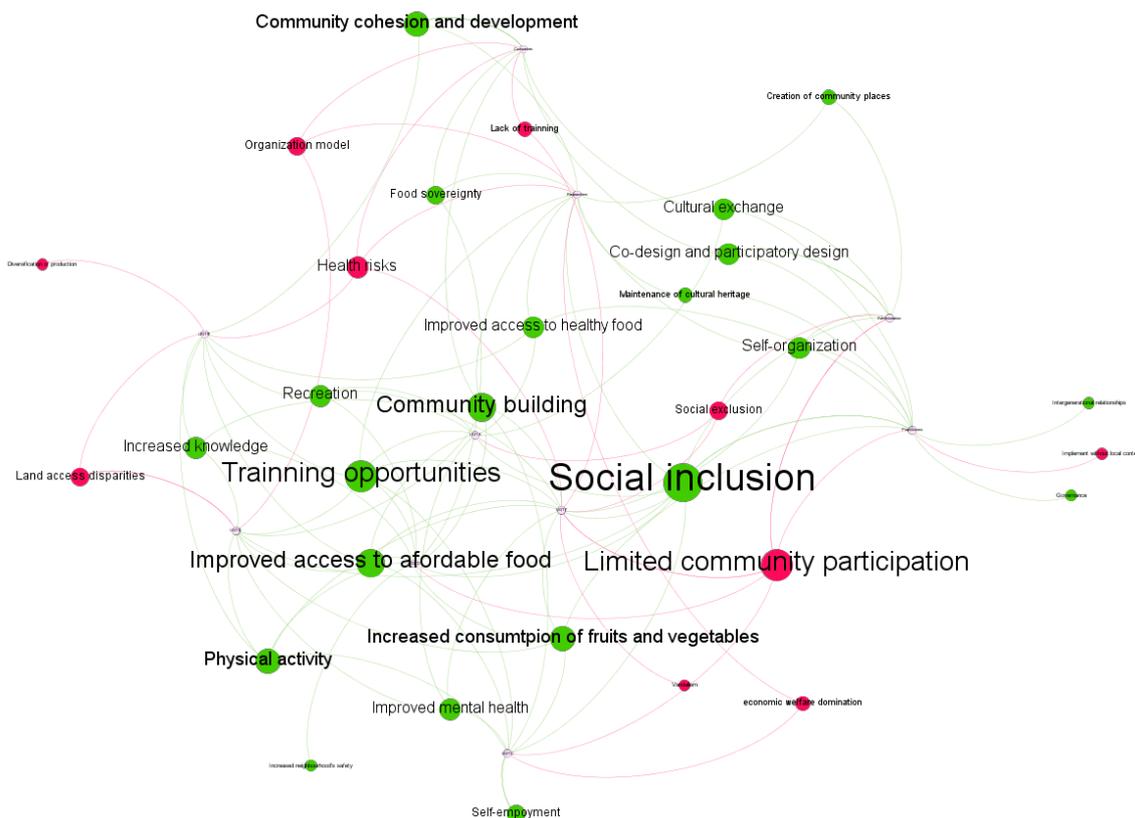


Figure 4. Network of elements comprising the social sustainability of UFP (green nodes represent positive elements, while red nodes represent negative elements).

3.1.3. Economic Sustainability

The global network describing the elements employed to define the economic sustainability of UFP is displayed in Figure 5. The positive aspects encompassed in the economic dimensions of sustainability were associated with economic development, reduced costs, social justice and the economic fabric of cities. The most relevant economic benefits were the “reduced costs due to self-production”, the promotion of a “short-chain” for food products, the generation of “employment opportunities” and the creation of “alternative economic models”.

Negative elements related to economic sustainability were associated with employment, property value, urban redevelopment, elitism, competition and the urban context. In particular, the aspects that concerned different stakeholders the most and, thus, were most cited were the “limited wage” that urban gardeners might have due to the limited profit of agricultural activities, the “low profitability” expected from UFP initiatives and the “need for subsidies” to access resources (e.g., land) and starting and maintaining the activity (Figure 5).

- “Land access occupation”: the limited land availability in the urban environment and the occupation and use of urban spaces for UFP could lead to negative outputs in environmental and social terms, particularly due to land use competition and land access issues.

The intersection with the economic dimension mainly resulted in positive synergies as economic savings or revenues can emerge from positive externalities. These bidimensional elements were the added-value from “increased biodiversity”, “local economy” and “diversification” and the economic savings related to “micro-climate regulation”, “reduced food transportation”, “environmental externalities” and “reduced food waste”. All of these elements outlined the positive outcomes from an economic perspective while reducing the use of environmental resources and decreasing the associated negative impacts. Nonetheless, the environmental conditions that can constrain the productivity or the scale of UFP (e.g., land availability, small-scale initiatives with low profitability) were negative aspects for both dimensions.

In the case of the society–economy interaction, economic savings that also benefit the society could result from “improved access to affordable food”, “reduced cost to self-production”, “reduced costs due to healthy food”, “food sovereignty”, and added-value was observed in “alternative economic models”, “employment opportunities”, “ethical work” and “economic redistribution”. However, a trade-off was observed in this bidimensional interaction, as UFP are related to “gentrification”, where increased property values in neighborhoods have a negative impact on the society due to displacement.

3.3. Multi-Scalar Sustainability

The stakeholders used concepts that are associated to different scale levels. The scale levels ranged from the individual to the global effects of UFP, outlining the multi-scalar nature of the sustainability of UFP, the necessity to identify such scales and the resulting implications. Figure 6 displays how the elements of sustainability (both benefits and impacts) were distributed among the different scale levels (individual, project, community, city and global).

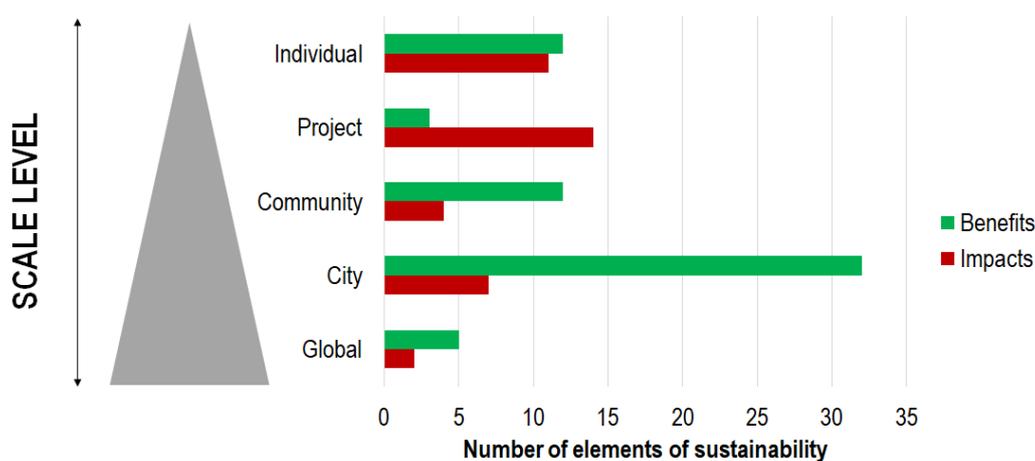


Figure 6. Distribution of the elements of sustainability (including the three dimensions) regarding the scale level—from global to individual—differentiating between benefits and impacts.

The city scale was the predominant one regarding the sustainability benefits of UFP. Positive effects were mainly related to the environmental dimension (e.g., improved local ecosystem services, micro-climate regulation, urban regeneration) and the economic dimension (e.g., employment creation, new businesses, alternative economic models). However, enhanced global health at the city level was also indicated as a social benefit. Both the community and individual levels were relevant from the perspective of benefits. While the community was related to several social benefits (e.g., community building, self-organization, co-design and participatory design), both positive effects in the economic

(e.g., reduced costs) and social dimensions (e.g., improved physical and mental health, food access, training opportunities, food sovereignty) occurred at the individual scale. The global positive effects mainly occurred in the environmental dimension, in relation to climate change mitigation and global resource efficiency. At the project level, positive aspects were related to the economic dimension, including innovation, ethical work and cooperation (e.g., shared production factors).

The sustainability impacts were mainly at the individual and project levels. Negative effects at the individual level were found in the social (e.g., social exclusion, access disparity) and economic dimensions (e.g., limited wage, elitism), while impacts on projects occurred in all of the sustainability dimensions, for example, environmental limitations (environment), lack of training (social) and small-scale constraints (economic). At the city level, UFP was associated with negative environmental (e.g., water consumption, soil management), social (e.g., vandalism) and economic impacts (e.g., monopoly). Regarding the elements associated with the community, limited participation and engagement (social) or gentrification (economic) were examples.

4. Discussion

The results show the complexity and importance of definitions and use of concepts in UFP sustainability. In this section, we discuss this broad definition in comparison with the available literature, the implications in policy and power relationships and the contribution to the global framework of the UN Sustainable Development Goals.

4.1. Completing the Vision of Sustainability

The comprehensive definition resulting from the stakeholders' views completed the current vision of the sustainability of UFP by providing terms and notions beyond the ones present in the current literature. To discuss to what extent the concepts provided by the participants to define the three dimensions complemented the current definition of the UFP sustainability, a recent literature review on the benefits and impacts of urban agriculture was employed as a reference [14]. For the environmental and social dimensions, the concepts that were most central and connected, i.e., the most relevant ones, were already present in the literature. Nevertheless, concepts that were less common in the narratives of the different stakeholders' groups, and therefore, less central, appeared as new elements beyond this literature review. In the case of the economic dimension, most of the elements were new elements, highlighting that the elements regarding the economic sustainability in the literature review used as a reference [14] mostly approached UFP as a business-oriented initiative (e.g., employment, training, increased property values, entrepreneurship, financial support, gentrification, limited wage), and concepts associated with socially-driven initiatives were more limited (e.g., reduced cost due to self-production), suggesting the need to approach these aspects more deeply.

The elements that were more relevant in the environmental sustainability category were increased biodiversity and habitat for pollinators, recycling organic waste, micro-climate regulation, and increased resource-efficiency. Notwithstanding that biodiversity has been linked to UFP due to the increase of green areas as new habitats, there is a lack of studies quantifying the patterns of biodiversity and the resulting ecosystem services from them (e.g., pollination) [61]. A recent study [62] evaluated the presence and abundance of ladybirds as a useful biodiversity tool in integrated pest management in an urban garden in Bologna (Italy) where the plant species that had a higher abundance of ladybirds were identified for future urban garden design. UFP has been proved to be a tool that can increase the recycling rate of organic waste, which can be used as fertilizer and substrate for food production [31,46]. Moreover, some entrepreneurs are seeking technical solutions to employ urban waste in food production, such as the use of coffee grounds for fungi production (e.g., La Boite à Champignons, Paris, France or Rotterzwam, Rotterdam, The Netherlands). This approach is in line with the EU action plan for a circular economy, which aims to reach a target of recycling 65% of municipal waste by 2030. The micro-climate regulation of UFP is still under evaluation, although some authors have referred to studies on green roof effects as proxies. Gasperi [63] evaluated the effects on

the micro-climate of an experimental rooftop garden in the city center of Bologna, which had a positive effect on human thermal comfort. Finally, a debate around the increased resource efficiency of UFP exists in the literature, as the comparison between urban food and conventional food strongly depends on the production system and the geographical context [16–18,31].

Regarding social sustainability, the most relevant aspects were social inclusion and improved access to affordable food. In Bologna, where this study took place, several UFP initiatives pursued the social inclusion of vulnerable communities, migrants and refugees by providing them with training and paid jobs in business-oriented activities as well as spaces for producing food for themselves. In the literature, some authors have evaluated the role of UFP in social inclusion [8,64,65], revealing that while UFP can lead to inclusionary activities for migrants, the effectiveness of them depends on the local context and policy. Increased access to affordable food has been demonstrated in the literature, particularly for socially-oriented initiatives where the individuals and the community directly harvest the food [41,66–68].

Reduced cost due to self-production, short-chain, employment and business opportunities were the key aspects of economic sustainability. Some authors have evaluated the costs of urban-grown food, highlighting the dependence on the crops, the cultivation technique and the geographical area for this to be an activity that provides economic savings to the gardeners. Undoubtedly, UFP promotes the development of short food-chains by reducing the distance between producers and consumers. Sanyé-Mengual [69] examined the benefits of UFP supply-chains compared to conventional and imported food, unveiling the benefits of a reduced transportation, packaging use and retail storage. Some authors have worked on characterizing and classifying the business typologies that have arisen in recent UFP development [11,70,71], outlining the multi-functionality of UFP and the need to consider the local context to achieve successful activities.

4.2. Policy Implications and Power Relations

The network analysis unveiled two common trends in the three dimensions of the sustainability of UFP. First, the more frequently mentioned elements (i.e., higher connectivity in the network) by the different stakeholder groups were also the most relevant and central. This fact indicates that the elements that were more used in the discourses of the different stakeholder groups were also the most common in the global discourse. Second, this trend was more common when indicating benefits—i.e., positive elements, represented in green (Figures 3–5)—than when introducing impacts—i.e., negative elements, represented in red (Figures 3–5). Hence, the stakeholders showed stronger agreement on the sustainability benefits of UFP than on the sustainability impacts. In this context, the development of UFP might focus on the potential sustainability benefits related to UFP initiatives as a common space of understanding between different stakeholders.

However, the results showed isolation in the network of elements of environmental sustainability indicating that certain groups had isolated discourses in which they highlighted specific issues and employed their own concepts. In this case, the “administration” group exclusively used concepts related to the territory to define the environmental sustainability of UFP, far from the comprehensive definition that other stakeholder groups used in their narratives, ranging from climate change aspects to urban planning improvements. Such phenomena can affect the power relationships and policy of UFP in daily life.

Primarily, contrary definitions between stakeholders that have different levels of power in the definition, and the implementation of UFP can lead to unsuccessful development of initiatives at the local level. Subsequently, when detached discourses are held by policy-makers, this can promote the deployment of policies and programs which cause unequal distribution of public resources and unfeasible long-term projects. For the case of Bologna, where this participatory process took place, the current programs related to UFP and the revitalization of vacant lands as a strategy for improving the urban territory already clashed with the willingness of citizens through top-down projects [55]. These results thus highlighted the relevance of definitions in the local context, where common elements

might re-address current policy orientations and put together different interests as the basis for new democratic and long-term policy-making regarding sustainable UFP.

Furthermore, a comprehensive definition of the sustainability elements around UFP might support the creation of innovative policies that link policy-making with real implementation, a common issue in UFP development. Cohen and Reynolds [72] evaluated the development of urban agriculture in New York City, where community members indicated their willingness to be more integrated into the policy-making process to be able to transfer their realities into effective policy-making. Sanyé-Mengual et al. [73] found out that stakeholders in Barcelona had several definitions of urban agriculture, leading to conflicting expectations in the potential development of rooftop agriculture. Therefore, participatory policy-making with definitions of UFP and their sustainability elements could promote overcoming such obstacles.

4.3. UFP Contribution to the United Nations Sustainable Development Goals

The global relevance of the sustainability definition of UFP has been discussed by contrasting the sustainability elements and definitions with the Sustainable Development Goals (SDGs). The description of the SDGs and their specific objectives in the UN Declaration is here discussed from the lens of the elements of the sustainability concept described by the stakeholders. The resulting definition of sustainability showed a great contribution to achieving diverse SDGs. In general, the contribution of UFP to the SDGs is very broad, and comprehensive quantitative studies are needed to evaluate the sustainability of UFP beyond the current narrowed assessments available in the literature that focus on specific aspects, such as the food security potential or the carbon footprint (Table 1).

The stakeholders highlighted the potential role of UFP in improving poverty and enhancing equal access to resources, particularly through initiatives that focus on citizens at risk of social exclusion (e.g., low-income, migrants). Furthermore, the sustainability aspects related to a more resource-efficient UFP (e.g., addressing climate change mitigation) can effectively contribute to building the resilience of vulnerable population (SDG 1 “no poverty”). Some of the elements proposed by the stakeholders highlighted the contribution of UFP to SDG 2 “zero hunger” by enhancing food security, coping with malnutrition, securing access to natural resources for food production, ensuring sustainable food systems and recovering and maintaining genetical variability in urban areas. The stakeholders’ definition included the improved mental and physical health of gardeners, diet changes and the increased food quality associated with UFP as well as improved environmental quality. Such elements could contribute to SDG 3 “good health and well-being”. The training opportunities and the environmental awareness and education associated with UFP could contribute to SDG 4 “quality education”, as suggested by the majority of the stakeholder groups.

Regarding SDG 6, “clean water and sanitation”, stakeholders acknowledged that UFP could have a positive contribution to water efficiency. The potential impact on SDG 6 would depend on agricultural practices as organic production can prevent water pollution or technological innovations can promote circular economy techniques to enhance water recycling and reuse. An increase in local food production would improve the global energy efficiency by decreasing food transportation and promoting short-chains, thereby contributing to SDG 7 “affordable and Clean Energy”. The stakeholders stated that UFP could have positive impacts in the economic dimension of the sustainability and contribute to SDG 8 “decent work and economic growth”, for example, through the development of the local economy by creating job opportunities, enhancing innovation and entrepreneurship and promoting resource-efficient markets. UFP activities oriented towards low-income, youth and social exclusion risk communities would contribute to specific objectives of SDG 8.

Greater equality in distributing food and access to resources, social inclusion and empowerment of the society through UFP were specific features of the sustainability definition of stakeholders that could contribute to SDG 10, “reduced inequalities”. UFP could have a positive impact regarding SDG 11, “sustainable cities and communities”, as the stakeholders outlined its potential role in

promoting sustainable urbanization, preserving the natural and cultural heritage, protecting vulnerable communities, reducing the urban environmental impact and increasing accessibility to green spaces. The diverse stakeholders highlighted the role of UFP towards achieving SDG 12 “responsible consumption and production” as UFP could strengthen the efficient use of natural resources, prevent food waste generation by shortening food supply-chains, reduce the use of chemicals and produced waste and enhance environmental awareness. Along the same line, the stakeholders agreed that UFP is associated with increased resilience and climate change mitigation (SDG 13, “climate action”).

Some SDGs were only considered in an indirect way, through the stakeholders’ definition of the sustainability of UFP. The impact to some SDGs relies on the indirect effect of resource efficiency and reduced environmental impact to natural environments beyond urban areas, i.e., for SDG 14 “life below water” and SDG 15 “life on land”. Finally, although the stakeholders used sustainability elements related to some SDGs (e.g., social inclusion, innovation, reduced crime), the contribution to these SDGs would depend on how UFP is managed, such as for SDG 6 “gender equality”, SDG 9 “industry, innovation and infrastructure”, SDG 16 “peace, justice and strong institutions” and SDG 17 “partnerships for the goals”.

5. Conclusions

This paper contributes to the literature on sustainability and UFP by revisiting the concepts associated with environmental, social and economic sustainability in order to incorporate the perspective and narratives of stakeholders. This bottom-up approach unveiled a comprehensive vision of sustainable UFP, the relevance of certain sustainability elements and key aspects to take into consideration for the implementation of UFP, the design of effective policy-making and the development of research studies on the sustainability of UFP that built upon the presented conceptual framework.

As a novel approach that systematically and visually evaluated the results from participatory narratives using a network analysis, the identification of bidimensional and tridimensional concepts and the appearance of isolated discourses unveiled key aspects. The existence of bidimensional and tridimensional concepts indicated priorities, synergies and trade-offs among the dimensions of sustainability. This aspect emphasized the need to approach sustainability in a transversal way.

This study provided evidence of the significance of participatory, bottom-up and democratic policy-making, confirming that isolated discourses of sustainability can lead to unsuccessful plans and programs. The participation of stakeholders in policy-making can also be vital for the definition of monitoring indicators.

The multi-scalar nature of UFP suggested that specific policies can be supported by global schemes (e.g., the Paris Agreement, SDGs) and that UFP can be a local tool for democracy and equity at lower scales (i.e., community, project, individual). With regard to the SDG scheme, the stakeholders’ definitions and concepts outlined the large contribution of UFP to different goals, highlighting the potential role of UFP in the design of sustainable cities.

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Appendix A. Workshop Participants

Table A1 details the list of participants in the participatory research workshops.

Table A1. Participants of the stakeholder meeting and urban green train workshop.

Workshop	Group	Participant	Number
Stakeholder meeting	Administration and associations	Local government, Regional government, National agency, Local environmental association	4
	Urban garden managers and practitioners	Managers and gardeners of local realities (Urban allotment garden, Community garden, Squatted garden) Representative of citizen-driven food co-op	6
	UFP-related companies and co-ops	Urban agriculture small/medium enterprises (SME), Association of local food producers, Food production co-operative manager, Periurban farmer	5
	Researchers on food systems	Researchers from University of Bologna, University of Macerata and University of Amsterdam	5
Urban Green Train course workshop	International students from urban agriculture pilot course	Applied Science University of South Westfalia (SWUAS)	10
		University of Bologna (UNIBO)	4
		Institut agronomique veterinaire et forestier de France (AGREENIUM)	6
		Independent students (The Netherlands, Serbia, Italy, France, Brazil): practitioners and local administration	11
Total			51

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