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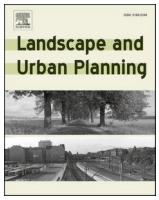

Review Article

Evidence on how urban gardens help citizens and cities to enhance sustainable development. Review and bibliometric analysis

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HIGHLIGHTS

- Research structured along 4 clusters 'Citizens', 'Drivers', 'Cities', and 'Soil'.
- The TBL framework applied to these clusters.
- The clustering conducted an overview of the published research on urban gardens.
- Promoting urban gardens could be a relevant urban policy directed towards SD.

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ABSTRACT

This paper offers a comprehensive review on a bibliometric analysis of the published research on the most recent generation of urban gardens. Urban gardens have been part of the cities ever since; however, the present paper focus on the latest wave of this type of garden, that has been triggered by individual bottom-up initiatives driven by sustainability-related motivations, which have an impact on cities' sustainable development. Its aim is to deliver an overview of the published scientific literature and to comprehensively review the evidence it provides on the role of urban gardens in Sustainable Development. A bibliometric analysis has been carried out using the Vosviewer software and searching the Web of Science database for 'urban gardens', 'community gardens' and 'allotments' as keywords. A narrow selection of the most co-cited publications on urban gardens pointed to four major strands of research grouped into four clusters. The first cluster ('Citizens') groups evidence on urban gardens and 'People, lifestyle and sense of community'. Citizens are found to be major triggers of urban gardens initiatives, driven by 'motivations, purposes and benefits' that are explored by a second strand of literature captured by the second cluster, the 'Drivers' cluster. A third group of publications addresses urban gardens in the context of the sustainable development of cities. The 'Cities' cluster shows how urban gardens contribute to urban sustainability as well as some aspects that can hinder it, namely not being acknowledged by local public policies and urban planners, while being neglected by urban planning policies framework. Finally, the fourth cluster ('Soil') refers to sustainability shortcomings of urban gardens resulting from their being situated in vacant land that is only available due to soil contamination, which is related with its lack of institutional recognition.

We were able to conclude the studies conducted are directly related to sustainable development and there are direct and necessary relationships between the three pillars and the literature on urban gardens that has been published in recent years. Besides, little importance has been given to this whole urban garden issue, not only because most of the studies reviewed in this work are case studies, but also because there is still much economic pressure affecting the sustainability pyramid.

1. Introduction

Urban gardens have been shaping cities for long in their conventional forms that include "community gardens" and city allotments. In more recent years, a new wave of urban gardens has emerged, differing from the previously existing in the sense that they derive from

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individuals' sustainability-related motivations. A quick overview of the numerous case studies on urban gardens available in the published scientific literature confirms these motivations, including: sustainable lifestyles (Camps-Calvet et al., 2015; Gasperi et al., 2016), sustainable eating dynamics (Coles & Costa, 2018; Pourias et al., 2016;), and, individual well-being derived from demands for a sense of belonging and social inclusion (Langemeyer et al., 2018; Partalidou & Anthopoulou, 2017).

Sustainability-driven urban gardens are flourishing across the world moulded by socio-cultural, political, geographical contextual diversity. This new generation is often differentiated according to their purpose, and include: Social Gardens, Urban Organic Gardens, Community Gardens, Recreational Gardens, Home Gardens and Pedagogical Gardens. The variety of designations expresses the diversity of their purposes. Despite some ambiguity that still persists regarding some of these designations, since the meaning of expressions like 'urban garden', 'community garden', and 'allotment'often overlap (Guitart et al., 2012), 'urban garden' is currently used to refer to urban gardens grown in small plots of land cultivated individually, also known as allotments, as part of collective action initiatives or collective governance schemes (Turner et al., 2011). 'Community gardens' has a broader meaning, since it includes both gardens grown in rural and in urban areas (Ferris et al., 2001a; Ferris et al., 2001b). According to Draper and Freedman (2010), urban gardens are named 'community gardens' when there is a public dimension in terms of ownership, access, or degree of democratic control. Guitart et al. (2012) state that a 'community garden' refers to open spaces which are managed and operated by members of the local community, mobilized through organised collective action, in which food or flowers are cultivated. Hence, given the purpose of this review - analysing how urban gardens are addressed respecting the promotion of the Sustainable Development (SD) in cities and other urban areas - 'community gardens' emerge as a relevant term to identify scientific publications related to the topic 'urban gardens'.

This paper will focus on this recent generation of urban gardens whose origin and dynamics are driven by the consolidation of the SD paradigm, distancing from motivations underpinning past generations of large waves of urban gardens. The definition of SD has been questioned throughout its 5 decades of existence. Since the Council of Rome in 1968, the natural an environmental resources as a limit to economic growth began to be perceived. There followed several summits that focused on the environment and development (Vanhulst & Beling, 2014), based on the Brundtland Commission's definition of sustainable development focused on intergenerational equity, until the most recent summits, namely that of 2002, which marked another expansion of the standard definition with the inclusion of three pillars of sustainable development: economic, social and environmental, plus the most recent imputs of participation and collective responsibility (Benson & Craig, 2014). Thus, defining sustainable development is very difficult and this stems on the one hand from its multidimensionality and on the other from its ambiguity. It is this same multidimensionality and ambiguity that gives it power and creativity. To render the concept operational for analysis, as needed in this paper, we rely on a definition of sustainable development focused on what it specifically seek to achieve: its goals (Walter et al., 2018), sumarised in its three founding pillars: economic, environmental, and social. These are currently embedded in the 17 SDGs that capture the multidimensionality of SD much better, and support its operacionalisation, a process that is on-going.

The first large wave of urban gardens is commonly associated with Industrialization and the consequent phenomena of rural exodus and urbanization. Even before this period, the origin of urban gardens in Germany is associated with the name Daniel Gottlieb Moritz Schreber. Although he was a doctor and had no a profession related to agriculture, Schreber became part of the history of urban gardens when he proposed to have sick children treated outdoors in gardens (Groning, 1996). In Detroit, one of the cities mostly hit by the US depression (1930's), landowners were asked to cede the uncultivated land to unemployed people, whose numbers were increasing exponentially, so they could grow food to ensure their own subsistence. For those unemployed people, cultivating the land was relatively easy given that most of them had a rural origin and were familiar with farming activities, and having migrated to urban areas in search of better living conditions (Walker, 2016). As underlined by Bassett (1981) P-Patches in the USA were created to help citizens in dire need of support, thus allowing them to have an occupation and sense of usefulness to society beyond their food security. The timeline associated to that phenomena varies substantially across those countries currently known as industrialised countries, but the factors triggering this 'first wave' of urban gardens were similar. The gardens were grown by newcomers from rural areas who felt the need to create spaces where they could grow fresh food and maintain their link to farming; besides, it made it possible to ensure a way to supply their own households with food they couldńt afford on account of their low wages.

The second large wave of urban gardens is associated with times of severe deprivation of fresh food supply in contexts of war or economic recession. P-Patches and Victory gardens were popular responses involving communities in contributing to cope with situations of dramatic fresh food shortage in urban areas resulting from the Great Depression and World War II. These were designated 'community gardens' because they were intended to make fresh vegetables available to the community (Bert Van Wee, 2015).

The more recent large wave of urban gardens, led by the SD paradigm, emerged in the nineties of the XX century and flourished since the first decade of 2000. These 'sustainability-driven' urban gardens convey the sense of well-being that traditional gardens have always provided, but they introduce new and legitimate citizens'concerns about the sustainable dimension of urban lifestyles and food systems. Hence, they are mainly the result of bottom-up dynamics led by individuals and inorganic collective action initiatives, and no longer represent national political initiatives to cope with food shortage periods.

This novel wave of urban gardens has motivated numerous studies, although we have not been able to find neither a systematic review nor a bibliometric analysis that would allow readers, both researchers and society, to grasp an overview of the evidence available, despite the vast number of available studies. This paper aims to contribute in filling this gap, relying on a comprehensive review of published literature on this new generation of urban gardens, anchored on a bibliometric analysis and guided by the need of understanding of how these gardens contribute to Sustainable Development (SD), assessed by its triple-bottom-line framework (TBL). Built on this review, the paper will identify relevant research gaps on the topic of urban gardens. In addition, the review will support the introduction of the discussion on how urban gardens might be acknowledged as an effective instrument of urban policy tool to reinforce both the citizens' and the cities' contribution to the implementation of sustainable development goals (SDG) to be attained by 2030.

Following an introduction, the paper is structured as follows: section 2, describing the methodology of the bibliometric analysis; section 3, presenting the results of the bibliometric analysis on selected publications, both by content and citation; section 4, discussing the results of the bibliometric analysis using the SD TBL framework; finally, the concluding remarks, including suggestions for further research and recommendations on how urban gardens could be part of the framework underpinning the design and implementation of urban sustainable development policies.

2. Methods

Due to a mounting number of available academic publications, bibliometric studies are becoming more and more popular and acknowledged as a systematic and relevant approach to compile and comprehensively synthesizing scientific literature on a specif topic (Homrich et al., 2018). Counting publications can be useful for doing

some comparisons, but citation analysis allows you to look at the impact those articles have had on others by determining how often they are cited. In order to extract and manipulate data, bibliometric methods, based on content or citation analysis, are often used (Wallin, 2005). Bibliometric methods extract scientific publications from electronic databases, such as the Web of Science (WoS) or the Scopus, based on content or citation analysis aiming at identifying trends and patterns and/or assessing the impact of publications (Ellegaard et al., 2015). In this paper, bibliometric analysis was conducted with both aims in mind, by relying on an in-depth review of the publications on the topic of urban gardens with the highest impact, in order to identify relevant patterns in the publication content and to assess how it addresses the Sustainable Development in cities and other urban areas.

In this paper, the search for scientific publications was limited to the Web of Science (WoS) database considering its wide-range coverage of the topic of 'urban gardens' and the fact that it allowed reaching all indexed journals with a calculated impact factor in the Journal Citation Report (JCR). The selection of keywords took into consideration the diversity of designations used to address urban gardens. Elected keywords were 'urban garden*', 'communit garden*' and 'allotment*'. All the words were inserted without the terminations 's' and 'y', to allow for the capture of all the papers that could be of interest for the systematic review proposed by this paper.

The search was conducted with the WoS search tools and the bibliometric analysis was supported by the Vosviewer software (1.6.9 version). Fig. 1 describes the procedure adopted for the search process.

The search for titles and abstracts of scientific publications available in the electronic database WoS prior to 2019 and using the search terms: urban garden*' OR 'community garden*' OR 'allotment*' retrieved a total of 2,320 publications. A sequence of two filters, commonly used in bibliometric analysis, were then applied, comprising the 'type of document' and 'scientific area'. Only the complete articles and book chapters were retained. The 'type of document' selected only documents with higher bibliometric relevance and delivering final and complete papers, leading to the exclusion of other publications, such as conference papers and papers in proceedings. By applying this filter, 724 documents were retained, corresponding to around 30% of the initial set of 2,320.

A large range of scientific areas was contemplated, given the expected multi and inter-disciplinary approaches to the topic under review. These included the following areas: 'agricultural economic policy', 'agricultural multidisciplinary studies', 'agronomy', 'ecology', 'economics', 'environmental sciences', 'environmental studies', 'geography', 'green sustainable technology', 'horticulture', 'law', 'multidisciplinary sciences', 'political sciences', 'regional urban planning', 'social sciences interdisciplinary studies', 'sociology', 'soil sciences', and 'urban studies". At this stage of the selection, duplicated publications were eliminated, and a total of 724 publications was retrieved.

The abstract screening was conducted by the authors in order to exclude publications outside the scope of this paper review. Excluded publications included topics, such as backyards, home gardens, school gardens, farming, grazing areas, rural land, the relationship between the use of green spaces and public gardens, the influence of plant taxa on pollinators, fertilizers, and water quality, or the domestic gardens. Abstract screening led to the final selection of 204 publications.

This final set of 204 scientific publications was the object of the bibliometric analysis and of a review including publication year, geographic location, and main research approach. The bibliometric analysis was built on the co-citation criterion to dentify the publications which havwe been co-cited 10 times or more by this set of 204 publications. The co-citation criterion led to the identification and selection of 49 publications whose content was analyzed through the Vosviewer software (1.6.9 version). This software enables constructing and visualizing bibliometric networks and depicting co-citation maps based on multiple dimensions.

3. Results

3.1. Overview of publications on urban gardens

The 204 publications selected as relevant based on their content were analysed in terms of year of publication, research methods, and the geographical location of the case studies presented.

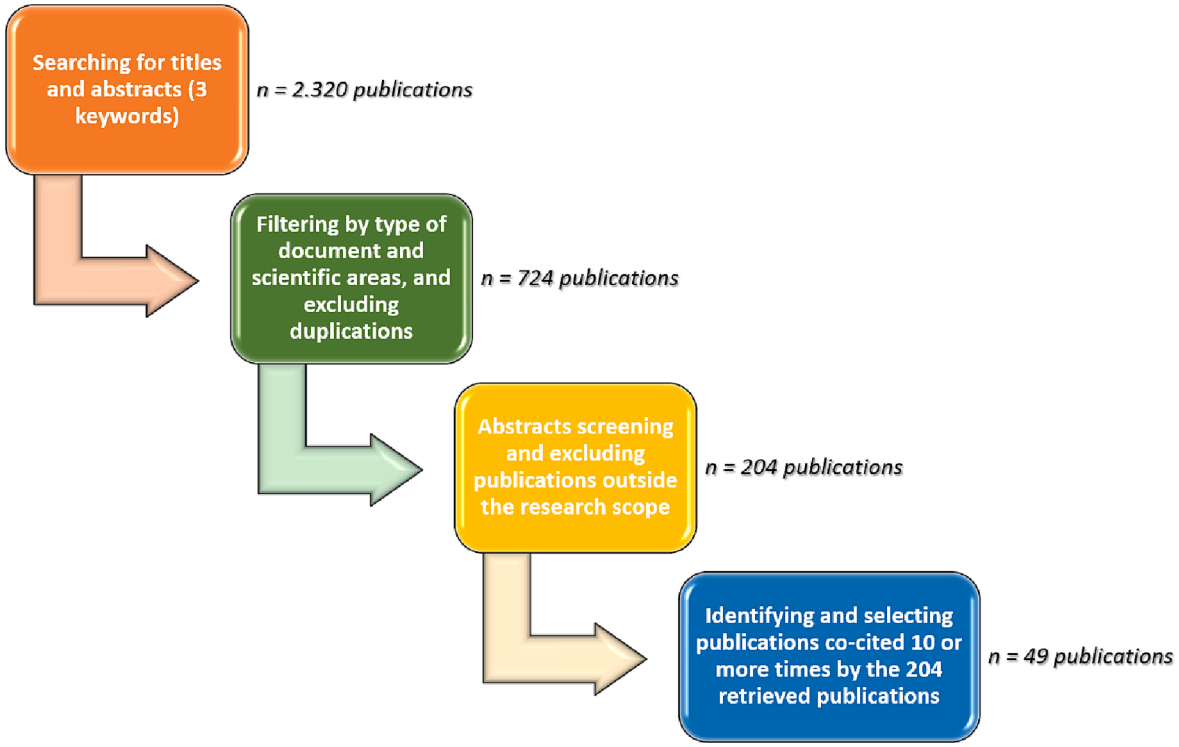

Fig. 1. Bibliometric analysis procedure.

As shown in Fig. 2, the distribution of the 204 scientific publications retained for analysis by publication date highlights an increasing interest in this topic in recent years, and an increase in publications targeting the indexation to the WoS in the coming years is to be expected.

The review of the publications according to the adopted research approach or method shows that 70% of the 204 publications that were selected are case studies focussing only on one case (e.g. Borcic et al., 2016; Delgado, 2015; Guitart et al., 2012; Langemeyer et al., 2018; Neo, Harvey & Chua, 2017; Ruggeri et al., 2016; Silva, Fernandes & Castiglione, 2016; Gasperi et al., 2016). Publications presenting cases studies with cross-comparison between different cities were less than 10% (e.g. Glavan et al., 2018; Pourias et al., 2016). A small number of publications (around 6%) consisted of literature reviews (e.g. Barthel et al., 2015; Gustedt, 2017; Opitz et al., 2016).

Regarding the geographical distribution, countries such as USA, the UK and Germany concentrate the majority of publications focus and the empirical evidence available, although case studies are available all over the world.

3.2. Most cited publications on the topic of urban gardens

The bibliometric analysis based on the co-citation criterion was conducted by means of the Vosviewer software. The set of 204 publications conveyed a total of 8,730 co-citations. The criterion of retaining the publications co-cited by 10 or more publications led to the selection of 49 publications. Vosviewer allows to map co-citations networks and to group co-cited publications by clusters that identify publication patterns. The selected 49 co-cited publications were grouped by the software into four clusters as shown in Fig. 3.

Fig. 3 shows the four clusters identified by the Vosviewer software to group the 49 publications picked as the ones associated with the most co-cited of the selected 204 publications.

4. Discussion

The WoS includes publications since 1996, notwithstanding that publications on 'urban gardens' rather centre in the 2010s, and particularly in more recent years, which suggests an increasing interest of the scientific research to address indexed publication. Researchers' growing attention to this topic is probably related to the worldwide expansion of the novel generation of urban gardens that has been happening since the 2000s. Some authors (e.g. Baumgarten, 2017; Camps-Calvet et al., 2015; Cangelosi, 2015) suggest that researchers' growing interest in this topic in the 2010s might have something to do with the global economic crisis of 2008, which brought back concerns over fresh food affordability as well as the notion of gardening as a way to cope with psychological distress caused by unemployment.

From 2014 until 2017, approximately 20 papers were published every year. The number of papers published in 2018 is much higher, over 60 papers. Such increase shows the interest of urban gardens to the scientific community, reflecting its escalating social relevance.

Urban gardens are presented in literature as having multidimensional importance, encompassing food security, individual health and well-being, along with environmental, pedagogical, and aesthetical aspects (e.g. Carlsson et al., 2016; Truong et al., 2016). Hence their suggested multifunctional role, comprising leisure and recreation, food supply, restoration and/or recovery of degraded land, and as well as social cohesion and individuals' sense of belonging (Barthel et al., 2013). In fact, urban gardens are being increasingly acknowledged for their contribution to individuals' mental and physical health benefits by providing a sense of usefulness needed by many. As a result, the establishment of urban gardens, e.g. the creation of allotments in cities, is envisaged as a socially desirable way of occupying urban vacant land (Camps-Calvet et al., 2015; McClintock & Simpson, 2018; Partalidou & Anthopoulou, 2017).

The publications reviewed tend to confirm that the new 'urban gardens' are driven by sustainability-related motivations and no longer to address food supply shortage. Sustainability-driven urban gardens are associated with the common citizen's desire to plant, sow, and see their own food grow; therefore, they are related to visions of contributing to a sustainable and healthy environment (SpilKová, 2017), new models of lifestyle (Camps-Calvet et al., 2015; Gasperi et al., 2016), ensuring healthy and nutritive food (Coles & Costa, 2018; Pourias et al., 2016), and pursuing a sense of belonging (Langemeyer et al., 2018; Partalidou & Anthopoulou, 2017). Armstrong (2000) systematized the sustainability-driven urban gardens according to the objectives pursued, which include: proximity, social cohesion, leisure and recreation, and environmental sustainability.

In addition, the review shows that, from 2016 onwards, urban gardens research has been transversal to different scientific areas and more and more approached as an interdisciplinary issue. There is an increasing number of studies concerning urban studies, environmental

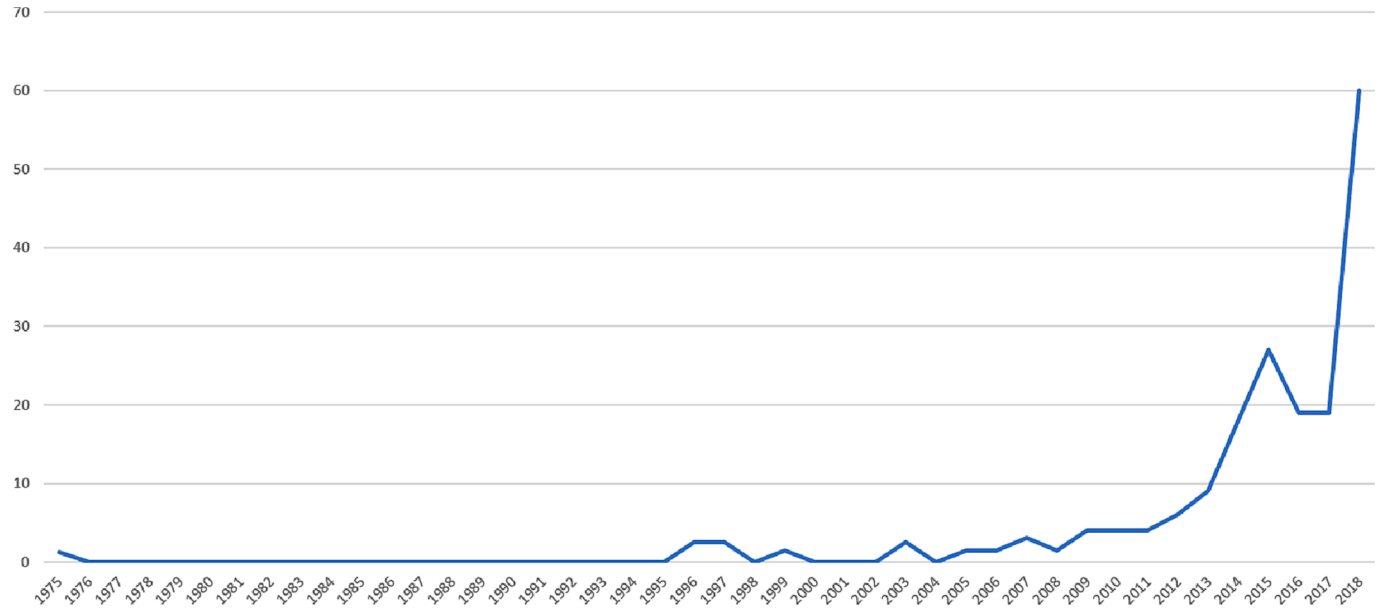

Fig. 2. Publications according to the year of publication.

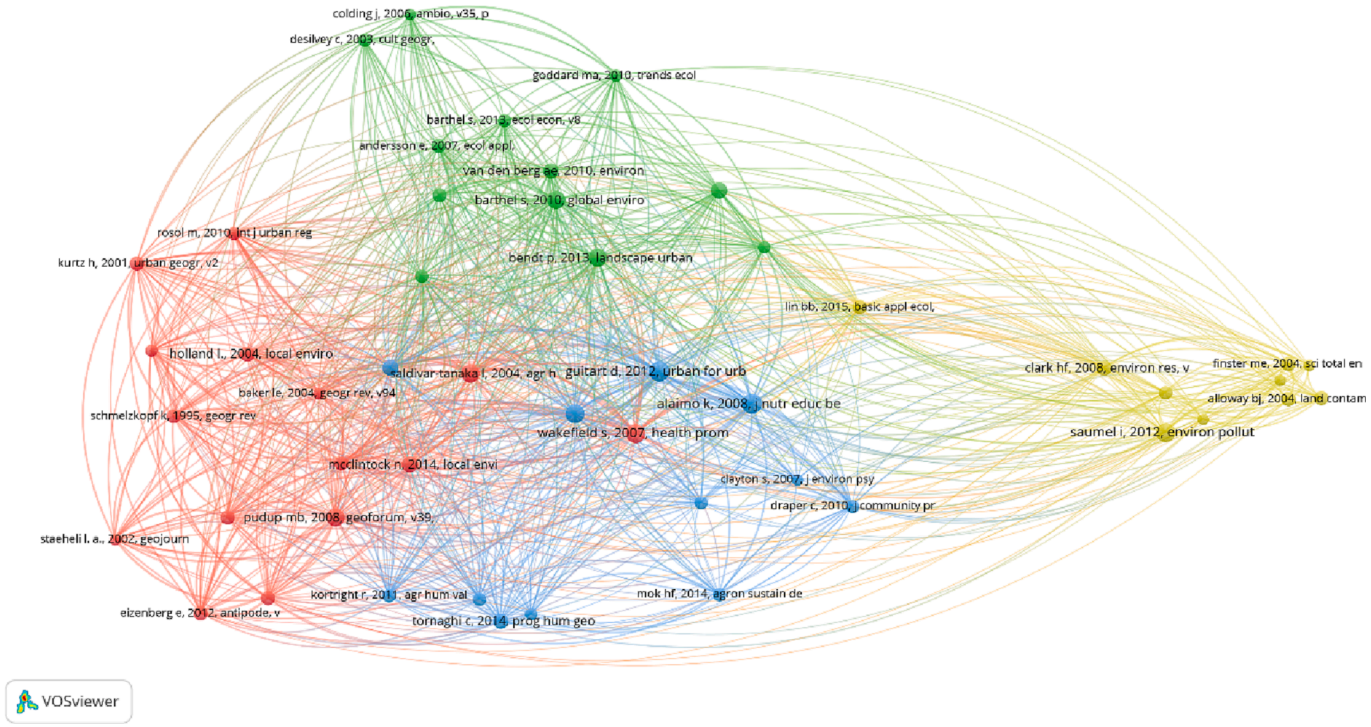

Fig. 3. Cluster analysis of the publications selected according to the most co-cited publications.

studies and environmental sciences and new areas with an interdisciplinary approach, and a decline in disciplinary publications.

The EUA have the largest number of scientific publications on urban gardens (e.g. Alaimo et al., 2008; Armstrong, 2000; Baker, 2004; Clayton, 2007; Mcclintock, 2014), followed by the United Kingdom (e.g. Ferris et al., 2001a; Ferris et al., 2001b; Holland, 2011; Pudup, 2008). According to Pudup (2008), much of the interest in the contemporary community garden movement originated in the 1970s, starting in North America. Firth et al. (2011) drew the attention to the renewed popularity of community gardens in the more industrialized countries like the UK, USA, and Australia in recent years.

As shown in section three, most publications basically convey case studies. These case studies focus mainly on large cities (Fig. 4), such as Barcelona (Langemeyer et al., 2018), Berlin (Bendt, 2013), Bologne (Gasperi et al., 2016), Milan (Ruggeri et al., 2016), New York (Egendorf et al., 2018), Paris (Demailly, 2017), Rio de Janeiro (Guanaes, 2014), Salzburg (Breust, 2014), and Zagreb (Borcic et al., 2016). There are also case studies in cities that belong to large metropolitan areas like Sheffield (Nam & Dempsey, 2018) or Vila Nova de Gaia (Silva et al., 2016); or refer to whole large urban regions like California in the USA (Mcclintock &Simpson, 2018). National-level case study approaches are available for Greece (Partalidou & Anthopoulou, 2017) and Poland

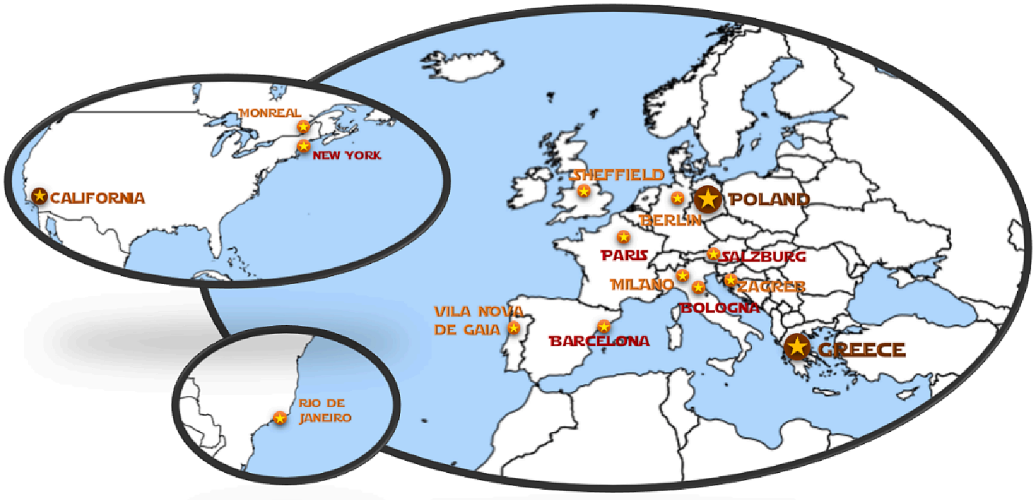

Fig. 4. Case studies addressing cities and metropolitan areas.

(Trembecka & Kwartnik-Pruc, 2018).

Fig. 5 posits the four clusters found by bibliometric analyses for the 49 most co-cited publications into the pyramid conveying the triple bottom-line framework (TBL) commonly used to assess Sustainable Development (Hacking & Guthrie, 2008). The interpretation of the four clusters identified by the co-citation clustering analysis, conducted by means of the Vosviewer software, builds on the in-depth reading and analysis of the 49 selected publications.

According to the TBL framework, in order to be considered sustainable, a policy, subject or theme has to encompass three dimensions of performance: financial, social and environmental, that is, to operate economic and social development and to preserve the environment. Hence, when depicting Fig. 5, the TBL framework corroborates the suggested interpretation of the clusters generated by the software analisys of bibliometric data. The four clusters were named based on their content, identified through the in-depth review conducted by the authors: Cluster 1 'People, lifestyle and sense of community' ('Citizens'), Cluster 2 'Benefits, motivations and purposes of the gardens' ('Drivers'), Cluster 3 'Sustainability of cities' ('Cities'), and, Cluster 4 'Soil contamination' ('Soil'). Abreviatted designations of the clusters will be used to facilitate its identification in the following sections.

The most co-cited publications allow us to conclude that individuals are responsible for this new generation of gardens, mostly through individual initiatives, including informal and formal collective action dynamics, as show by the 'Citizens' cluster. Another important literature strand focuses on the drivers, including motivations, benefits and purposes, getting individuals to engage with the urban gardens ('Drivers'). A third strand refers to the city's level of analysis of urban gardens, including the sustainability of urban ecosystems and biodiversity ('Cities). Finally, a fourth cluster ('Soil') represents the sustainability problems of urban gardens, that derive from their being often situated in vacant land that is only available because the soil had previously been used for industrial purposes and became contaminated. Studies about healthy lifestyles ('Citizens') also relate to the benefits of urban gardening ('Drivers'), and those about forms of participation in urban planning ('Citizens') give more solidity to people's contributions to sustainable development and boost green and sustainable cities ('Cities'). The intersection of these clusters confirms how urban gardens contribute to the development of the TBL sustainability paradigm, and the protagonism of the citizens - the "people" - in these processes.

Cluster 1 "People, lifestyle and sense of community" ('Citizens') brings together 15 publications (around 30% of retrieved publications) on urban gardens and their connection to citizens and their engagement in sustainable farming and food systems associated with sustainable lifestyles; they emphasize the social dimension of sustainability (e.g. Ferris, Norman & Sempik, 2001a; Saldivar-Tanaka & Krasny, 2004) and focus on their contribution to local sustainability (Holland, 2011; Saldivar-Tanaka & Krasny, 2004; Wakefield et al., 2007). This cluster also includes publications on citizens' concerns over land tenure, including issues on how they can maintain ownership of the land where they grow their urban gardens and for how long (e.g. Staeheli et al., 2003).

Thus, this cluster ('Citizens') offers evidence that the new generation of urban gardens is triggered by the need for a bottom-up citizenship action felt by individuals who wanted to be part of a sustainable system in the TBL sense. The drivers of this action encompass concerns over individual well-being, but also environmental sustainability of lifestyles, that is, lifestyles that respond to society needs (a social pillar of the sustainability) while respecting the environmental balance. The 'Citizens' cluster is clearly posited closer to the social pillar of SD and somehow distanced from the economic pillar, as noted by Schmelzkopf (2013) who claims the well-being that a green space brings is immeasurable, which leads individuals to bend towards the environment pillar.

The 'Citizens' cluster includes studies focusing on the issue of individual participation, in which urban gardens stand out as a way of engaging individuals in citizenship and endowing them with the sense of belonging to the community (Kurtz, 2013; Saldivar-Tanaka & Krasny, 2004). That is likely why urban gardens are often called community gardens: as a way of expressing the dimension of informal collective action involved in the individual initiative. Hence, this cluster of publications ('Citizens') emphasizes the contemporary movement of implementing urban garden projects to help people and places move towards new ways of participation in sustainable development (Pudup, 2008). Some studies within this cluster go further and associate urban gardens with existing wastelands, envisaging urban spaces as communities, by engaging people to be together (Eizenberg, 2012) for the sake

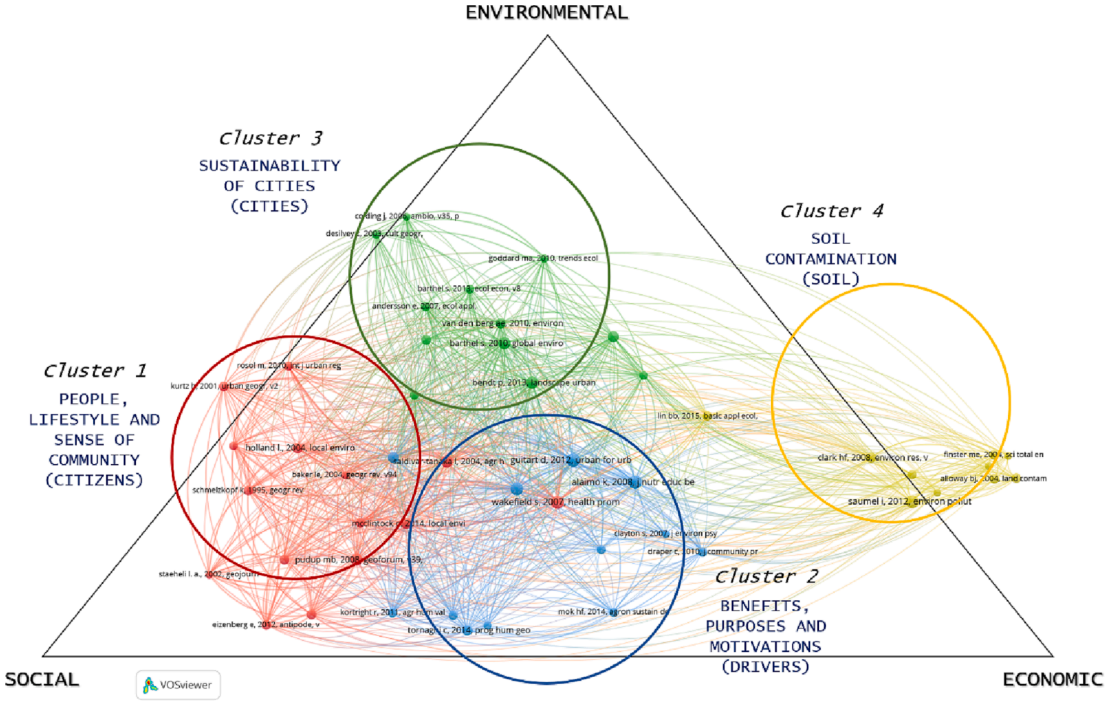

Fig. 5. Most co-cited publication clusters posited into the TBL SD development pyramid.

of the idea of community belonging (Firth et al., 2011).

The designation chosen for this cluster of publications "People, lifestyle and sense of community" summarizes its content, indicating a strand of literature focused on why and how urban gardens help individuals exert their citizenship in urban areas; this is done through the adoption of sustainable lifestyles and eating patterns, and by acknowledging the sense of community as an important dimension of urban lifestyle. The 'Citizens' cluster is about people, their well-being and their active participation in the community, society and the environment. How does it fit into the TBL SD framework? By showing individuals', 'common people's', importance in setting urban SD in motion, i.e., how they act as key actors to strength the bonds between the social and the environmental pillar of SD in cities and other urban areas. Individuals lead sustainability dynamics by cultivating urban gardens, driven by their environmental safeguard motivations (Ferris et al., 2001a; Holland, 2011; Kurtz and Kurtz, 2013; Rosol, 2012).

Authors captured by the 'Citizens' cluster claim urban gardens represent a strategy to regenerate local food systems and to provide access to healthy food; simultaneously, they are a social dynamic driven by achieving an healthier lifestyle, healthier eating habits, in addition to other benefits manifested in various papers (Wakefield et al., 2007). For instances, Holland (2011) points out that the sense of community that is created is grounded on social and environmental pillars, assigning density to sustainability dynamics led by the individuals. Baker (2004) emphasizes the creation of urban gardens as bottom-up social movements that could act as a model for the implementation of social, economic and environmental policies at the local level. The author gives examples of how people play an important role in transforming urban spaces and how healthy food plays a key role in those processes "*By digging into their small plot of land, gardeners are challenging conventional ideas of urban planning and design, working on community-development projects, engaging with place-based social movements, and creating alternative food systems*" (Baker, 2004, p. 306). These are inorganic movements of people, motivated by a healthier lifestyle, that look for alternative ways to exert their citizenship. We can, therefore, conclude that urban gardens are synonymous with sustainable food systems and opposite to the dominant agro-food industrial system (Mcclintock, 2014).

Most of the studies in the 'Citizens' cluster explores the social dimension of some already implemented sustainable development policies and, for this reason, this cluster of people and community is so close to the social aspects of sustainability, connecting education, health, community development and food with the use of green spaces in the city. That is why its closeness to the 'Cities'Cluster is not suprising, given that the relationship between the role of citizens and the transformation of cities tends to be strong. Rosol (2012) argues that changes in citizens' participation in the governance of contemporary green spaces is very important. Holland (2011) pinpoints the sense of community participation and empowerment as the links among the examples of community gardens. Kurtz (2013) points out the systemic character of urban gardens, acting as actor-networks, creating and reinforcing ties between individuals, and between them and the nature and also with the community.

Cluster 2, 'Benefits, motivations and purposes of the gardens' ('Drivers'), groups 12 studies that focus on drivers leading inviduals to engage in urban gardens. These studies identify a second strand of literature on urban gardens that identifies, typifies and discuss the motivations, purposes and/or the benefits of urban gardens. These motivations are manifold, including food security (e.g. Mok et al., 2014), citizens' will to eat healthier and more nutritious food (e.g. Alaimo et al., 2008),

The 'Drivers' cluster is at the centre of the TBL SD pyramid but closer to the axe linking the social and economic dimensions. Such a position is not extraneous to the growing awareness of issues like the quality and cost of food, and of food insecurity in some contexts, which raises the interest in growing food locally in the cities, while acknowledging its impact on sustainability (Clayton, 2007; Draper & Freedman, 2010). Actually, the multitude of motivations presented in the studies captured by this Cluster comprise the three vertices of the sustainability pyramid (Djokić et al., 2018; Gregory, 2015; Ruggeri et al., 2016; SpilKová, 2017).

Armstrong (2000) identifies several benefits that can result from urban gardens cultivation, such as having fresh food, a taste for nature and health benefits, breaking down social barriers and reducing crime. Moreover, the publications near the intersection of this cluster with the 'Citizens' cluster highlight the notion that these benefits are also visible even for those who do not grow the urban gardens (Alaimo et al., 2008). Hence, urban gardens enhance partnering with sustainable urban development and sustainable lifestyles and growing concerns about food security and environmental education (Alaimo et al., 2008; Clayton, 2007; Lawson, 2005). There are other issues, namely nutritional issues, but they cannot be very measured and, therefore, used as a basis for benefits (Guitart et al., 2012).

Urban gardens have a multidimensional importance to Draper et al. (2010), encompassing benefits like food security, health promotion and well-being (Berg et al., 2010; Nordh et al., 2016), and focusing on environmental as well as pedagogical and aesthetic aspects (Carlsson et al., 2016; Lindemann-matthies & Brieger, 2016; Truong et al., 2016).

Understanding the motivations and purposes of these 'gardeners' can better inform attempts to promote farming practices in more sustainable cities (Clayton, 2007). Thus, what differentiates traditional urban gardens (before the 1970s) from the current generation of urban gardens is actually their purpose and meaning. Urban gardens strengthen sustainable urban development and sustainable lifestyles leveraged by growing concerns about food security and environmental education (Lawson, 2005). 'Gardeners' are keen on feeding themselves with more tasteful, healthy and nutritious food while contributing to environmental sustainability. As a result, and paraphrasing Howes et al. (2017), due to the inability of policies to eradicate poverty, ensuring the nutritional quality of food and growing concerns about the sustainable development of cities, agricultural activity in the urban environment is reborn through a new generation of urban gardens in a bottom-up individual action (Howes et al., 2017). Some of the studies comprised by the "Drivers" cluster go a little further into the economic dimension of the urban gardens and try to understand whether cities can be mostly self-reliant in food grown by the citizens themselves (Grewal & Grewal, 2012).

Cluster 3, 'Sustainability of cities' ('Cities'), brings together 12 publications which are closer to the environmental vertex of the TBL SD pyramid. It groups studies focusing on urban gardens from the perspective of the cities (Barthel et al., 2013; Colding & Barthel, 2013), although reinforcing the role of individuals (Berg et al., 2010; Bendt et al., 2013) ('Citizens') driven by individual and community sustainability concerns (Drivers') (Andersson, 2007; Okvat et al., 2011). People have initiatives and are motivated by the perception of the benefits of urban gardens for food and health, well-being and living, which reveals itself in its fullness in their cities livelihood (Bendt et al., 2013). The publications in the 'Cities' cluster include research on the usefulness of the public area, on how urban gardens are addressed by urban planning, besides discussions about whether and how links between cities and urban gardens can have long term engagement revealing the citizens' resilience (Barthel, 2013; Barthel et al., 2010; De Silvey, 2003).

The 'Cities' cluster includes also a substantial number of publications motivated by the urbanization threaths to urban ecosystems and biodiversity. As urbanization grows globally, city ecosystems become excessively fragmented raising concerns about safeguarding biodiversity and the awareness of green space scarcity (Barthel et al., 2010; Goddard et al., 2009). The authors voicing these concerns argue that urban gardens can offer a solution to strengthening the sustainability of urban landscapes by supplying an important range of ecosystem services (Cabral & Weiland, 2016; Colding & Barthel, 2013).

This cluster also contains studies related to land ownership and citizens' right to space and how these "rights" pose a threat to real estate

projects (Colding & Barthel, 2013). In fact, although urban agriculture is a growing issue and acknowledged as playing an important role in urban planning and urban ecosystems' sustainability (Domene & Saurí, 2007; Goddard et al., 2009), there is a huge pressure coming from those who advocate the right to housing space, urban infrastructures and equipments, and alternative green spaces. The authors' represented in the 'Cities' cluster (Andersson, 2007; Barthel et al., 2010; Barthel et al., 2013; Colding and Barthel, 2013) argue that the solution may be in how one looks at these urban gardens, no longer as a marginal phenomena but as one that is institutionally appraised and managed.

Urban gardens are recommended by some of the authors (e.g. Bendt et al., 2013; Langemeyer et al., 2018) as key pieces on urban planning for sustainability. The publications in this cluster also discuss how sustainability in cities supports the idea that urban planners should create possibilities to protect urban spaces for local creativity rather than designing final solutions for urban environments (Bendt et al., 2013). Through urban gardens, citizens create alternatives to traditional parks and green spaces, which value urban space and enhance urban citizenship (Domene & Saurí, 2007).

In addition to the emphasis given to public health that urban gardens bring to cities (Berg et al., 2010, 2015), authors such as Lee et al. (2018) show that in Canada, South Korea and Australia, urban gardens are included in urban architecture plans and inserted into school curricula early for full environmental education. However, in many geographies, the lack of framing for urban gardens in municipal master plans and other territorial management instruments means that each urban garden has to negotiate its existence in two directions: On the one hand, to be included in territorial management instruments, urban gardens have to be legally taken seriously as an integral part of effective city planning; and, on the other hand, to make that possible, urban gardens have to be cherished and acknowledged by citizens and institutions to be able to cope with competitive urban land uses (Bendt et al., 2013).

Urban gardens highlight the contradictions of local public policies, wavering between a general attitude towards its elimination of the urban landscape if not planned, and its promotion in the context of sustainability initiatives to make cities greener (Domene & Saurí, 2007). Although the main motivation of 'urban gardeners' is not redesigning the city planning, through their action they shape greener cities and enhances urban ecosystems' sustainability (Barthel et al., 2015; Colding and Barthel, 2013).

Cluster 4,'Soil contamination' ('Soil'), aggregates 10 publications on soil contamination, a negative aspect of urban gardens that cannot be neglected. The manual screening conducted to exclude the publications outside the scope of this paper, left out publications related to contamination, chemicals and fertilizers. However, this strand of literature became important, on a second stage, when the selection was made following the co-citation criterion. Hence, it matters to understand why urban gardens tend to be installed on contaminated land and how that might reduce their contribution to SD.

Publications in the intersection of 'Soil' cluster with others highlight the issue of land dispute surrounding the establishment of some urban gardens (Säumel et al., 2012). Why are urban gardens often installed in contaminated land? First of all, land is scarce and much disputed in cities and urban conurbations, as shown by the evidence discussed in the previous cluster ('Cities'). Secondly, urban gardens are not yet acnowldged by urban planning public policies in most of the cities and countries as a component of the cities' designed green infrastructure, as aleady discussed in the literature strand of 'Cities' cluster. The fact they are mainly a consequence of the bottom-up citizens' action (see 'Citizens' Cluster) makes its institutional acknowledgment difficult, and consequently, the actions and funding required for soil decontamination (Jean-Soro et al., 2015). The cluster 'Soil' proves that urban gardens are still neglected by urban planning policies (Lin, 2015). The publications in this cluster show urban gardens' weaknesses respecting SD enhancement. The cultivation of contaminated soils might pose serious threats to human health, as is highlighted by a substantial number of studies within this cluster (Amato-Lourenco et al., 2017; Ashworth & Alloway, 2004; Hausladen & Brabander, 2008; Säumel et al., 2012).

Overestimating the benefits of urban gardens without taking into account its weaknesses and risks is dangerous, because that could end up marginalizing them, particularly in developed countries. For urban gardens to succeed, citizen bottom-up initiatives must be fully assumed as a whole in the sustainable pyramid, with its strengths and weaknesses. A balance of urban and rural agricultural production could be a city goal (Mok et al., 2014). To achieve that balance, however, urban gardens need to be taken seriously by urban public policies. For instances, in the Nantes (France) case study, presented in Jean-Soro et al. (2015), these risks were taken seriously by the municipality.

5. Concluding remarks

There is a growing consensus that urban gardens, triggered by individuals themselves, play an important social role that can be positively linked to sustainable urban policies (Ferris et al., 2001a; Ferris et al., 2001b) and contributes to the environmental sustainability of cities and to their participated development as sustainable urban communities Although this consensus is limited to a developed country context, as Global South is not included in the evidence gathered.

The TBL framework, applied to the clusters defined by the bibliometric analysis, underlines the role urban gardens play in strengthening the social-environmental interface of urban SD, underlining that nurturing individual dynamics through the promotion of urban gardens could indeed be a relevant municipal or urban policy directed towards SD. As the literature review presented in this paper shows there is a strong interrelation between urban gardens, urban policies, and sustainable development; urban gardens are, in fact, an instrument that can leverage societal changes towards SD in the TBL sense. Reinforcing its contribution depends on institutional acknowledgment and political engagement.

A more detailed overview of the published research can be provided through a digression across the four clusters of publications. 'Citizens' cluster provides evidence of how citizens put into practice sustainable development through urban gardens that emerge as an important tool to raise individuals' awareness of environmental, social and economic sustainability issues. The importance given to urban gardens in city planning, which often raises debates around urban vacant land property rights, as shown in the studies within the 'Cities' cluster, reinforces their role as an instrument to promote urban SD with a TBL approach. The literature review, and in particular the 'Drivers' ('Drivers' cluster) behind individuals' engagement in urban gardens initiatives, confirms the hypothesis put forward in this paper that the new generation of urban gardens is driven by sustainability-related motivations. However, for a major impact on the sustainable development paradigm they would also need to raise awareness of the economic side. A large number of case studies seem to be able to show this type of initiative (individual and collective) can, nevertheless, change some paradigms at the economic level.

At the same time, as urbanization grows globally, urban ecosystems become excessively fragmented raising concerns about the safeguarding of biodiversity, the supply of ecosystem services and the awareness of green space scarcity (Barthel et al., 2010; Goddard et al., 2009). The role of urban gardens in creating convergence between citizens' actions and city planners' design regarding urban SD is emphasized by some of the studies, which allows one to conclude urban gardens are not the antithesis of the city; on the contrary, they integrate urban dynamics and contribute to cities' self-sufficiency. Designing a future in which the urban grow green reinforces the need to renew urban minds about the direct relationship between citizens and life support systems (Bendt, Barthel & Colding, 2013). All the case studies show the importance of integrating bottom-up practices in urban planning (Ferris et al., 2001a; Ferris et al., 2001b; Rosol, 2012; Mcclintock, 2014). Urban gardens could be an appropriate tool to recover abandoned spaces through the

involvement of local governments and urban planners (Mcclintock, 2010).

Sumarizing, the literature review offered by the present paper highlights three major concluding remarks. Firstly, in present times, urban gardens are an effective new form of gardening, they are worth it for the benefits they bring, not for their size. Most of publications are from developed countries where well-known cities are located. Secondly, despite the plurality of publications found in the review, the case study approach still prevails, offering empirical evidence at the local scale, but lacking in comparative studies and failing to provide global analysis. Thirdly, the literature review evidenced relevant gaps in urban planning and urban development public policies, and the absence of a legal framework to adopt urban gardens as 'serious' instrument to promote urban SD. This situation reveals the limited importance assigned by urban planners and local politicians to urban gardens, which somehow contradicts a generalised idea of urban gardens being very popular. There might be substantial evidence on why and how urban gardens develop and evolve, but most likely it hasn't reached the awareness of the general public thus far, which is essential if public policies are to be developed at a more global level.

The main gap this study enabled to find was the aforementioned lack of public policies to implement and monitor urban gardens. Other relevant gap that have been uncovered by the review is the scarcity of comparative case studies and the lack of research aiming at providing an overview of urban gardens at broader scales, allowing for the identification of diversity and similarity patterns and dynamics across different geographical and socio-political contexts. The prevalence of single case study approaches makes it difficult to establish a favorable ground for public policies that take urban gardens into account, and probably explains the insufficient recognition of this type of urban agriculture by the mainstream urban planning pointed out by some of the referential authors with respect to the available research on urban gardens (e.g. Pudup, 2008).

For future research, it would be important to to fulfill the lack of studies in the global south. If there are examples of urban gardens resulting from the collective action of citizens, what does the lack of research and case studies on urban gardens mean? Does it mean it is a reality in developed countries and that the global south has not yet recognized them as sustainability-driven, still being in an earlier generation of urban gardens? These bibliometric analyses confirm the scarcity of studies and trigger the urgency of disseminating this knowledge to the global south so that studies like this can demonstrate a more diversified and wholesome reality.

Another opportunity for future research is to develop a framework allowing to comparatively assess urban garden initiatives encompassing the diversity of situations regarding its initiators, its integration (or not) in the city planning, the role of collective action in their governance and management, and land tenure-related issues. This framework would be useful to qualitatively assess urban gardens' contribution to the SDG goals according to their different conception and implementation, namely concerning the role of local public policies in facilitating and integrating them in municipal or city master plans and other urban policy tools. It would help design innovative municipal or city scale policies integrating urban gardens in a holistic concept of urban green infrastructures conveying multifunctional spaces and multidimensional wellbeing, including the supply of health, food, recreation and leisure, ecological services, and intangible benefits such as identity, sense of place and citizens' freedom of action.

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Data availability

Data will be made available on request.

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