34 | 2

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Main problems in urban agriculture and leverage points

Principales problemas de la agricultura urbana y puntos de apalancamiento

Principais problemas da agricultura urbana e pontos de alavancagem

Principaux problèmes de l'agriculture urbaine et points de levier

Fuente: Autoría propia

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Abstract

In order to identify the main problems of urban agriculture as well as some actions necessary to lead it towards sustainability, a bibliographic review was carried out with quantitative and qualitative methods, taking as a reference the theoretical methodological framework of leverage points. The results show that the main deficiencies in urban agriculture are related to inadequate management practices, a lack of organization, and absent or inefficient public policies. The leverage points with the greatest potential for change would be agroecology as a management system, designing policies for access to land and sustainable financing, and promoting dissemination processes. As documented, there are significant, although isolated, investigative advances in matters related to materials, practices, and processes. It is still necessary to delve into levers related to design and intentions. This bibliographic approach can be useful to reflect on and plan future interventions that seek to improve the conditions of agriculture in multiple urban contexts. Ongoing dialogue and collaborative work between all the key actors in this issue are crucial for strengthening its transition towards sustainability.

Keywords: agroecology, city, civil society, horticulture, sustainability.

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Resumen

Con el fin de identificar los principales problemas de la agricultura urbana, así como distinguir algunas acciones necesarias para encaminarla hacia la sostenibilidad, se realizó una revisión bibliográfica con métodos cuantitativos y cualitativos, tomando como referencia el marco teórico metodológico de los puntos de apalancamiento. Los resultados muestran que las principales deficiencias de la agricultura urbana están relacionadas con prácticas de gestión inadecuadas, falta de organización y políticas públicas ausentes o ineficientes. Por otro lado, los puntos de apalancamiento con mayor potencial de cambio serían la agroecología como sistema de gestión, el diseño de políticas de acceso a la tierra y al financiamiento sostenible, y la promoción de procesos de difusión. Según está documentado, existen importantes avances investigativos, aunque aislados, en cuestiones relacionadas con materiales, prácticas y procesos. Aún es necesario profundizar en palancas relacionadas con el diseño y las intenciones. Este enfoque bibliográfico puede ser útil para reflexionar y planificar futuras intervenciones que busquen mejorar las condiciones de la agricultura en múltiples contextos urbanos. El diálogo permanente y el trabajo colaborativo entre todos los actores clave de este fenómeno son cruciales para fortalecer su transición hacia la sostenibilidad.

Palabras clave: agroecología, ciudad, sociedad civil, horticultura, sostenibilidad.

Abstrait

Afin d'identifier les principaux problèmes de l'agriculture urbaine ainsi que de distinguer certaines actions nécessaires pour la conduire vers la durabilité, une revue bibliographique a été réalisée avec des méthodes quantitatives et qualitatives, en prenant comme référence le cadre méthodologique théorique des points leviers. Les résultats montrent que les principales déficiences de l'agriculture urbaine sont liées à des pratiques de gestion inadéquates, à un manque d'organisation et à des politiques publiques absentes ou inefficaces. D'un autre côté, les leviers ayant le plus grand potentiel de changement seraient l'agroécologie en tant que système de gestion, la conception de politiques d'accès à la terre et de financement durable, et la promotion de processus de diffusion. Comme cela a été documenté, d'importantes avancées en matière d'enquête, bien que isolées, ont été réalisées sur des questions liées aux matériaux, aux pratiques et aux processus. Encore faut-il se pencher sur les leviers liés au design et aux intentions. Cette approche bibliographique peut être utile pour réfléchir et planifier de futures interventions visant à améliorer les conditions de l'agriculture dans de multiples contextes urbains. Un dialogue permanent et un travail collaboratif entre tous les acteurs clés de ce phénomène sont cruciaux pour renforcer sa transition vers la durabilité.

Resumo

Para identificar os principais problemas da agricultura urbana, bem como distinguir algumas ações necessárias para conduzi-la à sustentabilidade, foi realizada uma revisão bibliográfica com métodos quantitativos e qualitativos, tomando como referência o referencial teórico metodológico dos pontos de alavancagem. Os resultados mostram que as principais deficiências da agricultura urbana estão relacionadas a práticas de gestão inadequadas, falta de organização e políticas públicas ausentes ou ineficientes. Por outro lado, os pontos de alavancagem com maior potencial de mudança seriam a agroecologia como sistema de gestão, desenhando políticas de acesso à terra e financiamento sustentável e promovendo processos de disseminação. Conforme documentado, há importantes avanços investigativos, ainda que isolados, em questões relacionadas a materiais, práticas e processos. Ainda é necessário aprofundar-se nas alavancas relacionadas ao design e às intenções. Esta abordagem bibliográfica pode ser útil para refletir e planear futuras intervenções que procurem melhorar as condições da agricultura em múltiplos contextos urbanos. O diálogo permanente e o trabalho colaborativo entre todos os principais intervenientes neste fenómeno são cruciais para fortalecer a sua transição para a sustentabilidade.

Palavras-chave: agroecologia, cidade, sociedade civil, horticultura, sustentabilidade.

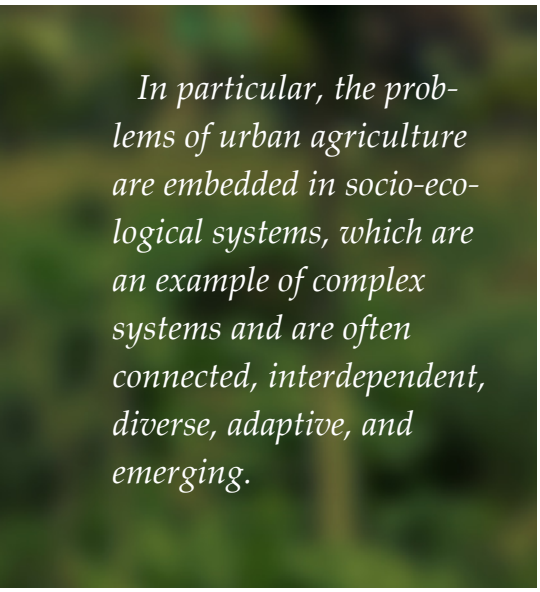
34 (2)

Main problems in urban agriculture and leverage points

Mots clés: agroécologie, ville, société civile, horticole, durabilité.

Introduction

Current socio-ecological problems cannot be addressed in their entirety through traditional methods. In the present day, a combination of holistic approaches is required to understand the dynamic nature of cities and act efficiently. In this regard, the paradigm of complex systems is one of the most useful theoretical–methodological tools, with a great potential for use in modern times. The theory of complex systems is a scientific approach that aims to understand the interactions of the components of a given system without seeking a radical reduction of its parts. This method provides epistemological approaches and methodological tools for addressing interdisciplinary problems, which are part of the sustainability sciences. In particular, the problems of urban agriculture are embedded in socio-ecological systems, which are an example of complex systems and are often connected, interdependent, diverse, adaptive, and emerging.



In the field of complexity sciences, a large number of methodological tools have been developed to study socio-ecological problems and offer sustainable approaches. An example is the multiscale variational methodology designed to understand the linkage between spatial and temporal structural changes, as well as critical phenomena occurring in complex systems. The analysis of complex networks is another applied methodology that is being used to understand the structure and configuration of systems and develop scalable solutions by intervening at key nodes. Fuzzy cognitive maps, a powerful machinery for modeling dynamical systems and linking interconnected concepts where these connections reflect causal relationships have also been widely used. The Cynefin framework is a heuristic tool that models how people perceive and make sense of situations to make decisions in the management of complex projects. In the same line, the Compram method has been used, which is based on the idea that complex problems must be handled cooperatively and must be guided by a facilitator, taking into account three essential elements: knowledge, power, and emotions.

However, the methodological framework of leverage points is perhaps one of the most important tools in complexity sciences that may be used to seek systemic changes towards sustainability. In particular, it can guide actions on key aspects that can have a multiplicative and beneficial effect on the system of interest, in order to avoid linear or isolated efforts (Meadows, 1999). In this case, the categories proposed by Fischer and Riechers (2019) were taken into account. These authors conceive that every socio-ecological system presents four levers, which they call materials, processes, designs, and intentions. In the field of urban agriculture, the first lever has been adapted as materials and practices, to refer to inputs (soil, fertilizer, water, seeds, etc.) and management techniques at the agroecosystem level. The processes are the result of the interactions and experience of people who practice urban agriculture with each other and with cultivated spaces. Designs in this context are institutional structures with political interference and the ability to manage processes, practices, and materials in the system. The intentions refer to the paradigms and value systems that define and transversally permeate the configuration of urban agriculture.

The categories of leverage carry a logical order, but their conceptions can be adapted to the system of interest, in this case to the system of urban agriculture in urban territory. In any case, these levers are organized hierarchically according to the potential of speed and depth to generate changes within the system where they are employed. Therefore, leverage points are an ideal instrument that seeks, from a transdisciplinary perspective, to plan and strategically carry out actions that improve the state of socio-ecological systems. Fundamentally, the leverage points framework is a comprehensive response to current unsustainability issues, which require durable solutions that take into account tangible and intangible aspects at multiple scales (Riechers *et al.,* 2022).

This tool has already been used to develop systemic interventions in multiple urban settings, in order to work transformations, promote transitions, and build sustainable and resilient cities. In general, it has been observed that most interventions aimed at improving agrifood systems focus on superficial actions involving materials, practices, and processes that do not achieve significant changes. In related problems of this sector, studies that use leverage to address the dysfunctionality of agricultural landscapes and food insecurity have been documented, with clear guidance for decision makers. In this case, we focus on interventions related to urban agriculture, a socio-ecological system that has deep links to urban sustainability, especially since urban agriculture has historically been plagued by a number of multidimensional problems that put its sustainability and associated benefits at risk.

At this point, it is important to define the concept of urban agriculture. According to the Food and Agriculture Organization (FAO, 2022), urban agriculture is the practice of raising livestock and growing crops within and around cities. Urban agriculture can include horticulture, aquaculture, animal husbandry, greenhouses, rooftop farming, and hydroponics. Some conceptualizations generalize and others divide it according to its intra-urban and peri-urban location. They also distinguish between production of food or non-food items (e.g., ornamental plants). This phenomenon could include various scales and be limited to food production and/or processing, distribution, and marketing. Urban agriculture inclusion is heterogeneous in terms of its actors, communities, methods, places, policies, institutions, systems, ecologies and economies, largely using and regenerating local resources to meet the changing needs of local populations while serving multiple goals and functions. Therefore, these practices can be understood in different ways in the Global North or South; their conceptions can even present multiple nuances within the same territory.

In this study, a quantitative and qualitative literature review was carried out to provide an overview of the scientific literature that refers directly or indirectly to the framework of leverage points in the field of urban agriculture. The objective was to understand the frequent problems that have been addressed and the levers that have been pressed to achieve systemic changes towards sustainability of city gardens. This was undertaken with the intention of learning about trends in this area, as well as to explore and reflect on the potential of these points of influence in future interventions.

Methods

A bibliographic review is a method of documentary research that consists of carrying out a critical evaluation of the literature on a specific topic and learning the state of the art in terms of research. The intention is to track the information published on a topic of interest and propose an organization of that material according to a specific point of view. Generally, reviews of scientific literature include discrete steps such as topic delimitation, data collection, information analysis, and visualization of results. In this case, the theme was urban agriculture, its frequent problems, and the actions needed to lead it towards sustainability. The bibliographic review took as a reference the theoretical methodological framework of leverage points.

The bibliographic data were obtained systematically through Dimensions, a global database that is part of Digital Science & Research Solutions. The specialized search was performed using the following keyword combinations with Boolean operators: “leverage point AND urban agriculture,” “leveraging AND community garden,” and “leveraging AND urban garden.” It should be noted that the search using English keywords was prioritized, because when it was done in other languages, no relevant results were obtained. Scientific articles, book chapters, and conference proceedings published between 2000 and 2023 were chosen. In particular, conference proceedings were not excluded because they treated interesting problems and levers.

The analysis of the selected texts was carried out manually to identify the cities and countries where the studies were conducted. In addition, a set of bibliometric data offered by Dimensions was taken into account, specifically on the affiliations of the authors, to enable analyses of geospatial collaboration networks. Subsequently, the texts were read carefully to identify frequent problems of urban agriculture and the actions suggested through the lens of leverage points. The quantitative review was complemented by a focused qualitative review to provide

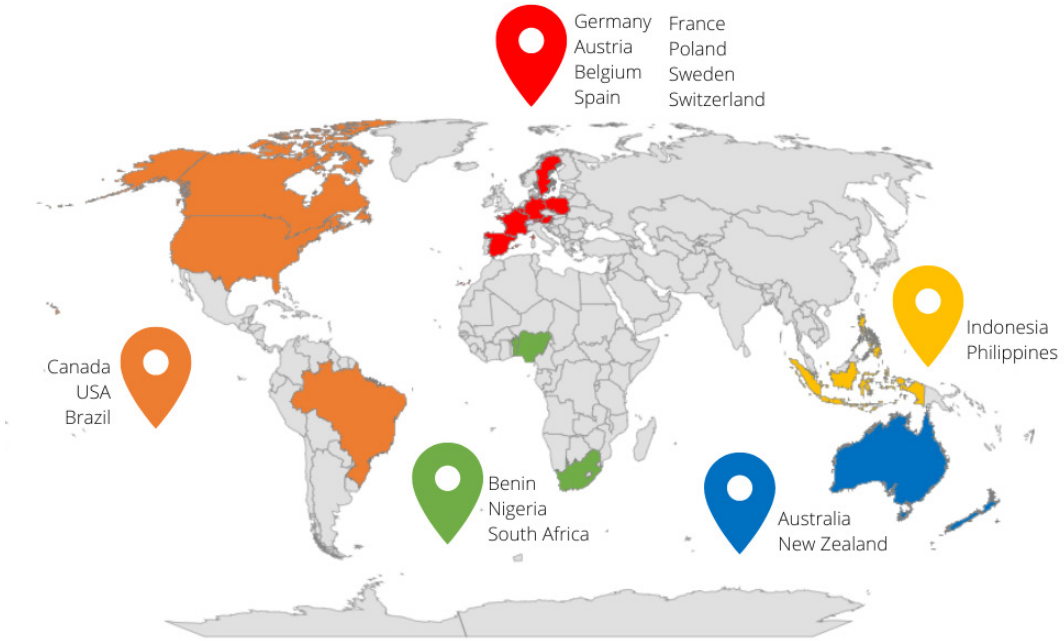


Figure 1. Geographical distribution of the study areas of the reviewed studies

Source: The authors.

feedback to a discussion of the results. The main findings were tabulated and plotted using the tools Microsoft Excel (2019), Atlas.ti (v.8), Canva (v. 2.5) and SankeyMATIC (2014).

Results and discussion

Bibliometric aspects of the review

The initial specialized search yielded a total of 42 texts. However, after systematically excluding those not related to urban agriculture, as well as duplicate and missing data, a total of 21 texts were obtained. The 21 studies reviewed were published between 2011 and 2022; however, 15 of them were published from 2018 onward, with 2022 being the year in which the most studies (6) are registered. This shows a growing interest in recent years to develop research processes in the field of leverage of urban agriculture. These research works were carried out or had as an area of study 18 countries distributed on all continents, with representation from the global North and South (Figure 1).

These results are consistent with recent reviews on urban agriculture, in which Europe and North America account for the largest number of studies. It is important to take into account the evident bias of the predominant language in the scientific literature and with which searches are generally made. In addition, it is important to emphasize that the leverage point paradigm emerged in the Global North, and its applications in the global South are just beginning to manifest themselves.

In this case, there were articles that addressed the topic on a global scale (Barthel *et al*., 2019), a study that involved seven European countries (Cundy *et al*., 2016), and works that involve at least one city each from two different countries (McCann *et al*., 2022; Plevyak, 2022). The rest of the texts referred to one or more cities in the same country. The United States accounted for the largest number of studies, with 10 articles, of which one was nationwide and the other nine related to 14 cities in that country. Canada was represented with a study on the national scale (Summer, 2018) and another on a local scale in the coastal city of Vancouver in British Columbia (McCann *et al*., 2022). The Republic of Benin had a study for the cities of Cotonou and Porto-Novo (Houessou *et al*., 2019). From a systemic perspective, it is important to consider the geographical dimension of urban agriculture, since its biophysical, sociocultural, political, and economic causes manifest themselves at different scales of space and time.

The co-authorships of the reviewed research on urban agriculture and leverage show a network made up of five clusters (Figure 2). The first is made up of 16 universities in the United States, where the largest number of studies on the subject of interest are concentrated. Some of these investigations were individual (Kelley, 2011; Magalhães, 2021; Plevyak, 2022), others were authored by groups associated with a single university (Taylor and Lovel, 2012; Self *et al*., 2012; Orta *et al*., 2021; Adebiyi and Olabisi, 2022) and a large number were of inter-institutional authorship (Blum-Kemelor *et al*., 2012; Freedman *et al*., 2022; Larson *et al*., 2022). None of these studies were conducted in tandem with any institution outside the United States, but some studies were carried out in other countries; Nigeria and Brazil (Adebiyi and Olabisi, 2022; Magalhães, 2021).

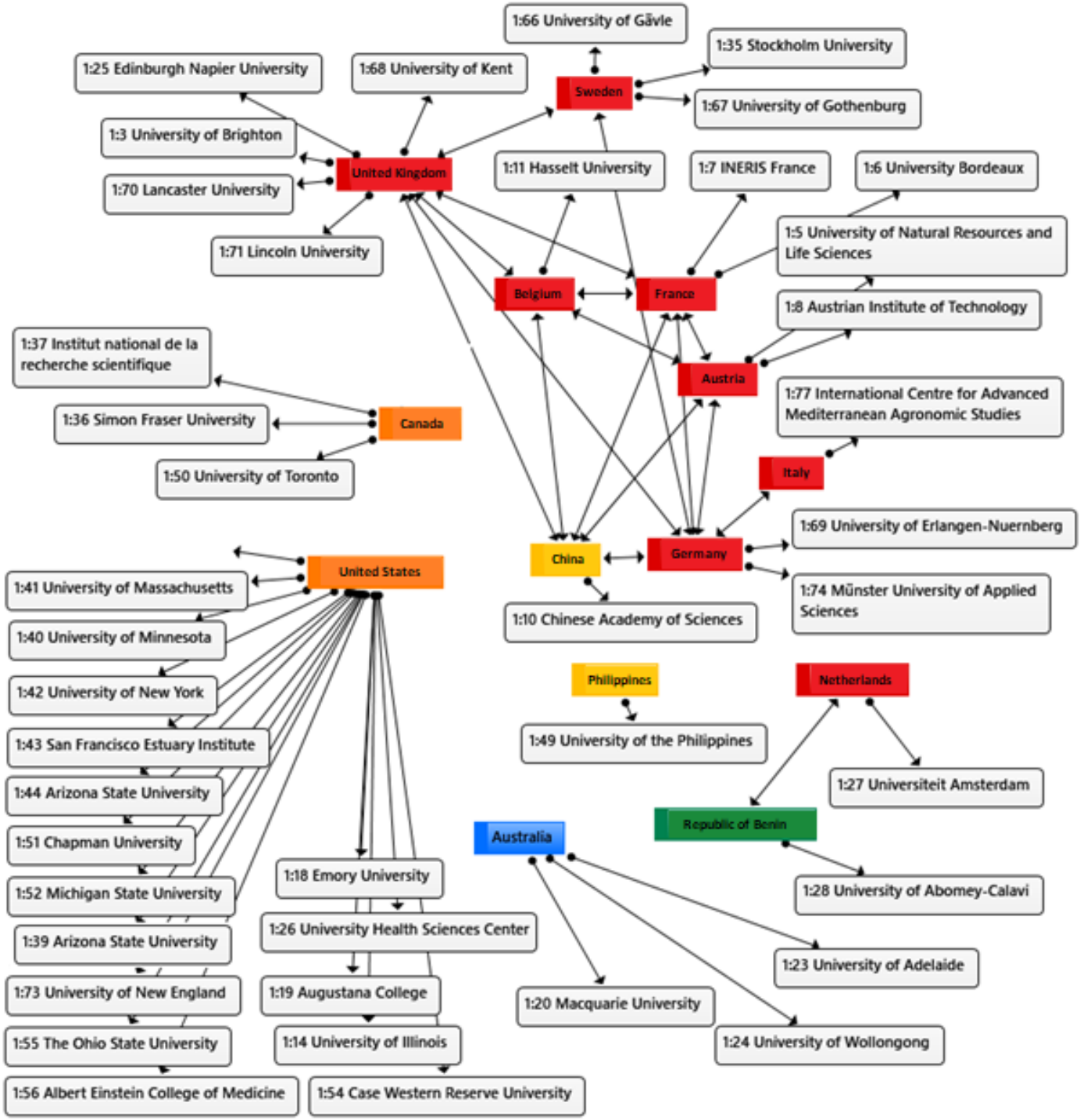


Figure 2. Clusters of collaboration arising from the affiliations of the authors of the reviewed texts. Note: Colors represent continents as in Figure 1. The numbers inside the boxes have no informative function, they are only the order in which the institutions were coded.

Source: The authors.

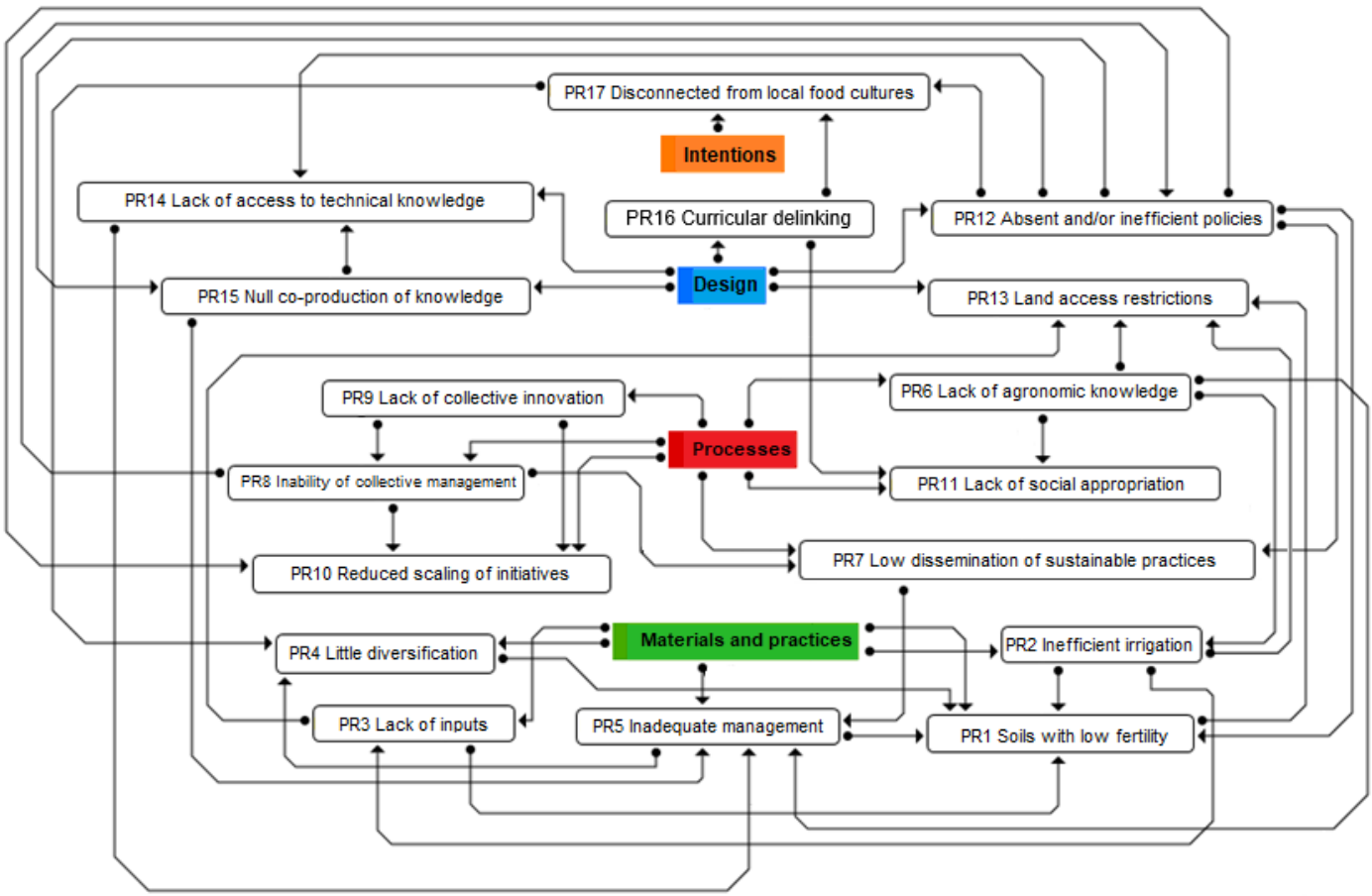


Figure 3. Systemic representation of common problems in urban agriculture
Source: The authors.

The second cluster is structured from 17 different affiliations, linked in particular by seven European countries (Germany, Austria, Belgium, France, Italy, United Kingdom, Sweden) and one Asian country (China) (Cundy *et al.*, 2016; Goodness, 2018; Rich *et al.*, 2018; Barthel *et al.*, 2019; Wittenberg *et al.*, 2022). This network has 16 interactions between its nodes, making it the network with the highest degree of nesting; in this case, Germany (6), the United Kingdom (5) and China (5) have the largest number of links.

The third cluster is composed of collaborative work between Europe and Africa, with the participation of authors from the University of Amsterdam (Netherlands) and the University of Abomey-Calavi (Republic of Benin) (Houessou *et al.*, 2019). The fourth and final cluster is given by isolated studies by authors from institutions in Canada (Summer, 2018; McCann *et al.*, 2022), Australia (Nguyen *et al.*, 2020), and the Philippines (Zamora *et al.*, 2013). At this point, it is important to note that seven of the studies included people with affiliations to and associations with heterogeneous fields of knowledge, which is crucial to address the multidimensionality of urban agriculture problems.

Main problems in urban agriculture

Urban agriculture initiatives and projects are not exempt from multifactorial problems that shape their optimal growth and development. Generally, the main drawbacks are associated with the biogeographic area in which the city is inserted; that is, its elevation, climate, rainfall, and soil quality. These environmental aspects determine the suitability of the area for the establishment of agriculture, or the type of crops that can thrive under the dynamics of such conditions in cities. The accelerated and disorganized growth of urban sprawl transforms the territory into a metropolis with sealed and compacted soils that limit agricultural activities. This occurs under scenarios of socio-environmental injustice, since land and urban water are often in dispute. These phenomena lead to city matrices with numerous heat islands and the gradual displacement of local crops and diets.

The initial review identified 17 basic problems for urban agriculture, which were grouped into categories suggested by leverage points (Figure 3). Most of these impediments are related to processes (6), design (5), materials and practices (5), and to a lesser extent to intentions (1).

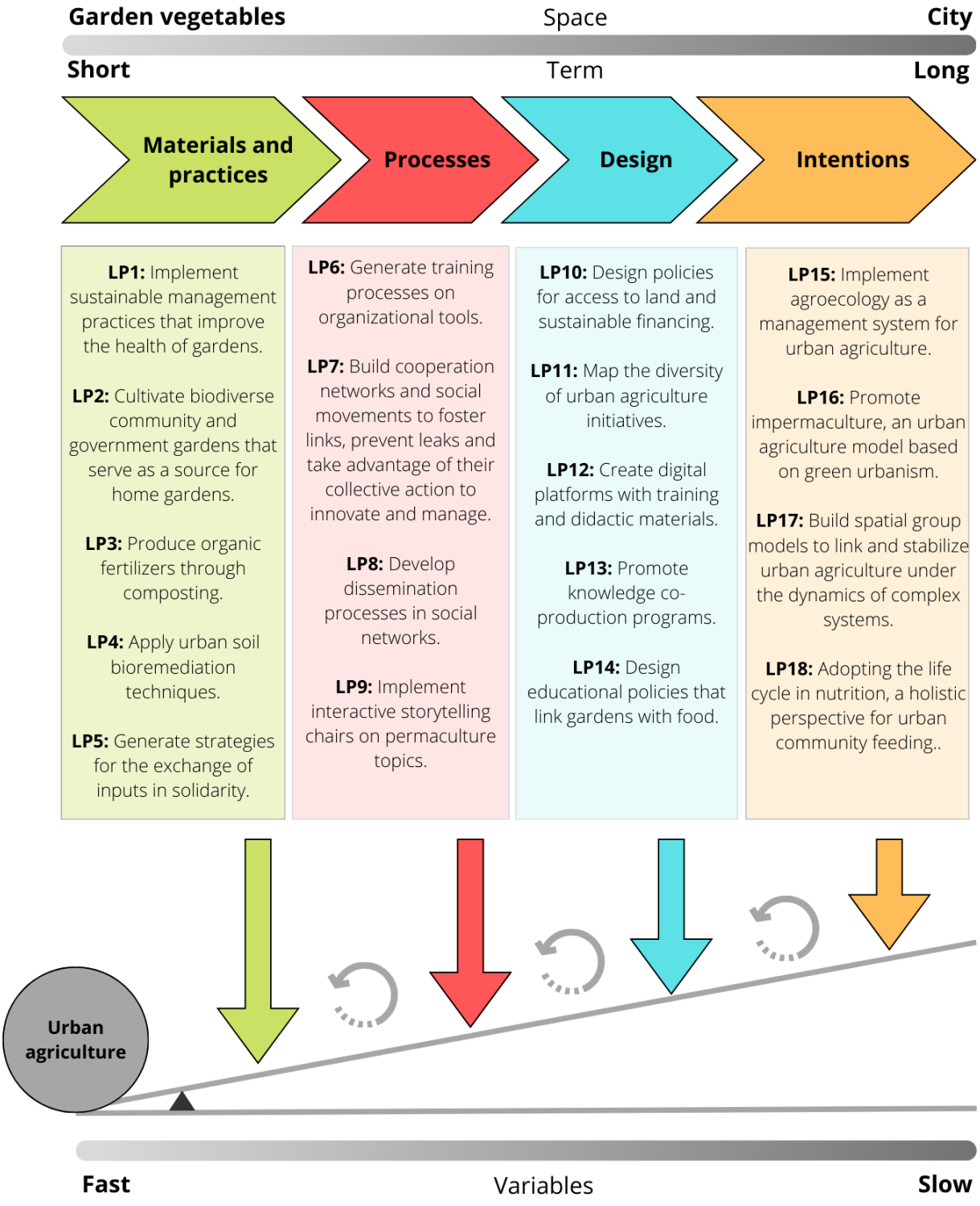


Figure 4. Leverage points for urban agriculture
Source: The authors.

That is, the studies reviewed have concentrated on organizational, educational, political, and technical/scientific aspects. However, the paradigmatic aspects that define and shape the structures and value systems for the institutions, collectives, and individuals who practice urban agriculture are only beginning to be taken into account. Subsequently, based on personal experience, some causal links were established between problems in visualizing feedback loops and important nodes requiring intervention. In any case, this systemic representation enables us to appreciate the complexity that is configured from the interactions between multiple factors that limit urban agriculture.

In terms of materials and practices, the low adoption of sustainable management techniques is common (Adebiyi and Olabisi, 2022), which explains the low diversification of crops (Larson *et al.*, 2022) and inefficient irrigation (Nguyen *et al.*, 2020). For example, monocultures established on soils contaminated with heavy metals and irrigated with chlorinated and/or gray water perpetuates contamination in cultivated soil and robs it of fertility. This is largely due to lack of knowledge of sustainable techniques, lack of co-production and access to reliable local knowledge, and low dissemination of knowledge and practices. In addition, it is important to note that lack of access to native seeds and/or the use of transgenic seeds is another problem that has been reported in cities. The excessive use of agrochemicals for soil fertilization, as well as for pest and disease management has also been documented. These problems not only alter the health of the soil and people, they also generate strong dependencies on external inputs and put the security and sovereignty of urban agriculture at risk. Furthermore, a lack of tools and inputs to till the soil and carry out efficient phytosanitary management is common.

With regard to processes, there has been little perceived management capacity of collectives to self-organize, request government support, or have an impact on public policies that reduce the instability and disarticulation of urban agriculture (Houessou *et al.*, 2019). This is accompanied by a clear lack of organization, lack of clear objectives, little dissemination of sustainable practices, ignorance of proper management, and absence of feedback processes. All this translates into a lack of collective innovation, that indispensable capacity to establish collaborative alliances and solve emerging problems in all dimensions of urban agriculture (Summer, 2018).

Particularly when this phenomenon fails to connect learning communities, it is common for a lack of social appropriation to occur, since people fail to obtain the desired results and do not identify with the root causes that mobilize this type of process (Egan *et al.*, 2020). Consequently, there is a marked difficulty in promoting the scaling up of flagship urban agriculture initiatives, as many of them work disjointedly (Orta *et al.*, 2021).

In matters of design, it is a great challenge to ensure that institutional structures have policies and programs aimed at cultivating in cities, and when they do, they are usually disconnected from local needs (Taylor and Lovel, 2012). This is why urban agriculture often does not have solid government support, not only in terms of financing but also in terms of socio-environmental aspects (Zamora *et al.*, 2013). For it is up to the municipal administrations to provide and regulate access to land for crops; however, in modern cities, grey infrastructure is given greater priority (Barthel *et al.*, 2019). Other crucial components that receive little support from government structures are co-production of local knowledge and free access to it for communities that practice urban agriculture (Kelley, 2011; Zamora *et al.*, 2013). An important impediment which has been highlighted is that educational policies do not include educational gardens in the curriculum, although it could be done through multiple subject areas such as health, nutrition, food, and sustainability (Blum-Kemelor *et al.*, 2012).

In relation to intentions, the main problem is that urban agriculture may have been disconnected from local food cultures (Zamora *et al.*, 2013; Freedman *et al.*, 2022). Particularly when gardens are dissociated from food traditions, problems occur in matters of practices (monocultures), processes (reduced social appropriation), and designs (absent nutritional policies). The absence of links between people, what they sow, and food impedes the building of collective identity around urban agriculture (Rich *et al.*, 2018). As a consequence of these factors and the dynamics of cities, it is common for urban agriculture to be an unstable phenomenon (McCann *et al.*, 2022). All of the above partly explains why many urban garden initiatives fail because they are not rooted in the territory.

Main leverage points for urban agriculture

The diagram in Figure 4 presents 18 leverage points that could help systemically address the multidimensional problems of urban agriculture. The levers are merged and grouped according to their affinity with the categories of materials and practices (5), processes (4), designs (5) and intentions (4). This almost uniform distribution of levers allows 17 problems of urban agriculture previously mentioned to be addressed in an integrated, complementary way.

The suggested actions are coupled on a spatio-temporal scale that includes technical aspects in the agroecosystem for the short term and paradigms for the management of agriculture in cities in the long term. Indeed, actions linked to materials, practices, and processes would have superficial effects on the urban agriculture system, but they are operations that could quickly solve basic problems. On the other hand, actions related to design and

intentions could have profound influences on the structural problems of agriculture in cities, although their effect can be slow and long-term.

In terms of materials and practices, it is essential that urban agroecosystems be worked with sustainable techniques that promote biodiversity and synergies to increase their resilience. This involves increasing technical knowledge and raising awareness among producers and consumers about the multiple benefits of producing food with sustainable practices (Adebiyi and Olabisi, 2022). It is recommended to encourage open and biodiverse community and government gardens that serve as a source of native plants to combat the lack of diversification of home gardens (Goodness, 2018). To address the low fertility of urban soils, Pleviak (2022) recommends the creation of environmental management systems that include separation of organic waste so it can be transformed through composting, producing fertilizers for gardens.

Additionally, soil fertility must be managed with practices such as crop associations and rotation, soil mulching, and incorporating green manures. It is also suggested that integrated water management be carried in the orchards; this may include measures from water collection systems to a large number of sustainable irrigation techniques (Nguyen *et al.,* 2020). Urban soil pollution can be remedied through phytoremediation, a technique that uses plants that bioaccumulate and naturally remove pollutants (Cundy *et al.,* 2016). This can be accompanied by the incorporation of organic soil amendments that immobilize heavy metals through biochemical reactions so that they are not assimilated by crops. Finally, strategies such as solidarity baskets of seeds, seedlings, and bioinputs must be generated, a key strategy to promote genetic improvement and replace the use of agrochemicals. Also, it is necessary to promote the exchange of tools, knowledge, and services around urban agriculture, and if necessary, manage these aspects collectively with the corresponding government agencies.

In relation to processes, it is essential that people who practice urban agriculture be able to equip themselves with organizational tools through self-management or through collaboration with other social sectors (Self *et al.,* 2012). Social organization and participatory leadership should lead to the mobilization of discourses, as well as to the increase of management capacity and collective innovation for urban agriculture. In any case, it is essential to return to the existing social structures in cities to organize cooperative network structures that can define collective agendas and set the course for urban agriculture (Houessou *et al.,* 2019). Also, it is crucial to develop dissemination processes in social networks to strengthen knowledge and practices, as well as to make urban agriculture initiatives visible (Magalhães, 2021). Collaborative work and constant dissemination are essential to build social movements, foster links, prevent leaks, and leverage collective action for advocacy (Wittenberg *et al.,* 2022). This should lead to social appropriation and the construction of collective identity on urban agriculture. There is no single recipe for consolidating these processes but it is always possible to find inspiration in other initiatives. For example, Egan *et al.* (2020) documented the implementation of interactive storytelling chairs on permaculture topics and the activities of a university garden to generate ownership among the educational community.

In terms of design, political will and efficient norms are required that offer clear guidelines for the planning, development, promotion, regulation, and financing of agriculture in urban territories (Zamora *et al.,* 2013). In this regard, it is necessary to design land tenure and use policies connected to the zoning of urban agriculture according to the suitability of the soil (Barthel *et al.,* 2019). It is important to map the diversity and distribution of garden initiatives in cities, their objectives, needs, and future projections to bring about results suited to the particular city (Taylor and Lovel, 2012). Local governments have the infrastructure and capacity to create digital platforms with resources and teaching materials adapted to the context (Zamora *et al.,* 2013). Experimental programs for the co-production of technical and scientific knowledge among urban agriculture communities should be promoted with support from universities and non-governmental organizations (Kelley, 2011). Finally, the generation of educational policies that include the use of technologies, food guides, and other strategies to link gardens with nutrition in school canteens is recommended (Blum-Kemelor *et al.,* 2012).

With regard to intentions, it is important to know that agroecology as a pluriepistemological science, social movement, and set of techniques offers comprehensive guidelines for the management and scaling of urban agriculture. Agroecology presents a series of dimensions (ecological, technical, productive, sociocultural, economic and political) that describe aspects ranging from sustainable practices to lifestyles for urban communities. Additionally, McCann *et al.* (2022) suggest alliances between urban farmers, developers, and the local state to promote impermaculture, a model of urban agriculture based on green urbanism which helps prevent it from being replaced or fractured by grey infrastructure. Rich *et al.* (2018) proposes conceiving urban agriculture under the dynamics of systems employed to zone it, implementing participatory models and connected spatial groups. Zamora *et al.* (2013) recommend adopting the life cycle in nutrition, a holistic perspective to strengthen urban community feeding, where agriculture is sensitive to the nutritional

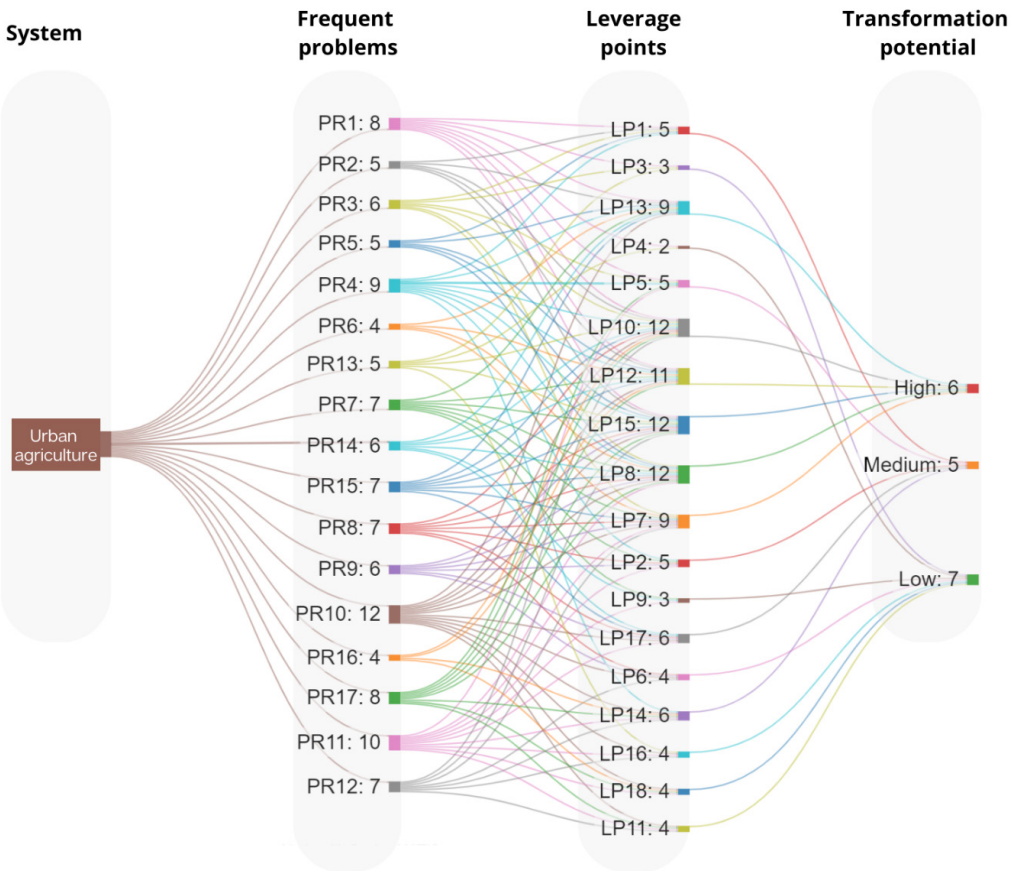


Figure 5. Sankey diagram with connections between frequent problems (PR), leverage points (LP) and transformation potential for urban agriculture.

Source: The authors.

Note: each interaction has a value of 1 point; each node has cumulative scores.

needs of people throughout their lives.

Transformative potential in the urban agriculture system

The 17 frequent problems were correlated with the 18 leverage points to visualize the connections and divide the actions according to the potential degree of transformation (Figure 5). In general, this set of levers could serve to address five structural problems strategically and in parallel that are located as materials and practices, processes, and intentions. In this order, aspects such as reduced soil fertility (PR1) and low crop diversification (PR4) are well covered, essential issues to maintain the health of urban agroecosystems. The problems best covered are the reduced scaling of initiatives (PR10) and the lack of social appropriation (PR11), vital processes to link the human part and extend the benefits of urban agriculture over the territory. Finally, the decoupling of food cultures (PR17), the only problem ascribed to intentions, is also fully addressed with eight key levers. Therefore, the proposed leverage points are ideal for concurrently addressing management aspects, vital processes that involve the social base and paradigmatic issues that permeate the entire urban agriculture system.

These interactions enable of six levers to be identified that have high potential for transformation in the urban agriculture system. Implementing agroecology as a management system (LP15), designing policies for access to land and sustainable financing (LP10), including social media dissemination processes (LP8), could help solve most current problems in urban agriculture. Additionally, greater benefits would be obtained if this is accompanied by the construction of cooperation networks and social movements (LP7), digital platforms with permanent training activities and contextualized didactic materials (LP12), and knowledge co-production programs (LP13). Leverage points with medium leverage potential are coupled to high points and can help to synergistically complement the governance of urban agriculture and its transition to sustainability. During this process, leverage points with low transformation potential should not be underestimated, since although these simultaneously address fewer problems, many of them have influence on agroecosystems, where it is essential to solve sociotechnical issues.

The leverage points outlined in this study are a reference guide to facilitate the transition of urban agriculture towards sustainability. These guidelines could be taken into account in bottom-up self-management processes by

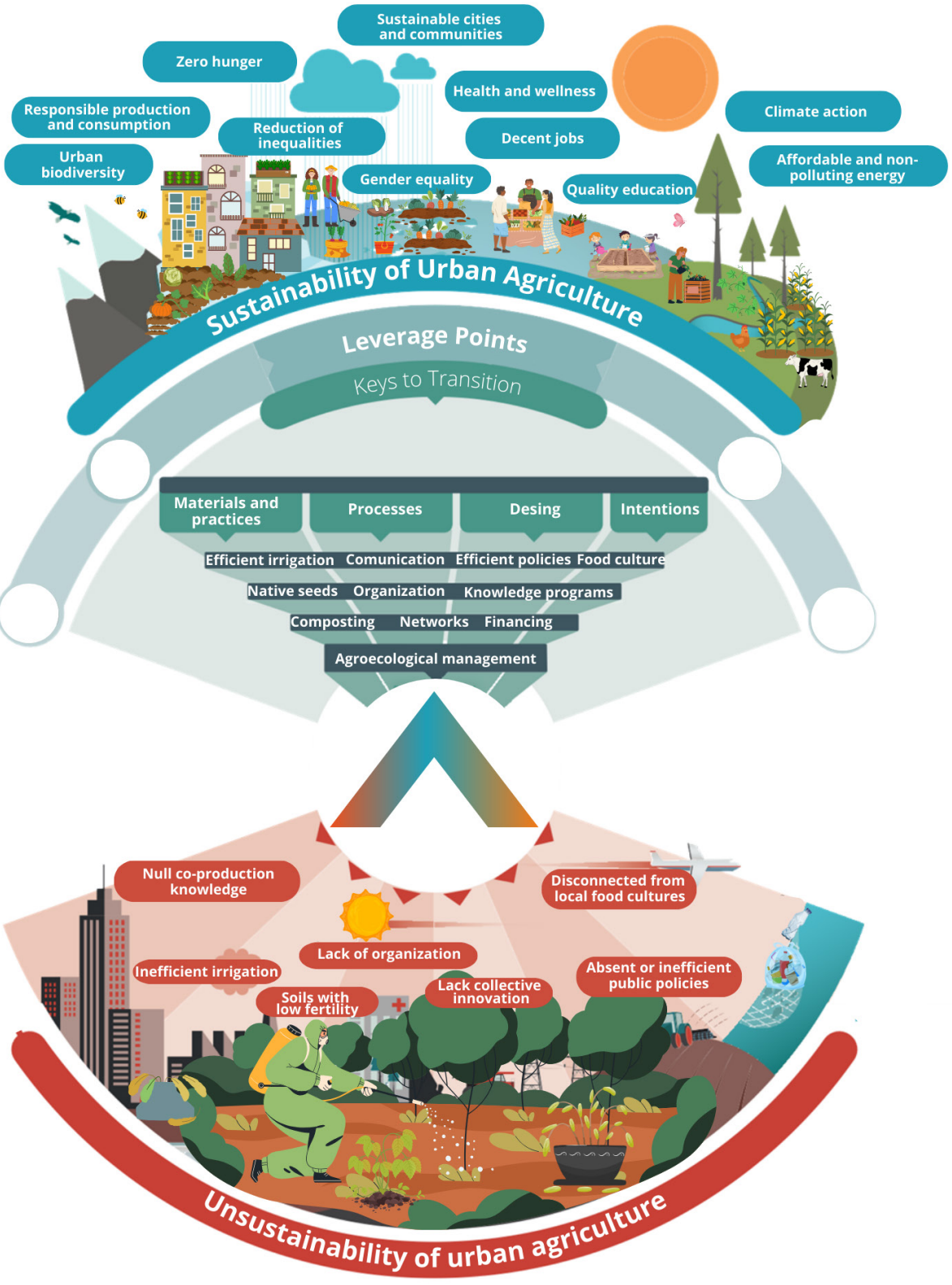


Figure 6. Moving towards sustainable urban agriculture through leverage points.
Source: The authors.

organized communities that mobilize urban agriculture initiatives, as well as by top-down decision-makers who drive public policy. In this way, the benefits of urban agriculture could be more visible, given favorable scenarios where frequent problems are fully remedied. This transition favors the achievement and/or contribution of some of the sustainable development goals set out in the 2030 Agenda for Sustainable Development; particularly those that have to do with zero hunger, sustainable cities and communities, responsible production and consumption, health and well-being, and decent employment (Figure 6). Finally, the findings of this study show a comprehensive vision of urban agriculture with the potential for application in urban planning, development processes and territorial management.

Conclusion

In sum, the leverage points framework is a useful tool to address socio-ecological problems and build sustainable solutions in the urban environment. Although this approach has scarcely been used in the field of urban agriculture, the few documented studies represent important contributions and open a large window of research opportunities. In particular, there are important isolated advances in matters of materials, practices, and processes; however, we still need to delve into design levers and intentions. At present, the most important challenge is to achieve the consolidation of transdisciplinary exercises to holistically press for a large set of actions that include all types of levers in a particular urban scenario.

This exercise has enabled us to identify that urban agriculture presents a set of multidimensional problems that put its development at risk and limit the socio-ecological benefits of this activity in urban territories. In particular, most of these problems interact strongly or are closely linked to lack of public policy, poor access to fertile soil, and unsustainable management practices. Therefore, to positively transform the urban agriculture system requires both collective effort by the social base and the facilities of government institutions. In this regard, agroecology is one of the leverage points with the greatest potential for the transition from urban agriculture to sustainability.

However, it is necessary to consider that the problems and levers presented here are only an approximation based largely on the conditions of urban agriculture in the global North. Although the realities outlined here can be useful for reflecting and planning future interventions in multiple urban contexts, it is essential to take into account the local characteristics of this phenomenon. In any case, the governance of urban agriculture must be woven from a negotiation of interests between the different networks and social structures that make up urban territories. This is why permanent dialogue and collaborative work between all the key actors of this phenomenon are crucial to

strengthen the sustainable future of urban agriculture.

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