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Cities in the loop: A social science perspective on the role of cities in food system circularity

Daniel Polman [a,*], Liesbeth de Schutter [b], Stephanie Begemann [c], Jose D. Lopez-Rivas [d], Eveline van Leeuwen [b], Joana Wensing [b,e]

[a] Public Administration and Policy Group, Department of Social Sciences, Wageningen University, the Netherlands
[b] Urban Economics Group, Department of Social Sciences, Wageningen University, the Netherlands
[c] Knowledge Technology and Innovation Group, Department of Social Sciences, Wageningen University, the Netherlands
[d] Centro ODS, Universidad de Los Andes, Colombia
[e] Maastricht Sustainability Institute, School of Business and Economics, University of Maastricht, the Netherlands

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ABSTRACT

The transition to a circular food system is crucial to address the environmental pressures, inefficiencies, and socioeconomic inequalities inherent in "linear" food systems. Cities as dense population hubs with substantial food consumption and waste generation, possess considerable—though largely untapped—potential in steering food provisioning systems from a consumption perspective, particularly when equipped with the institutional, economic, and behavioral dimensions for transformative change. Conceptualizing urban food systems as networks of actors, institutions and resources interacting across spatial scales, we argue that food system circularity is critically dependent on multi-level relations and governance structures that go beyond the material dimension of urban food provisioning. Rooted in food system thinking, this paper explores social science approaches to understanding if and how cities can drive and scale food system transitions on the basis of circular principles and practices. We conceptualize circularity as a transformative design principle from an urban food consumption perspective, and identify three key areas where we challenge social scientists and policymakers to seize opportunities for a richer social science perspective on food system circularity: (1) equitable economic relations and (spatial) interdependencies; (2) governance of the social dimension of circularity and (3) implications for everyday food practices and urban resilience. We explore current advancements in each of these social science approaches and provide a roadmap toward food system circularity from an urban perspective.

1. Introduction

There is broad scientific consensus that provisioning of food within ecological boundaries is among humanity's most important challenges (e.g., Willett et al., 2019; Rockström et al., 2020; Creutzig et al., 2022). With technological innovations, specialization, and globalization, human consumption has become increasingly detached from natural nutrient cycles and seasons of food provisioning, while experiencing year-round availability of–and access to–fresh and processed foods for a growing and urbanizing world population. This detachment is especially visible in cities, which take a central role in shaping global food networks from a consumption perspective (Solecki et al., 2018; Fattibene et al., 2020). Yet, cities produce only a limited amount of food (e.g., Langemeyer et al., 2021), making them reliant on inputs of resources and provisioning services from regional and global hinterlands. This dependency heightens urban vulnerability to socio-political disruptions and amplifies shocks related to impacts of climate change and other disruptions—for example due to natural disasters, pandemics, or violent conflicts—both at the urban level and elsewhere (FAO, 2023; Ihle et al., 2020; Polman et al., 2023). These dynamics underline the need for a more comprehensive understanding of the potential role of cities in a more sustainable food system.

To address food system issues, and the vulnerability of cities to food-system disruptions, circular economy approaches provide a promising outlook (Koppelmäki et al., 2021). Circular economy approaches aim at reducing virgin resource extraction and emissions to the environment by closing loops of materials and nutrients among food producing and consuming activities (Van Zanten et al., 2019). From an urban

* Corresponding author.
E-mail address: daniel.polman@wur.nl (D. Polman).

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consumption perspective, changing dietary patterns towards more plant-based foods potentially reduces global resource use and related soil nutrient disturbances, while circular economic relations in city-region food systems can save energy and reduce GHG emissions and pollution in regional food provisioning networks. As such, food system circularity has been associated with decreasing food insecurity (e.g., Lever and Sonnino, 2022), food system resilience (e.g., Sgroi, 2022), and the adoption of more sustainable practices, such as food sharing and reducing waste in urban contexts (e.g., Schröder et al., 2019). Examples in this regard include reusing out-of-date retail foods through food banks, using secondary processing flows as animal feed, composting food waste and converting organic materials into bioenergy, among others.

Transitioning toward more circular food systems requires a systemic change away from linear take-make-dispose structures and practices in the food system, which necessitates involving all actors and institutions in the food value web across multiple geographical scales (Koppelmäki et al., 2021). Cities, as central nodes in global food networks with their concentration of citizens, businesses, and institutional influence (Glaeser et al., 2016; Fratini et al., 2019), have the capacity to drive transitions toward more circular and sustainable systems (Wensing et al., 2023). As leverage points in this transition, cities can actively shape interactions within food networks by connecting citizens, civil society, private entities, and local governments to foster coordinated action (Moragues-Faus and Morgan, 2015; Lázaro et al., n.d.).

We can already see that cities and city networks have started initiatives to adopt circular economy principles, such as the city doughnut in Amsterdam, or Copenhagen's circular economy strategy (Khmara and Kronenberg, 2023). With regard to food system transformation, we also observe a trend where cities are increasingly engaged in promoting sustainable local food systems, for example through the development of urban food strategies, and other policy and governance innovations (e.g., Polman and Bazzan, 2023). Moreover, cities have increasingly become at the focal point of international research projects as their high resource consumption makes them critical for circular economy strategies.[1,2]

When looking at the focus of the literature on food circularity, however, we see that most studies approach this transition primarily from technical and/or environmental perspectives (Korhonen et al., 2018). For example, scholars often explore nutrient flows (e.g., Koppelmäki et al., 2021), agricultural applications (e.g., Barros et al., 2020), or digital tools (e.g., Freeman et al., 2022), focusing on specific resource streams or detailed case studies. Inherently social aspects of circularity transitions—such as impact on daily lives (e.g., differences in consumption choices, or waste-collection procedures) and political decision-making processes (e.g., breaking with dominant interests)—are underexposed, or even neglected (Kruse and Wedemeier, 2023). As a result, city governments more and more see the urgency of sustainable food systems in general, but not the City's potential impact, nor the way the municipality could contribute.

Moreover, current approaches to circular food systems tend to overlook the potential role of cities in changing food system governance, economic aspects and the everyday social practices (e.g., Hobson, 2020). Also the organizational and spatial factors of cities—which enable them to act as key drivers of circularity transitions—have been largely overlooked (e.g., Murphy, 2015; Binz et al., 2020). Similarly, studies on urban food system governance—often oriented at local innovative arrangements such as food policy councils and localized innovations (e.g., Zerbian, de Luis Romero, 2023; Papangelou et al., 2020)—do not fully address the broader social implications and role of cities in the shift from linear to circular food systems. For example, circular food supply networks in city-regions call for place-based policies and effective governance arrangements that promote trust and coordination among local actors (Bourdin and Torre, 2025).

Other social science research that explores steps toward more food system circularity—such as the shift from meat to plant-based diets (De Boer and Aiking, 2018) and circular business models (Dagevos, Lauwere., 2021)—indicate structural lock-ins, different (and hence, unclear) interpretations and varied ambitions with respect to circular food and farm systems. The limitations of a supply side focus on food system circularity risks perpetuating existing power structures and trade-offs between people, capital, and space, potentially reinforcing patterns of ecological degradation and social inequalities (Béné et al., 2019).

In this paper, our starting point is that transitioning towards a regenerative circular food system means to transition towards closed agricultural and food production cycles of superfluous input and output materials, with processing by-products being shared, residual waste minimized and valorized, and human capital not exploited (Wensing et al., 2023). However, in cities, most nutrients leave the urban system through the sewer via our metabolism (Baccini and Brunner, 2023). So, a fully circular food system can only be reached by closing the loop between regenerative agricultural production, food demand and bio-based waste of cities, including nutrients in the sewage systems, at multiple spatial scales.

With a growing majority of people living in cities, we argue that food system circularity cannot be addressed without taking cities in the food loop, both from an economic, societal and transformative perspective. An urban perspective on food system circularity requires a broader social science perspective, including social practices, governance arrangements and institutions, and economic power relations, to assess and reduce social inequalities and patterns of environmental degradation, also from a consumption perspective. The research question guiding such broader social science explorations is how cities can become a transformative force towards food system circularity and to what extent this contributes to equity, resilience and sustainability in urban food networks.

In the upcoming sections we explore the role of cities in the transformation towards food system circularity, both from an economic, governance, and behavioral perspective. First, we explore how a systems perspective can help to understand the interactions between institutions, actors, places, and resource systems that must be considered in food system transitions from an urban perspective. Next, we explore circularity as a design principle for economic arrangements and (spatial) interactions from an urban perspective, after which we turn to the role of governance as institutional (and political) barriers and enablers of economic interactions and outcomes. We then examine the implications of urban food system circularity for daily practices and how changes in practices towards circularity can support urban resilience. Finally, we conclude with considerations for future social science research on the role of cities in a transition toward more circular food systems.

2. Food systems thinking for circularity

The concept of a food system generally depicts a stylized network of food producers, trade flows and consumers, (soft-)linked to resource systems and socio-economic outcomes (e.g. Oosterveer, 2016). The primary system purpose is food security for a growing population through various interconnected economic activities, such as agricultural production, food processing, transportation, retail and waste management (Ericksen, 2008; Van Berkum et al., 2018). Recently, food system thinking has been advanced towards empirical and modeling approaches to assess the environmental pressures on land, biodiversity, fresh water resources and the climate system, as well as social impacts in terms of food insecurity, income and decreasing resilience, associated with the increasingly global and linear organization of the global food system (e.g., Willett et al., 2019; Caron et al., 2023; FAO, 2023; Ihle et al., 2020). See for a practical example around food waste Fig. 1 below.

[1] The HOOP Project | Vitalise Europe's Urban Bioeconomy

[2] Bin2Bean Project – From biowaste to soil regeneration. Co-funded by the European Union, Grant n°. 101113011

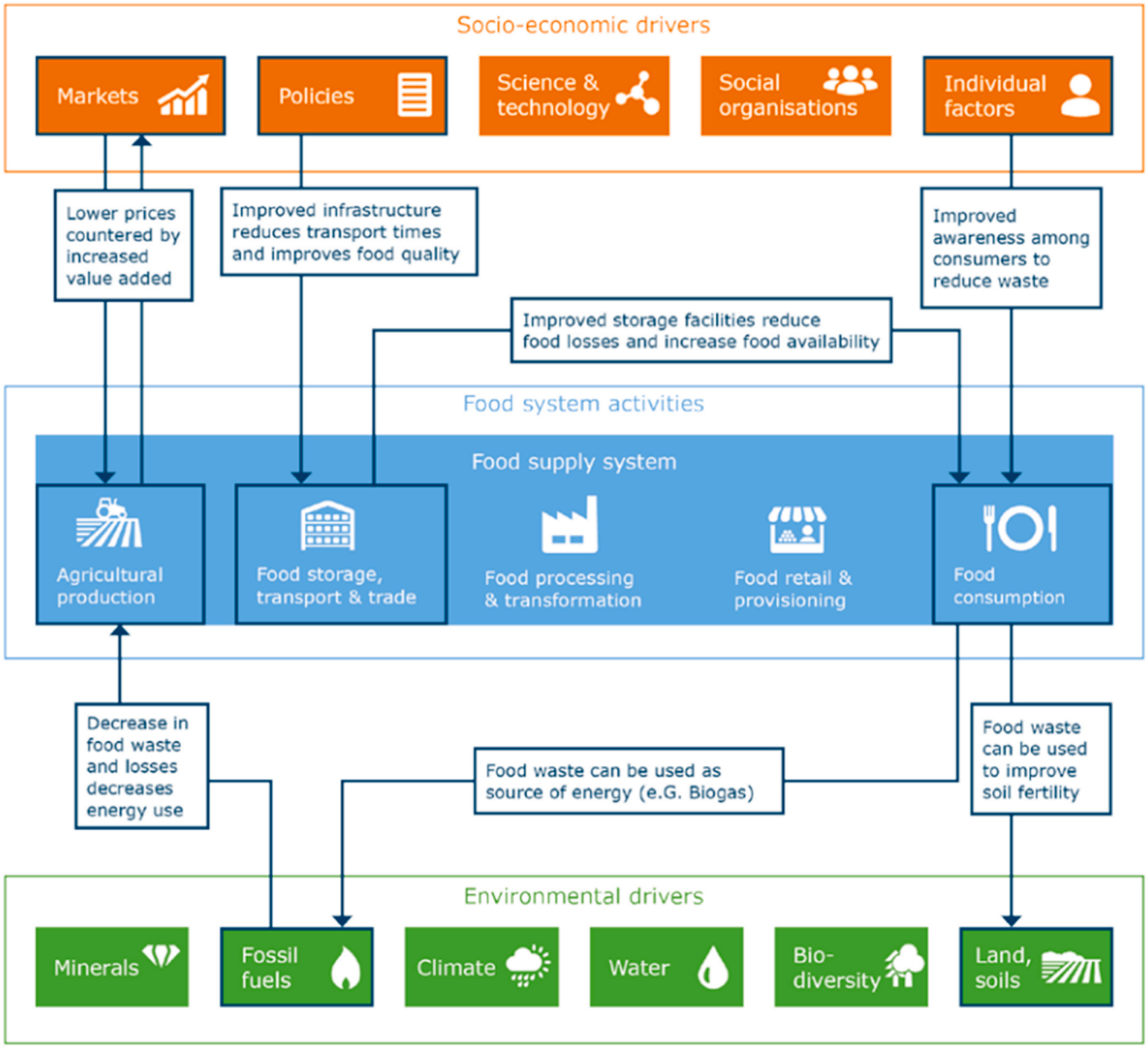

Fig. 1. Food system thinking around production, post-harvest and waste (copied from Van Berkun et al. (2018), p. 18).

With cities as emergent agents (markets) in shaping the global food system (Barrett et al., 2022; Kennedy et al., 2007), scholars like Goldstein et al., 2017; Zhong et al., 2021, Kasper et al. (2017) developed and applied the concept of urban food systems, including proposals to curb or reduce environmental impacts at the local (urban) and global level. Building on that, broader social science perspectives have highlighted cities' socio-economic relationships, consumption-driven pressures and potential intervention points from an urban perspective (Stelwagen et al., 2021; Lauk et al., 2022). However, such scenario studies often lack a transformative approach towards actualizing potentialities from a system perspective, maintaining a so-called implementation gap between theoretical wants and practical needs (Sonnino et al., 2019).

To fill the gap between "can" and "do", transformative food system concepts are being proposed, with a more explicit representation of civil society, governments and academia, next to supply chain actors as key agents in the transformation towards sustainability (e.g., Kok et al., 2019; Worley et al., 2024). By changing the shared system goal from food security to, for example, climate change mitigation, the authors argue that cooperation among key stakeholders in the food system is a precondition for aligning (private) food consumption and production activities with public goods (such as a safe climate system). Finally, to bring down abstract economic processes in highly stylized food system conceptualizations to the daily life worlds of (urban) actors in the food system, the construction of individual and community-level causal loop diagrams (CLDs) has been proposed as a methodology for highlighting and understanding critical relations, feedback loops and barriers towards shared food system goals, as well as for identifying critical intervention points to overcome such barriers (see Fig. 2 for an example of a CLD of the Amsterdam biowaste system, distinguishing factors in of food waste production, urban waste collection, biowaste processing and end use of soil improvers from urban biowaste) (De Schutter et al., n.d.).

Applying a systems perspective helps to identify which elements within the food system need transformation and which actors hold responsibility for initiating change by taking an holistic instead of a siloed perspective (Leeuwis et al., 2021). In addition, a spatially-aware, systems-based approach reveals how cities both shape and are shaped in

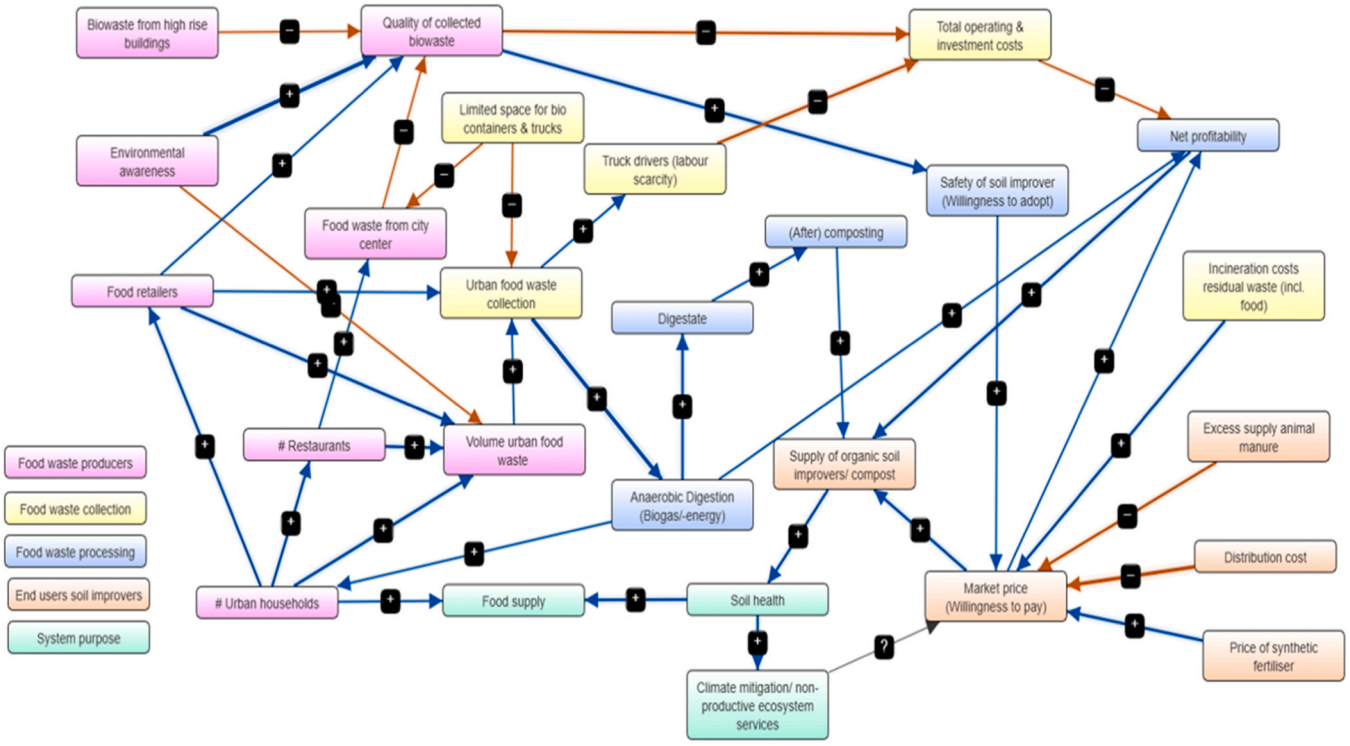

Fig. 2. Causal loop diagram of critical factors in the biowaste system in the city of Amsterdam, the Netherlands (Source: Own compilation based on ongoing research[3], for illustration purposes only).

socially constrained interactions with complex systems like water, energy, and mobility (Klerkx and Begemann, 2020). Larger cities, as hubs of population, education, commerce, and infrastructures such as ports, have a central position in the current—largely linear— 'take--make-waste' structure of urban food trade networks, both as consumers of final products and of intermediary commodities in food manufacturing, including fossil-based materials and energy. In this context—following a material flow perspective on food system circularity—cities can be identified as central hubs in commodity trade and circular bioeconomy approaches based on urban waste accumulation (e.g. Dahiya et al. 2018). Horn and Proksch (2022) provide a comprehensive overview of proposed and implemented "Circular City" (CC) frameworks, including local food production, controlled environment (urban) agriculture, nature-based solutions and valorization of organic waste at the urban level. From a spatial perspective, Koppelmäki et al. (2021) reveal a nested pattern of nutrient, biomass and energy flows from the local to the global level, increasing complexity in food system circularity from the farm to the regional and global level, and with cities as population dense hotspots of nutrient losses to the sewage system. In particular, the authors identify livestock production and global trade in animal feed as a key structure in food system linearity, contributing to excess nutrient accumulation in importing regions and cities. Hence, advancing food system circularity from an urban perspective highlights the potential of cities to shape more sustainable food networks and practices from a consumption perspective.

More recently, the concept of "regenerative soil systems" has emerged from a social-ecological systems perspective, where urban communities are co-responsible for recycling their accumulated food waste back to agricultural soils at the urban, peri-urban and rural levels of the food system,[3] emphasizing both social and social-ecological relations in multi-level food systems (De Schutter et al., n.d.). Here, food system circularity is built around soil health which, from a relational perspective, is conceptualized as commons. At the urban level, however, recycling (unavoidable) food waste as soil improvers is hampered by higher costs as compared to scale and agglomeration advantages in food waste incineration or landfilling–highlighting an important barrier for breaking away from linear practices in an urban context (Lever and Sonnino, 2022). In this context, moving toward a more socially-embedded and relational circular economy perspective may help to support the willingness to adopt and share changes in societal burdens and social-ecological benefits collectively.

In the upcoming sections we will explore the transformation towards food system circularity from a (spatial) economic, governance and behavioral perspective, articulating a more explicit social science approach, and address what that offers to an understanding of the potential role of cities therein.

3. Circularity as relational design principle for transformative urban food strategies in a circular economy

After being more prominent in the 1970's, the concept of circular economy (re-)emerged in the 1990s in a context of price volatility of virgin materials and waste accumulation in industrialized countries, aiming at increasing resource efficiency and extending life cycles of non-organic materials used in economic processes (Lu and Halog, 2020; Raasens and van Leeuwen, 2024). In essence, the idea of circularity supports cooperative, creative and system-level solutions, instead of competitive, efficiency oriented and individual-level outcomes. Circularity approaches articulate the relational dimension of economic interactions as a source of innovations and their diffusion (Granovetter, 1985). We propose exploring circularity as a relational design principle for transformative food system strategies, connecting actors and places beyond the material and financial dimensions of circularity (also see Ziegler et al., 2023). However, it is particularly challenging to go beyond quantitative measures for social dimensions that do justice to the relational aspects of a circular economy (Kruse and Wedemeier, 2023).

Current methodologies of assessing circularity–such as Material-

[3] www.bin2bean.eu

Flow Analysis and Life Cycle Assessment–focus particularly on respectively the materials and environmental impacts associated with the production and consumption of final products (Fischer-Kowalski and Haberl, 2015). As compared to the mere mechanistic reuse and recycling principles of non-organic materials, however, circularity assessments of biobased materials often struggle to take the total (upstream) resource use embedded in (urban) food consumption into account (particularly relevant for urban diets high in animal-based products), changes in the qualitative structure of organic materials after consumption, and the nested interdependencies of regenerative social-ecological systems (e.g., soil, farm, community, regional, national dimension of food system circularity) in urban food trade networks (Pires and Martinho, 2019; Koppelmäki et al., 2021). Hence, despite the importance of efforts to close nutrients loops (e.g., nitrogen and phosphorus), to recycle food packaging materials and to recover energy from biological materials, the material (flow) principle "waste is food", is an insufficient argument for circular food systems (Kopnina et al., 2022).

With biobased materials such as food and food waste, it is important to note that there are different design principles for organizing circularity, such as financial, environmental, ecological, social or relational design principles, where one or more principles may be prioritized dependent on social-political values, power structures and related institutions in society (Holcombe, 2020, p.51). For example, although common waste hierarchy frameworks prioritize "reduce" before "reuse" and "recycling" processes (Lu and Halog, 2020), circular bioeconomy approaches tend to prioritize environmental and financial objectives when prioritizing (industrial) recycling strategies oriented at the production of biobased alternatives for fossil-based materials and products in a climate-constrained environment (e.g., Van Stijn and Gruis, 2020), thereby overruling social and ecological values embedded in food system circularity. Circular food economies, on the other hand, tend to emphasize social and ecological values, among others, when exploring city-region food systems from a circular economy perspective, highlighting benefits in terms of equity, local income multipliers and urban resilience from a territorial perspective, while recognizing critical spatial dependencies in the global food system (Lever and Sonnino, 2022).

Using circularity as a transformative design principle in the relations among food economies requires looking at three spatial levels in urban food systems, to better understand how they interact and depend on each other. First, we can look at economic interaction among actors at the urban level, where the spatial clustering of diverse agents in energy, water and food sectors offers opportunities for new and unusual collaborations to recycle by-product and waste flows in urban agriculture, and/or business or community activities that support inclusive food networks, local economic multipliers and equitable social outcomes (Säumel et al., 2022). In this context, cities tend to attract diverse groups of people and talents, supporting cities in becoming progressive hubs for innovative circular solutions and technologies (Duranton and Puga, 2001; Batty, 2016), emphasizing cooperation, creativity, and learning at the local (urban) level (Kopnina et al., 2022). Importantly, this requires overcoming structural lock-ins such as (EU) law-based safety and treatment regulations that prevent local, neighborhood solutions for circularity from an urban perspective.

Second, economic interactions between urban and peri-urban actors offer opportunities for circularity to reshape processes and relationships within regional food economies, advancing circular city-region food systems that prioritize spatial factors, reciprocity, and cooperative strategies for sustainable resource management. Second-tier cities could play an important role here, since they are the middle ground of the urban system (van der Gaast et al., 2020). For example, these systems may involve directing food supplies to the city while composting urban food waste to regenerate peri-urban soils or urban payments for ecosystem services provided by peri-urban actors (Lever and Sonnino, 2022; Witvliet et al., 2024).

Third, we should look at economic interactions among urban and rural actors, or distal places, where multidimensional social-ecological interdependencies should become more explicit, including not only food supply but also climate change adaptation and mitigation, water storage, clean air and recreational services (Van Leeuwen, 2015). In urban food networks, relations among urban and distal rural places are mostly indirect and institutionalized in multi-level governance arrangements in which price-based markets and profit maximization tend to dominate (Gereffi et al., 2005). In the wider context of social and environmental concerns of urban food systems, efforts to achieve food system circularity from an urban perspective is potentially most transformative at this level, as it concerns the majority of resource use embedded in urban consumption, mainly by urban dietary change towards more plant-based foods produced with sustainable land management practices. Urban food strategies can thus support food system resilience at the local (urban and rural) level of the food system (Béné, et al. 2023), emphasizing the need for spatial economic approaches to highlight critical relations, both social and social-ecological, from an urban food system perspective (Koppelmäki et al., 2021; Sonnino and Milbourne, 2022; Van Der Gaast et al., 2020).

To conclude, economic research should contribute to a relational approach of food system circularity from an urban perspective, including material, social, ecological and financial (multiple) value principles. Extending beyond its material dimension, food system food system = circularity can become a transformative design principle for the development, analysis and evaluation of socially-embedded economic strategies across spatial levels.

4. Governing the social side of circularity

The interactions between actors, production processes, and material flows across the spatial layers of food systems are structured by a set of formal and informal rules, processes, and instruments between public and/or private parties (Termeer et al., 2018). This structure, with its rules and institutionalized processes, shapes to a large extent what people in cities eat, and how food waste is processed. Despite the interconnected nature of food systems, their governance often also remains siloed across different policy domains, actors, sectors, and jurisdictions, with a primary focus on production and supply chains (Termeer et al., 2018). A governance perspective is essential to understand who decides what, where, and when in shaping urban food systems, and for realizing the promises of circularity through the development of new, integrated governance arrangements that connect food systems with related sectors such as energy, water, and waste (Wensing et al., 2023; Lázaro et al., n.d).

Cities have a long history of food system governance (Steel, 2023), however, food policies with a specific urban character declined with the emergence of nation states (Daviron et al., 2019). Only recently, modern cities have started to re-engage in the development of food system governance (Halliday, 2022). Understanding urban food system governance departs from the historical context in which specific arrangements have been agreed upon. Governance arrangements reflect existing power relations and interests–mostly representing and institutionalizing linear economic logics–making them resistant to (transformative) change through mechanisms of path dependency, policy lock-ins, and closed policy networks. These dynamics are well understood in literature on the historical development of policies and institutions, and pathways of incremental or radical change (Hall and Thelen, 2009).

The spatial agglomeration of actors and institutions in cities, however, has a great potential to facilitate change, because it offers opportunities for new actors to be involved, and to experiment and learn from the variation of policies that can emerge across cities (Ostrom, 2010). This has already led to an emergence of diverse and context sensitive local food system policy innovations, instead of a one-size-fits all model, increasing the adaptive capacity to tackle socio-ecological challenges. However, the majority of food consumed in cities is not produced locally, and decisions that affect the food system are made across

decision-making bodies and scales, which currently lack coordination (Van Bers et al., 2019). A major challenge in this regard is how to connect and create complementary governance arrangements across the multi-level and multi-sectoral structures of the food system (Pimbert, 2018). In this regard, we see that there are already promising collaborations emerging between local governments globally, such as the Milan Urban Food Policy Pact, where cities can exchange practices and lessons (Polman and Bazzan, 2023) and the explorations in the EU on the establishment of a multi-stakeholder and multi-level European Food Council. Moreover, collaborations between cities and their surrounding rural areas—where much of the food production occurs—should be integral to circular food governance. Such partnerships are essential to tackling food insecurity (e.g., Sonnino, 2009), closing nutrient loops effectively (e.g., McConville et al., 2015), and strengthening the competitive position of city regions (Docherty et al., 2004). Moreover, through mechanisms of learning these innovations and networks can propel wider food system circularity.

Zooming in on the actors involved in food systems, governance arrangements should also ensure that diverse voices and perspectives are included in the transition (Pimbert, 2012; Zorbas et al. 2022), creating local place-based policies, and supported by effective governance arrangements that involve local stakeholders and promote trust and coordination among local actors (Bourdin and Torre, 2025). Current arrangements have been criticized for being dominated by globalized, centralized, and corporate governance arrangements not involving producers, consumers, civil society and marginalized groups (Hospes and Brons, 2016). Existing initiatives to overcome these challenges are for example food policy councils and modes of co-production or participatory planning, where citizens and stakeholders are involved in decision-making (Sacchi et al., 2022) under the assumption that these new actors with different interests lead to new trade-offs and other policy directions. Furthermore, literature on participatory governance can help to understand how to create policies that enjoy social and political support and do justice to the plurality of actors and legislation that is involved in food systems governance (Bavinck et al., 2014).

However, the consequences of phasing out governance arrangements and consumption and production practices may not be popular amongst the actors benefiting most from the mainstream food system, so this will not be a simple process which requires different policy actions to achieve the objectives of a circular food system. This requires both a shared understanding about the meaning and objectives of a circular food system and effective policy instruments.

Regarding the former, it is important to consider that the concept of circularity is socially constructed and used politically. Dominant political discourses on circularity reflect power relations, so we need to understand better what circularity means in both the political and public debate (Sibbing and Candel, 2021). We should not forget that circularity can be used for the justification of unsustainable practices. This raises questions related to the narratives that are constructed, and the types of change that are envisioned (e.g., high technological, or low technological). Moreover, t circularity discourses–which can vary across contexts–can affect popular and political support for specific governance arrangements and interventions (Leifeld, 2020). But this also raises questions on how circularity should be communicated to gain more political leverage (e.g., Metze, 2020; Schagen et al. 2025).

Once circular policy objectives can be agreed upon, or find enough political support, innovation studies highlight the importance of developing policy mixes that use different logics and can address various elements of the food system simultaneously (Kivimaa and Kern, 2016). We need to be aware that current practices and power structures are deeply rooted, and that multiple interventions are required, for example by simultaneously dismantling unsustainable structures—for instance by implementing sugar taxes or true pricing—and supporting the emergence of new circular practices—through financial incentives and norm setting.

5. Daily circularity: urban diets and other food-related practices

Zooming in on urban food-related practices, some studies point out that urban food consumption has its own dynamics. These dynamics are also context-sensitive and show differences across geographies. Urban populations have been found to consume higher amounts of calories and animal food products than their rural counterparts (Willett et al., 2019; Wiskerke, 2015; Garnett 2011), while other research indicates that urban households allocate a smaller portion of their (higher) total income on meat and processed meat compared to rural households (Dangerfield et al., 2021). Moreover, in India for example, urban citizens were found to consume more diverse and quantitatively more food than their counterparts in rural areas, influenced by factors such as a higher percentage of women working, higher income levels, local food availabilities, prices and retail structures (Pandey et al., 2020). As food is inevitably related to culture, urban diets and their degree of circularity also depend on religious restrictions, agri-food policies and social norms around food (Constantinides et al., 2021; Tseng et al., 2019).

Regarding food and bio-waste, there is no debate that cities produce large quantities which are usually not kept in the material cycle but end up in landfills or in waste-to-energy plants (Jensen and Orfila, 2021; Papangelou et al., 2020). Studies show that urban households typically dispose more food waste than rural households across different regions in the world, e.g., in Canada (Van der Werf et al., 2018), in Norway (Hanssen et al., 2016) and in South Africa (Chakona and Shackleton, 2017). With rising population numbers and urbanization rates, the amount of urban food and bio-waste is expected to increase unless current waste management practices are changed. However, being mainly exposed to distribution and consumption activities in the food system, urban citizens generally lack the awareness of how food is grown, what is locally produced and how the collection and valorization of bio-waste into compost can benefit soil health (Pothukuchi and Kaufman, 1999). This disconnect has also been linked to a reduced sense of agency of urban citizens to initiate change in the system (Bricas et al., 2019).

In this regard, there are increasing practical experiments where urban citizens cooperate to reshape food production, shifting from consumers to so-called “prosumers” (Moreira and Morell, 2020). For example, by engaging more actively in re-using food waste through composting, and urban agricultural practices (e.g., McLean and Roggema, 2019).

As there are many different actors involved in an urban food system, a transition towards circularity is not solely the responsibility of citizens, but it is a collective process that requires all actors to adapt their food-related activities from linear to circular (Geels, 2020). The degree and the speed of the transition therefore depends on the number of farmers, food companies, entrepreneurs, consumers, and policymakers adopting novel circular technologies, products and/or practices (Härri et al., 2020). However, although the concept of circularity is part of the global agenda in the UN’s Sustainable Development Goals, circularity practices remain largely absent in urban food systems (Petit-Boix and Leipold, 2018).

Addressing this gap requires targeted interventions to shifting urban consumption and other food-related practices towards greater circularity. In this regard, changing social actions can be understood through various social science lenses. For example, behavioral economists posit that human behavior is guided by people’s emotions as well as their physical and social context in the situation of choice (Kahneman, 2003). Sociological perspectives, in turn, conceptualize human activities on a collective level as social practices acknowledging on the one hand that behaviors are embedded within larger systems of institutions, materials and norms (Schatzki, 1996), and on the other hand how actor identities and decision-making emerges from participation in different networks (Schäufele and Janssen, 2021; Zorbas et al., 2022). Both perspectives can inform interventions supporting changes in social actions.

Such interventions can be categorized into educational and

informational strategies appealing to intrinsic motivations of actors, and regulatory or financial measures aiming at structural changes in their physical and social choice environment. Meadows (1999) argues for educational strategies as cultural transitions such as the circularity transition require the change of people's underlying belief systems. Indeed, farmers seem to be motivated to adopt circular practices based on their rather stable environmental values (De Lauwere et al., 2022; Wensing et al., 2019), so that awareness campaigns could strategically be used to trigger those. More fundamentally, outdoor activities, role plays and modeling exercises in schools and universities have been shown to foster respectively an increased ecological worldview and systems thinking abilities (Sterman et al., 2015). However, as values are relatively stable across time and context, strategies aiming at changing production and consumption environments may be more feasible as short-term solutions. Leveraging insights from behavioral economics, farmers and food company managers could be motivated to engage in circular practices by redesigning the environment in which choices are made (Wuepper et al., 2023). For example, strategic financial incentives could (further) convince farm and food company managers to reuse by-products from agricultural production or food processing, close nutrient cycles and innovatively redesign farming and food production to reach greater circularity (Awasthi et al., 2021). In consumption environments, subsidies could be implemented for consumer products together with appropriate labels for e.g., recycled products or nudges that trigger social norms to collect bio-waste (Cialdini, 2003).

For the success of interventions, it is especially important to consider that agrifood activities from producing to distributing, consuming, and disposing food are interrelated. This means that one activity cannot be transformed in isolation as it also affects other activities and actors performing them (Muscat et al., 2021). For example, converting food waste of households into fertilizers for the regeneration of agricultural soils can only be successful if biowaste is collected in sufficient volumes, if farmers are willing to adopt alternative fertilizers and if regulations allow them to do so. Therefore, we need relational approaches, this means that besides focusing on advancements in circular resource use, social-science scholarship needs to understand diffusion processes and social interrelationships of circular practices in the food system and their impact across different spatial scales.

6. Connecting social science perspectives to a practical roadmap toward circular urban food systems

Envisioning a circular urban food system poses significant challenges, particularly given the dominance of linear, asymmetrically distributed food production systems that depend largely on global value chains (Arauzo-Carod et al., 2022). While scientific research has made considerable progress in uncovering the complexities of food systems, it often underrepresents the social dimensions of circular transitions (Kruse and Wedemeir, 2023). We have argued that from an economic perspective addressing these gaps requires shifting from a merely transactional economic logic to an approach that explicitly recognizes and appreciates economic interactions as social relations among actors and spatial scales in urban food provisioning, influenced by multi-level governance structures and daily food practices in cities. In the following section we present a roadmap with key components where social science perspectives should contribute to understanding how cities can become a transformative force towards food system circularity, and insights from steps that have been taken in this direction.

6.1. Understanding and valuing systemic interdependencies

This understanding requires making interdependencies in the food system explicit, embracing the complexity of food systems, including recognizing the broader spatial and temporal dimensions of social relations and outcomes. The impacts of urban food system changes are not limited to local well-being but extend to future generations and communities elsewhere, both regionally and globally (PBL, 2020; Willett et al., 2019; FAO, 2023). The "butterfly effect" serves as a good metaphor to describe these ripple effects, illustrating how urban transformations can trigger far-reaching consequences in interconnected food systems, and vice-versa.

We need awareness of how this urban transformation affect interactions across different scales: (1) among actors at the urban level, emphasizing local cycles in integrative environmental strategies; (2) among actors at the urban and peri-urban level, emphasizing regenerative resource systems with reciprocal food and waste flows; and (3) among the urban and rural level, highlighting the potential increase in circularity associated with reductions in urban metabolism. In rewiring these relationships, for example through shorter supply chains, changes in diets and stimulating urban food production we must also consider its impacts on marginalized communities and small-scale producers. Making these relations and reciprocities more tangible is crucial for promoting mutual dependence and inclusive governance (Poudel and Shaw, 2024). Emerging methodologies, such as blockchain technology for transparency and traceability for inclusive value creation (Chu and Pham, 2024; Jell-Ojobor and Kramer, 2022) or social life cycle assessment tools (Petti et al., 2018), offer promising approaches to operationalizing circularity. Further developing such tools that provide realistic insights in how changes in urban food systems affect social outcomes across scales is crucial to inform decisions that do justice to the social aspects of circularity.

6.2. Applying systems thinking in urban food governance

A growing number of cities are successfully applying systems thinking to redesign their food systems, incorporating social dimensions alongside environmental and economic considerations. Identifying best practices from these cases can provide valuable insights. The city of Amsterdam, for example, has concrete ambitions to contribute to a more sustainable, healthier, and local food system. In their food strategy they highlighted six action lines, focusing on food as a social connection, a healthy food environment, but also regional production and distribution and food waste. Within several (EU-funded) projects—such as EU4Advice on short food supply chains, and the aforementioned Bin2Bean—-they are building on networks of people to create synergies between innovation activities in both high-tech and low-tech food activities.

6.3. Leveraging existing regulatory frameworks for circularity and overcoming barriers to policy innovations

Although there are important differences in the forms of local autonomy–depending on the relation to national governments (Bulkeley et al., 2018)–cities can have significant influence on urban planning and infrastructural development, offering opportunities to integrate circular food strategies within existing regulatory frameworks. However, despite growing interest in circular urban food governance, several barriers still hinder food governance innovation. Relevant constraints have been identified in this regard, including the absence of stakeholder mapping, weak policy integration, and the lack of food strategies and monitoring mechanisms (Polman and Bazzan, 2023).

Moreover, cities may be severely restricted by current legal frameworks, both at the international (e.g., EU), and national level, which hinders circularity transitions at the urban level. For example in the legal frameworks that regulate waste (e.g., Greer et al., 2020), overcoming these barriers requires a combination of structural (legal) policy adjustments and targeted interventions aimed at shifting non-circular behaviors (Lazaro et al., n.d.; Wensing et al., 2025).

Lessons from the built environment demonstrate how innovative assessment tools can evaluate urban circularity (Chartier and Pot, 2024). Such tools could be extended to food systems but should explicitly incorporate social dimensions. However, current public policies for the circular economy tend to be designed at higher administrative levels,

such as the EU, overlooking the benefits of localized governance (Arauzo-Carod et al., 2022). This mismatch between policies and regulations at multiple spatial scales, is often perceived as one of the main barriers for actors in implementing policy innovations (van Leeuwen, Meinardi, 2024).

One recurring aspect related to urban food governance is that of policy integration of food in other policy domains—for instance, combining urban agricultural policies with initiatives that empower marginalized groups (Burke, 2024)—and coordinating with other cities and peri-urban areas. The push for integrated policy agendas remains valuable, but existing attempts still underemphasize the social dimensions and the differential impacts on various communities (Sonnino, 2023). This observation by Sonnino (2023) further emphasizes the importance of understanding and valuing systemic interactions.

6.4. Changing socio-cultural drivers of circularity

Effective urban food system governance can steer social actions toward more circular practices and behaviors. In order to do this it is paramount to develop policy interventions to not just change the inclusion of actors in policymaking or regulate the material context, but also affect socio-cultural drivers that affect circularity, such as environmental awareness and social practices. Strategies such as education campaigns, community-based initiatives, and broader environmental education programs have been identified as effective tools, while regulatory approaches that penalize non-circular behaviors may be counterproductive (Voukkali et al., 2023). Ultimately such interventions that change socio-cultural drivers should result in more circular social norms.

6.5. The role of social norms and perceptions

Cultural norms and values play a crucial role in shaping public acceptance of circular practices. For example, social norms around diet and waste management, such as consuming insects or adopting indoor composting, can either facilitate or obstruct circular transitions. Further understanding the dynamics of acceptability is therefore essential. Psychological and cultural barriers significantly impact the adoption of circular behaviors (Gonella et al., 2024). Social influence—via peers, family, and broader social networks—can be an important factor in overcoming these obstacles.

Moreover, there are different perceptions in society about what circularity is, or should be. These different imaginaries of circularity influence policy and governance decisions, raising critical questions about whose visions of circularity are prioritized (Fratini et al., 2019). Being transparent about these normative dimensions is key to ensuring an inclusive and equitable food system transition. We therefore emphasize the importance of recognizing the normative dimensions of circularity, encouraging both researchers and practitioners to engage in action-oriented research that acknowledges the diversity of perspectives and knowledge, and therefore develop contextually grounded understandings and problem-solution pathways (Fazey et al., 2018). This involves valuing local knowledge from (urban) stakeholders as much as academic knowledge from social scientists in shaping sustainability transitions (see for example the initiative of IPBES, nd, for inclusion of local indigenous knowledge in biodiversity governance). Co-creation efforts between researchers and local stakeholders are essential to navigate power dynamics, diverse goals and trade-offs in food system transitions (Chambers et al., 2021).

For this purpose, urban living labs offer a practical tool, creating experimental spaces where researchers, policymakers and citizens can collaboratively design, test and iteratively refine circular solutions in real-world contexts (Florez Ayala et al., 2022; Dijkstra and Joore, 2025), encouraging quick trials of innovative ideas in real-word environments (Scholl et al., 2022). For example, the Horizon Europe Project Bin2Bean currently establishes three urban living labs in Amsterdam (Netherlands), Hamburg (Germany) and Egaleo (Greece) to enable the cities' transitions towards the valorization of their biowaste into soil improvers (Bin2Bean, 2024). These urban transitions require the collaboration of diverse groups of stakeholders, the integration of their knowledge and–most importantly–a continuous discussion and reassessment of the common goals of the living labs. Moreover, a such projects can have important educational aspects—such as raising awareness and creating trust—and can provide valuable insights into whether systems align with current waste disposal and collection practices, while offering insights into how to make more circular forms of waste separation *the right thing to do*.

6.6. Limitations

While this paper offers a comprehensive exploration of circular urban food systems from a social science perspective, several limitations should be acknowledged. First, given the breadth of social sciences, it is impossible to fully capture the diverse theoretical and methodological approaches that could inform this topic. Our perspective attempts to grasp broader trends and insights, however, we want to emphasize that local applications remain essential, as broad scalable frameworks conflict with the large variation in contextual factors shaping urban food governance. Moreover, when we discuss governance and policy innovations, we mostly focus on changes implemented at the local level, we therefore do not comprehensively address the spillover of these changes on the governance of global value chains, which are an important aspect in interconnected food systems. Also, data limitations hamper our ability to fully assess the social dimensions of circularity, as existing research primarily emphasizes environmental and economic aspects (Kruse and Wedemeier, 2023). Addressing these gaps will require the development and application of innovative methodologies for capturing the complexities of social interactions within circular food systems.

7. Conclusion

Despite the sheer potential agency in reducing environmental impacts and related societal risks associated with urban food consumption and food waste accumulation, cities struggle to lead the transition away from linear take-make-dispose constellations. This paper takes circularity beyond its material dimension and argues for socially informed food system perspectives that consider economic processes and relations, governance, and daily practices as fundamentally interrelated aspects of circularity transitions. The idea of circularity emphasizes cooperative, creative and system-level solutions–as opposed to competitive, efficient and individual-level pursuits–we conceptualize circularity as a relational design principle across different spatial levels.

To move toward socially informed circular urban food systems, there are several important steps that can help to address the asymmetries in food consumption and production. First, emerging methodologies, such as blockchain technologies for transparency and traceability, and social life cycle assessment tools, need to be advanced to help operationalize circularity in a way that captures social outcomes across spatial scales. Second, networks of actors across diverse food practices should be developed, fostering synergies and promoting shared learning across food value chains. Third, more integrated and coordinated governance and policy approaches are required to overcome barriers to system transformations. These approaches should include education campaigns and community-based initiatives, as important tools to shift socio-cultural norms and stimulate behavioral change. Finally, creating experimental spaces for researchers, policymakers, and citizens to collaborate, co-design, test, and refine circular innovations can continue to support the development of inclusive and adaptive governance models.

In each of these steps more work is to be done for social scientists to develop new methodologies and policy interventions that make the

complexity of social interactions within food systems visible, enabling more context-sensitive and socially grounded transitions.

With this paper we call for a further exploration of the transformative potential for designing, analyzing and evaluating circular economy strategies, governance and practices from an urban perspective. We invite scholars to engage in a socially embedded food system perspective on urban circularity transitions, by highlighting important conceptual, methodological and empirical research avenues and contributions that we see as relevant to a broader social science perspective on the role of cities in in food system circularity.

In conclusion, connecting social science perspectives to a practical roadmap for circular urban food systems requires a context-sensitive multidimensional approach that embraces interdependencies, rewires relationships, and integrates social aspects into governance frameworks, alongside technological and infrastructural changes. By addressing barriers to policy innovation and leveraging socio-cultural drivers, cities can foster inclusive, socially sustainable circular system food transitions.

CRediT authorship contribution statement

Joana Wensing: Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Eveline van Leeuwen:** Writing – review & editing, Conceptualization. **Jose D. Lopez-Rivas:** Conceptualization. **Stephanie Begemann:** Conceptualization. **Liesbeth de Schutter:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Daniel Polman:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization.

Declaration of Competing Interest

We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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