TRANSITION TO CIRCULAR FOOD SYSTEMS: A STUDY OF STAKEHOLDERS IN FIVE BRAZILIAN MUNICIPALITIES

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TRANSITION TO CIRCULAR FOOD SYSTEMS: A STUDY OF STAKEHOLDERS IN FIVE BRAZILIAN MUNICIPALITIES

Transição para sistemas alimentares circulares: Um estudo dos stakeholders em cinco cidades brasileiras

Transición hacia sistemas alimentarios circulares: Un estudio de stakeholders en cinco municipios brasileños

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ABSTRACT

The circular economy (CE) proposes a development model that favors economic growth combined with the rational use of natural resources and the reuse of waste. To mitigate food insecurity and gas emissions, CE principles can be applied to urban food systems. This study addresses how stakeholders can influence the development of the circular economy to create more sustainable and equitable urban food systems. The research analyzed qualitative data collected with management teams from the cities of Rio Branco (AC), Santarém (PA), Recife (PE), Maricá (RJ), and Curitiba (PR) to analyze municipal governance and identify good practices aligned with the development of policies and programs to promote circular food systems. The results suggest that the change to circular food systems requires the qualification of local technical teams, quality management, a systemic vision of food, and multi-level governance, in addition to the ability to connect food and nutritional security programs with the aim of minimizing the generation of waste and maximizing the use of healthy foods. The research contributes to advancing the governance of urban food systems and provides input for improving local public policies aligned with environmental sustainability and food sovereignty in cities.

Keywords: circular economy, sustainable food systems, food security, food waste, social justice.

RESUMO

A economia circular (EC) propõe um modelo de desenvolvimento que favorece o crescimento econômico aliado ao uso racional dos recursos naturais e reaproveitamento dos resíduos. Para mitigar a insegurança alimentar e as emissões de gases, os princípios da EC podem ser aplicados aos sistemas alimentares urbanos. Este estudo aborda como os stakeholders podem influenciar o desenvolvimento da economia circular na constituição de sistemas alimentares urbanos mais sustentáveis e equitativos. A pesquisa analisou dados qualitativos coletados com equipes gestoras das cidades de Rio Branco (AC), Santarém (PA), Recife (PE), Maricá (RJ) e Curitiba (PR) para analisar a governança municipal e identificar boas práticas alinhadas ao desenvolvimento de políticas e programas de fomento a sistemas alimentares circulares. Os resultados sugerem que a mudança para sistemas alimentares circulares requer qualificação das equipes técnicas locais, gestão da qualidade, visão sistêmica da alimentação e governança multinível, além da capacidade de conectar programas de segurança alimentar e nutricional com o intuito de minimizar a geração de resíduos e maximizar o aproveitamento dos alimentos saudáveis. A pesquisa contribui para o avanço da governança dos sistemas alimentares urbanos e fornece insumos para o aprimoramento de políticas públicas locais alinhadas à sustentabilidade ambiental e à soberania alimentar nas cidades.

Palavras-chave: economia circular, sistemas alimentares sustentáveis, segurança alimentar, desperdício alimentar, justiça social.

RESUMEN

La economía circular (EC) propone un modelo de desarrollo que favorece el crecimiento económico combinado con el uso racional de los recursos naturales y la reutilización de residuos. Para mitigar la inseguridad alimentaria y las emisiones de gases, los principios de la CE se pueden aplicar a los sistemas alimentarios urbanos. Este estudio aborda cómo las partes interesadas pueden influir en el desarrollo de la economía circular en la creación de sistemas alimentarios urbanos más sostenibles y equitativos. La investigación analizó datos cualitativos recopilados con equipos de gestión de las ciudades de Rio Branco (AC), Santarém (PA), Recife (PE), Maricá (RJ) y Curitiba (PR) para analizar la gobernanza municipal e identificar buenas prácticas alineadas con el desarrollo. de políticas y programas para promover sistemas alimentarios circulares. Los resultados sugieren que el cambio hacia sistemas alimentarios circulares requiere capacitación de equipos técnicos locales, gestión de la calidad, una visión sistémica de la alimentación y gobernanza multinivel, además de la capacidad de conectar programas de seguridad alimentaria y nutricional con el objetivo de minimizar la generación de residuos y maximizar el uso de alimentos saludables. La investigación contribuye a avanzar en la gobernanza de los sistemas alimentarios urbanos y proporciona insumos para mejorar las políticas públicas locales alineadas con la sostenibilidad ambiental y la soberanía alimentaria en las ciudades.

Palabras Clave: *economía circular, sistemas alimentarios sostenibles, seguridad alimentaria, desperdicio de alimentos, justicia social.*

INTRODUCTION

Local governments, especially in Northern Hemisphere countries, have been applying the principles of the circular food economy to help mitigate greenhouse gas emissions (Lever & Sonnino, 2022). Meanwhile, there are growing initiatives in the Global South to include public policies more strongly on municipal agendas that favor the fight against hunger and align with the logic of so-called circular food systems (FAO & ICLEI, 2022; Tangari & Porpino, 2023). The shift towards a circular economy in food systems stems from the need to tackle inefficiency in the use of natural resources, socio-environmental effects, and food waste (Jurgilevich et al., 2016). It also encompasses more sustainable production practices, greater stakeholder accountability and awareness, and appropriate policies and instruments. Programs involve promoting healthy and sustainable diets, reducing food waste, strengthening short food supply chains, and supporting sustainable urban and peri-urban agriculture practices (IPES-Food, 2023).

The circular economy of food mimics natural regeneration systems so that there is no waste but raw material for another cycle (Ellen MacArthur Foundation, 2019). This study, based on the experience of the cities of Rio Branco (AC), Santarém (PA), Curitiba (PR), Recife (PE), and Maricá (RJ), is based on the assumption that circular food systems, characterized by the promotion of regenerative farming practices, minimizing waste generation at different stages of the production chain, reusing waste and maximizing the use of food, are a local alternative (Dagiliene et al., 2021) to tackle two global challenges: food and nutrition insecurity and climate change. This work answers the following research question: What is the most effective role for cities in implementing circular food systems? The general objective is to analyze the implementation of circular economy practices in food systems within local governments. The specific objectives are to identify best practices, examine causes of success, analyze implementation obstacles, and evaluate the governance of public food policies.

The involvement of local governments in promoting Food and Nutrition Security (FNS) is justified by the challenge of expanding access to healthy food in urban areas, one of the action axes of the national program "Alimenta Cidades", launched at the beginning of 2024 by the Brazilian Ministry of Development and Social Assistance, Family and Fight against Hunger (MDS). According to the MDS (Alimenta Cidades, 2024), 83% of severely food insecure Brazilians live in cities, equivalent to 27.4 million people. As Grisa et al. (2022, p. 26) point out, the appreciation of local governments in the implementation of food policies is due to "the intensification of urbanization; the intertwining of food, environmental and social food, environmental and social issues in the territories; and the opportunities that local and regional opportunities that the local and regional offer for articulating actors and sectors, and building of integrated food policies".

The qualitative study is justified by the perspective of depth and proximity to the actors who plan and implement circular and urban food systems in Brazil, considering that the concept of circular food systems is recent in the literature. As Moustier et al. (2023) point out, the productivist narrative that it is necessary to increase food production in order to strengthen global food

security is still strong in the literature, but efficiency gains by reducing waste can contribute to increasing food availability in cities. In addition, consumer access to food is increasingly relevant in urban environments, where the majority of consumers do not produce their own food.

Food systems are impacted by conflicts, economic crises, and climate change. The combination of these elements with food inflation and social inequalities forms the basis of the main factors causing food insecurity and nutritional deficiency (FAO et al., 2023). In this context, which puts to the test the ability to provide healthy, safe and affordable food to the entire society, the need to drive the transformation of food systems becomes urgent, and requires strategies that involve multiple actors (Bernardi et al., 2022) and the dynamic engagement of municipalities (Wensing et al., 2023).

In addition, the adoption of circular food systems in cities is emerging as a promising strategy to transcend the paradigm of linear production, consumption, and disposal in favor of making full use of food. This can be achieved through initiatives such as food redistribution, strengthening composting, new uses for organic waste, and encouraging social gastronomy and entrepreneurship (Ellen MacArthur Foundation, 2019; European Commission, 2023, 2024).

For the purposes of this analysis, governance is conceptualized as the framework made up of rules, regulations, spaces for dialogue and consultation, as well as the positions that preserve and regulate the doctrines of the food system, including the dynamics and command relationships between the entities participating in the food agenda in cities. Thus, the fulfillment of governance in food policy is manifested by the governing provisions that guide the dialogues between the participating and potential agents, as well as their fundamental activities (Carvalho et al., 2022).

Considering that 87% of Brazil's population lives in urban areas (IBGE, 2024) and approximately 80% of the total food produced globally is used in urban areas (EAT, 2022), cities emerge as drivers for positive change, promoting the cultivation and consumption of food in a sustainable way. In addition, in the European Union (EU), approximately 75% of inhabitants live in urban areas (Eurostat, 2022), which leads to obstacles in ensuring proper nutrition (FAO et al., 2023).

Among the obstacles, there is a greater prevalence of processed foods, which are accessible and low-cost but have abundant sugars, salt and fats, and encourage a preference for nutritionally deficient products (FAO et al., 2023). This reality of modern food systems contributes to the global syndemic of obesity, malnutrition, and climate change. According to Grisa et al. (2022), processed and ultra-processed foods are not only widely available in easily accessible areas in Brazilian cities but are also cheaper and more convenient to consume, accommodating the so-called food deserts or swamps, where access to healthy foods is more restricted. In addition, there is an insufficient supply of vegetables and fruit needed to meet the nutritional requirements of balanced meals for citizens, the marginalization of family farmers from formal production systems, and the loss of property and assets due to urban growth.

In turn, urbanization provides opportunities for more extensive and intricate food supply chains and promotes the growth of income-generating activities in non-agricultural sectors in cities, particularly benefiting young people and women entrepreneurs (FAO et al., 2023).

Furthermore, successful cases observed in this study in the municipalities of Maricá and Curitiba show that the synergy between rural and urban areas can be stimulated by producing food in horticultural and urban agricultural spaces, along with supporting production in belts around metropolitan regions. There is also the possibility of integrating municipal policies with the interests of urban consumers for organic products, as illustrated by the program to encourage agroecology in Recife. The challenges remain, however, of guaranteeing smaller-scale producers broad access to technical assistance and rural extension and credit, especially public Technical Assistance and Rural Extension (ATER) for locations in the North and Northeast (Cruz et al., 2020).

In urban contexts, possibilities arise for establishing connections between distribution centers and retailers with food banks, strengthening solidarity kitchens, and other social gastronomy actions connected with community gardens. In addition, integrated and transdisciplinary approaches to food and nutrition education can be implemented in educational institutions, as exemplified by initiatives in Santarém, a city with several cooperatives of floodplain producers that supply food to the local school feeding program.

THEORETICAL FRAMEWORK

Stakeholder Theory in Food Systems

Stakeholder theory proposes that organizations consider the preferences and shortcomings of all the agents included (shareholders, employees, customers, local communities, and governments, among others) rather than focusing solely on maximizing shareholder value (Freeman, 2010). In the context of food systems, this theory highlights the interconnection between various participants, from farmers to consumers, policymakers and civil society organizations, as well as Technical Assistance and Rural Extension institutions, agricultural research, and actors involved in promoting agricultural credit and transferring technologies to rural producers, for example. It also offers a framework for analyzing the power dynamics within food systems, in which inequalities are rooted and conflicts between actors can exist, which are fundamental for long-term sustainability and supported by an ethical perspective (Freeman et al., 2007). By identifying the various actors and their interests, we can ensure that their perspectives inform decision-making procedures, barriers, and motivations in the development of the circular economy (Jabbour et al., 2020). Recognizing and addressing the needs of marginalized communities, smallholder farmers, and vulnerable populations is crucial to creating inclusive and equitable food systems that achieve food security and reduce inequalities (Miranda et al., 2021).

Stakeholder theory highlights the importance of building trust, promoting dialogue, and creating shared value between diverse groups (Freeman, 2010). By bringing stakeholders together and aligning their interests, we can develop innovative solutions, harness collective resources, and drive systemic change towards sustainability and resilience. In addition, it proposes the

inclusion of diverse actors in decision-making processes, recognizing their legitimate rights and expectations. This approach encourages transparency and accountability, essential principles for establishing more sustainable and equitable food systems (Horisch et al., 2014).

In the context of food systems, the application of stakeholder theory can lead to greater traceability, responsible sourcing practices, and ethical consideration of social and environmental impacts in all interconnected businesses. Through transparency and accountability, we can build trust between stakeholders and ensure that food systems operate in a way that respects human rights, promotes environmental stewardship, and takes social responsibility (Kayikci et al., 2022). The combination of diverse perspectives and resources empowers stakeholders to implement innovative solutions together, ranging from sustainable production methods to the development of efficient distribution channels and the promotion of responsible consumption patterns, highlighting elements of co-creation throughout the chain (Norde et al., 2023). In this sense, cities can be true innovation laboratories, with solutions for urban food systems being thought up and implemented by actors from farm to fork in conjunction with startups, entrepreneurial institutions, and academia. This has been observed in the city of Valencia (Spain), which has a social and urban innovation center (Las Naves) working on food and climate change (Comida do Amanhã, 2023).

Circular Economy and Sustainable Food Systems

The current economic model has driven economic expansion for decades but at a significant environmental cost, evidenced by reduced biodiversity, pollution, and increased waste. The concept of the circular economy (CE) is a challenging alternative to this paradigm and seeks to decouple economic activities from the unbridled consumption of resources and the deterioration of the environment (Kirchherr et al., 2023). CE is based on regenerative principles, with the continuous circulation of productive systems, conceiving principles of reintegration throughout the life cycle of food products, which minimizes the generation of waste and residues (Kayikci et al., 2022). Within food systems, CE encompasses regenerative and organic agriculture, the use of renewable energies and organic raw materials, and the reuse and recycling of packaging (Ellen MacArthur Foundation, 2019). To achieve this transformation, a change of perspective is needed, migrating from the "end of life" vision to that of "renewal at the end of use". This shift requires rethinking product design, business models, and consumption patterns, paving the way for a resilient and ecologically balanced future (Henderson, 2023).

Sustainable food systems balance economic, social and environmental dimensions and provide nutritious, affordable and culturally appropriate food for the entire population, in line with the protection and regeneration of natural resources and biomes (FAO & ICLEI, 2022; Wensing et al., 2023). They derive from the implementation of sustainable food systems, positive impacts on (i) the adoption of healthy diets; (ii) the regeneration of ecosystems; (iii) the mitigation of climate change and (iv) the promotion of social justice (Caron et al., 2020).

Food systems are characterized by the complex interconnection of their elements. Stakeholder theory offers a systemic lens to analyse the complexity of food systems, distinguishing the interrelationships between the multiple agents involved and the compromises necessary to create systems that are characterized by sustainability. Adopting this approach makes it possible to understand the multifaceted effects of food systems on ecology, health, and the economy. This holistic understanding helps to develop cohesive strategies that take into account the diverse perspectives and interdependencies of food systems.

In contrast to modern food systems, characterized by long chains of production and consumption and associated with the production of commodities for export and an ample supply of food that increases the risks of overweight and diseases associated with poor diet (HLPE, 2017), local food systems take into account local culture, forms of governance, territorial modes and processes of production (Grisa et al., 2022).

The adoption of agroecological practices is a fundamental pillar for building sustainable food systems (Gliessman, 2021). These practices aim to promote biodiversity, healthy soils and nutrient cycling, using techniques such as crop rotation, integrated pest management and the use of bio-inputs. In addition, sustainable food systems encourage the preservation of traditional knowledge and the strengthening of small producers (FAO, 2020).

Food systems are characterized by their complexity and interconnectedness and generate effects that transcend specific entities or sectors. Stakeholder theory proposes a systemic lens to analyse this complexity, recognizing the interdependencies between the various actors involved and the compromises needed to establish more sustainable systems (Kusumowardani, 2022). Adopting this comprehensive perspective allows for a deeper understanding of the multifaceted impacts of food systems on environmental health, public well-being, economic growth, and social equity. This holistic view facilitates the identification and treatment of crucial issues and promotes the creation of cohesive solutions that consider the diverse perspectives and interdependencies present in food systems (Miranda et al., 2021).

Urban Food Systems

As global populations concentrate in metropolitan regions, the need to supply food to these urban conglomerations intensifies (CEMAS, 2020). Metropolitan food networks constitute a broad network of actors that guarantee access to food for urban residents. This network encompasses cultivation, processing, distribution, consumption, and post-consumption management of food waste, all within the specific socio-cultural and economic context of urban environments (Miranda et al., 2021). City governments should encourage the use of regional resources to develop more resilient systems capable of addressing, in a more coherent way, the complex interaction of social and economic factors and environmental problems present in food systems (Lever & Sonnino, 2022). To this end, promoting sustainable consumption, increasing the use of by-products and co-products from the food industry, composting organic waste for use in urban and peri-urban agriculture, community gardens and social gastronomy actions (CEMAS, 2020; Azunre et al.,

2019) are part of the agenda for local governments. These initiatives also promote circularity by incorporating connections between the production of urban gardens and solidarity kitchens or, for example, between local retailers and food banks.

Innovative models such as social retail, itinerant food vendors and even sustainable community currencies (Diniz et al., 2024) are improving the link between producers, consumers and the public sector. This increases the availability of fresh and healthy foods, while strengthening the local economy and increasing social justice by expanding the acquisition of nutritious foods by the low-income population.

Building sustainable and equitable urban food systems requires the collaboration and engagement of a multitude of stakeholders (Caron et al., 2020; CEMAS, 2020). City administrations, urban development planners, farmers, food industry entities, social organizations and consumers take on relevant roles in orchestrating the food landscape of urban environments (Kayikci et al., 2022). By adopting a synergistic approach to overcoming challenges and seizing opportunities, it is possible to create urban food systems that are not only characterized by their proficiency and robustness, but are also configured as environments conducive to health, equity and ecological preservation (Norde et al., 2023). In short, urban food systems are complex and constantly evolving entities that face numerous challenges but are also full of untapped potential.

METHODOLOGY

This study is part of a research project approved by the Technical Committee of Embrapa Foods and Territories, and complies with regulatory requirements. The methodology employed is structured into the following phases: 1. criteria for choosing and selecting the participating cities; 2. data collection methods; 3. data analysis and coding.

The determination of the cities included in the study was based on the local heterogeneity of the municipalities and their participation in the Urban Laboratory of Public Food Policies (Luppa), an initiative made up of 38 Brazilian cities coordinated by the "Comida do Amanhã" Institute. A public call was issued to municipalities with a population of more than 150,000 inhabitants, members of Luppa, to apply for one of the five positions available. The cities expressed their interest using an electronic form, detailing initiatives that are congruent with the sustainability of urban food systems, explaining their reasons for joining the project, and providing a letter of commitment signed by the mayor. Participants were selected from government representatives and non-governmental organizations (NGOs), including the first and third authors as active members who took part in the research on site. The choice was based on an analysis of the information with a focus on theoretical relevance and understanding of the phenomenon (Flick, 2008), including as one of the criteria the inclusion of at least one city from each of the four clusters of food systems identified in Brazil (Norde et al., 2023). The cities selected were Rio Branco (AC), Santarém (PA), Recife (PE), Curitiba (PR) and Maricá (RJ).

After selecting the cities, a schedule was drawn up for visits to collect empirical data, opting for focus group discussions as the method, given the range of actors involved in each location. The focus groups included managers from the five cities and a semi-structured script was used, developed on the basis of the literature review and aligned with the research objectives. The Stakeholder Theory highlights the interdependence between stakeholders, which, in the context of urban food systems, include suppliers, distributors, government agencies, and community organizations. The strategy was to involve representatives from diverse groups, which allowed different perspectives to be captured, leading to a more comprehensive understanding of the system and gleaning effective improvement strategies.

In total, 44 people were heard in the focus groups: 13 in Santarém (PA), 11 in Maricá (RJ), 9 in Curitiba (PR), 8 in Rio Branco (AC), and 3 in Recife (PE), shown in Table 1. To ensure the comparability and consistency of the data collected in the face of variations in the number of participants, the scripts were applied consistently and with a focus on the participants' ability to contribute to the theoretical development of the research (Flick, 2008). The discussions were monitored in person by one researcher, and another researcher monitored the focus group remotely. In addition to the data collected through the focus groups, on-site observations were made, with field notes taken during visits to public food security facilities and initiatives to promote sustainable urban food systems in the five cities. The researcher involved in the field visits spent at least two days in each city to get to know the local programs and interact with the management teams. Interactions with the cities continued by digital means during the data analysis phase to clarify doubts. The research project also involved a technical mission to Europe to learn about the experiences of the cities of Barcelona, Ghent, Milan, Turin, and Valencia, which have sustainable urban food systems.

Table 1. Sample breakdown

Focus group location	Number of participants	Institutions represented	Main initiatives visited
Curitiba	9	Food and Nutrition Security Secretariat; Education Secretariat	Urban farm; food bank; Family warehouse; Family market; Urban gardens; Composting / Caximba; Popular restaurants; FNS school; Municipal market; Ahú open market.
Maricá	11	Secretariat of Agriculture, Fishing and Supply; CONSEA; Secretariat of Social Assistance; Secretariat of Sustainable City; Mayor's Office	Agroecological square; Dehydrated food factory; Public farm; Fish truck; Urban gardens; "Baldinho do Bem" composting project; Popular restaurant.
Recife	3	Urban Agriculture Department	Public schools (school meals and vegetable gardens); composting yard/mayor's office; urban vegetable garden; seedling nursery; São José market; Santa Rita and Afogados street markets; Sesc food bank.

Continue

Table 1. Sample breakdown — Concludes

Focus group location	Number of participants	Institutions represented	Main initiatives visited
Rio Branco	8	Environment Secretariat; Planning Secretariat; Education Secretariat; Food Safety Division.	Waste Treatment Unit (UTRE)/composting; school gardens; urban garden; popular restaurant; food bank; producer's market/ Ceasa.
Santarém	13	Department of Education; Department of Agriculture and Fisheries; Department of Social Assistance; School Feeding Coordination.	Rural producers' cooperatives; public schools (vegetable gardens and school meals); seedling nursery; popular restaurant; fish market.

The discussion groups began with an introduction of the participants and a presentation of the project. The moderators (2 researchers) of the session continued the interaction with the interviewees. Next, challenges in the management process were addressed, evaluating successful practices and the failures observed on the journey. Throughout the interview, the moderators allowed for slight deviations from the subject that contributed to the dynamic. The sessions lasted between 45 and 120 minutes (average 90 minutes).

The sessions were recorded, and the data was transcribed. The transcribed data and field notes were coded using Excel spreadsheets. The data was examined using thematic analysis by identifying themes and patterns without prior judgment and observing patterns about the themes (Riger & Sigurvinsdottir, 2016). Coding of the full transcripts was done independently by two researchers. Subsequently, the themes were compared and reviewed by two reviewers external to the project. The themes were identified by grouping them by similarity, using a process of iterative refinement by the researchers. The categories that emerged as the most relevant were validated through review by some participants in the discussion sessions.

RESULTS

The thematic analysis, based on the empirical data from the focus groups and observations, revealed four central themes, previously defined in the literature (Gibbs, 2009), in the urban food systems analyzed: 1) People, emphasizing the various dimensions and impacts of human resources in the planning and execution of policies aligned with food systems; 2) Quality management, which focuses on the quality of services provided by public FNS facilities, in addition to the food safety aspect; 3) Intersectorality and a systemic view of food, which highlights the interdependence between the different sectors and levels of government involved in implementing programs; and 4) Multilevel and democratic governance, reinforcing the importance of the participation of

different stakeholders in the governance of food systems. These themes emerge as key areas for discussing the structures that govern more sustainable food systems in Brazil. Detailed results for each theme are presented below.

People

The effective implementation of permanent public food policies, conceived as a duty of the state, requires technical administrators with managerial skills and leadership abilities. The human factor, including the participation of staff in the implementation and operation of initiatives, is crucial for establishing a solid and effective urban food program. This dimension is clear from the following observation, based on the data collected and observations made:

> Establishing and maintaining a qualified technical staff represents the fundamental step for municipalities to outline urban food policies. The presence of technicians with decision-making capacity is a critical factor for the continuity of food and nutrition security programs (Tangari & Porpino, 2023).

There was also a link between the availability of a technical team made up mostly of career civil servants, as observed in Curitiba, and the sustainability of food programs and policies. Having people with a specific focus on local food systems, as in the case of Recife's Urban Agriculture Department, is also crucial to leveraging policies aligned with local production and access to food. By opting for a technical team, municipalities reduce the risk of actions being discontinued with each change of government. The "people" segment, which also includes the number of employees in the municipal departments involved, emerges as a condition for cities to achieve the other central themes identified in the study: quality management, intersectorality, a systemic vision and circularity.

Quality Management

Quality management, focused on the provision of services by public FNS facilities and the running of municipal programs, emerged as an important factor from the content analysis of the focus groups and, in particular, after the observations conducted in Curitiba. In addition to guaranteeing the quality of the service provided, for example, by popular restaurants and food banks, management must take a specific look at food safety in public markets, open-air fairs, and the organization of traditional retailers through regulations. In Curitiba, free markets and public markets are obliged to sell animal protein exclusively on refrigerated shelves. The regulations for permission holders also include guidelines for the minimum product mix in social retail initiatives (e.g., Sacolão da Família). It was also observed that, in Rio Branco (AC), the constant presence of nutritionists in popular restaurants and the involvement of social

workers in serving the population increases the perception of the quality of the service provided. In Santarém, the constant dialog between public agents and rural producers' cooperatives and the involvement of nutritionists in drawing up school menus contributes to the provision of school meals based more on local foods and increases students' acceptance of the food on offer, as well as generating income for small producers and avoiding losses due to the difficulty of accessing markets.

Intersectorality and a Systemic View of Food

The principle of intersectorality emphasizes the importance of networking, which encompasses the collaboration of various municipal departments, configurations between various stakeholders, including civil society, various strata of government, academia and the productive sector. It is accepted that intersectorality manifests varying degrees of application, considering civic participation through councils as a crucial initial stage in this process.

The diversity of the scope of actions focused on Food and Nutrition Security is a significant axis. Common initiatives include solidarity kitchens, community gardens, popular restaurants and food banks, but there is the possibility of strengthening the multifunctionality of the programs. This has been seen, for example, in Curitiba's urban farm, which, in addition to producing vegetables, works as an education and training tool and also connects with the municipal food bank. These ventures encompass various dimensions of public policy interventions, fostering the congruence of food policies and the practice of management based on different sectors. For example, popular restaurants, when established in spaces that favor well-being, go beyond their original purpose of providing healthy food to vulnerable segments of the population and become environments for social interaction for immigrants and the elderly, as seen in Rio Branco (AC) and Santarém (PA).

Achieving circularity requires a systemic perspective and involves analyzing the relationships between agents from agricultural production to consumption, taking into account the macro-structure of food systems and all the restrictive side-effects in these sectors. Encouraging local producers represents the first stage in the food production process and has the potential to be amplified by public procurement projects. Recognizing local producer cooperatives and strengthening the connection between these arrangements and the school feeding program, as identified in Santarém, generates income in the countryside, fosters short production and consumption circuits and avoids losses due to lack of access to markets, and promotes positive impacts on the nutrition of the student community.

Another positive example of a systemic vision is the promotion of agroecological production, exemplified in Recife, a government strategy to meet the demands of urban consumers for healthy food. Agroecology facilitates the relationship between producers and consumers, contributes to income generation in the peripheries and peri-urban areas of cities, and promotes the connection between healthy habits and agriculture.

Multilevel and Democratic Governance

While cities can direct the standardization and stimulation of food systems toward promoting population health, environmental harmony, and positive climate impact, a relationship and orchestration with the state and federal government is necessary. These can also support the formation of circular urban food systems. In addition to promoting practices and encouraging the advancement of local entities and legal frameworks, the transparent management and availability of data are topics on a tripartite agenda of responsibility. According to Caron et al. (2020), the reconfiguration of food systems requires people within territories with the autonomy to implement solutions.

The assessment of the data provided by the interviews showed that, in addition to shared management by different sectors and the articulation of a common agenda, it is essential to recognize roles and capacities at multiple levels. Effective communication and good coordination with the state and federal levels of government are essential to give dynamism and progress to local initiatives. Equally important is the duty to share and manage information within each municipality, so that systems operated by different municipal departments can support each other.

The sustainability of public urban food policies also depends on specific budget revenues, as well as the establishment of plans and legal frameworks. Despite the importance of pilot projects, successful public policies are those that are integrated into society and take over government action, guaranteeing their continuity regardless of changes in government. This co-creation gives authenticity to the government program and boosts the effectiveness of the public policy, as indicated in the following sentence, adapted from the discussion in one of the focus groups:

the leadership of the urban food agenda requires clear definition, preferably involving a programming council made up of representatives from various municipal secretariats and continuous dialog with residents and entrepreneurs through the municipal food and nutrition security councils (Tangari & Porpino, 2023).

Food systems are complex, and tackling challenges such as nutritional deficiency and hunger, food waste, and the integration of rural workers requires action on several fronts. Municipalities have the capacity to become laboratories of innovation in the implementation of new organizational arrangements. These arrangements can involve various entities, such as the retail sector, Sistema S, education, and research institutions, with the aim of accelerating the transformation of food systems.

Circularity

The main characteristic of circularity, aligned with the governance of urban food systems, is the connection between initiatives to promote FNS. The Maricá dehydrated food factory exemplifies how a program can be connected to farm-to-table initiatives and comply with the premise of reducing waste generation at different stages of food production. It was observed that the factory reduces losses in the field through public purchases of bananas that are not up to the

aesthetic standard required by retailers and generates income for local producers, who would not be able to access markets if it weren't for the public initiative. In addition, it strengthens student nutrition by distributing vacuum-packed food (e.g., dehydrated bananas, cassava, and lightly processed sweet potatoes) and also produces organic compost for use in urban gardens. In Rio Branco (AC), there is an extensive composting program and the compost is used in urban gardens. Other circularity initiatives can be seen in the connections created between local supermarkets or wholesalers and food banks or solidarity kitchens, as well as in the incentive to collect organic waste from households and exchange it for food produced in urban gardens, as advocated by the Baldinho do Bem project run by the Maricá city council.

DISCUSSION

The transition to circular food systems, a more developed initiative in the European Union, is a subsequent step for cities in the process of recognizing food as a central area of municipal management. Initiation can involve engaging and facilitating individuals to adopt conscious consumption guidelines through Communities Supporting Agriculture (CSA) programs and different strategies to bring producers and consumers closer together (Wensing et al., 2023). Governments should also encourage and implement circular economy initiatives, including public tenders for sustainable food. The results also highlight the importance of tax incentives to promote sustainable habits in the handling of waste and the creation of other products from materials that would otherwise be discarded. In short, it is necessary for cities to encourage innovation in partnerships and experimentation between different agents in order to activate circular business models, contemporary lifestyles, and broaden the social fabric (Wensing et al., 2023), in line with the principles of cities as laboratories for urban and social innovation. This corroborates the Stakeholder Theory guidelines for decisions based on ethical and moral obligations and solutions and creates value for all stakeholders (Freeman, 2010).

The implementation of urban food strategies requires a political commitment aligned with the perception of food as a strategic axis for urban development. This presupposes the inclusion of food as a priority on the political agendas of municipal governments and in urban organization schemes. The intersectoral dimension, highlighted by the pattern of governance observed in the municipalities examined in the study, emphasizes the importance of network collaboration, which integrates various municipal secretariats, provisions from different sectors with citizen involvement, different government bodies, academia, and private initiative. Increased social cooperation can be expanded through campaigns and ongoing communication with the general population and, specifically, with groups of relevant stakeholders, with the aim of promoting community engagement and oversight of public policies. These guidelines reinforce the holistic vision of value generation based on relationships, aligned between stakeholders and with multiple benefits (Freeman et al., 2007).

In the context of quality, it is essential to develop and implement action strategies aimed at reducing waste and promoting reuse through composting and biogas generation. Open-air

markets in cities such as Curitiba and Recife are responsible for generating a high volume of organic waste every year. Bearing in mind that a portion of this waste represents avoidable food waste, urban harvesting initiatives are emerging as an optional measure to prevent avoidable food waste. In Rio Branco, excessive food waste was observed in the retail sector, which encouraged the creation of a union between retail associations and food banks to reduce expenses related to the disposal of organic waste, helping to combat food insecurity and mitigate waste. The promotion of donations needs to adopt standards that ensure the safety of the food offered and promote the formation of a supply with adequate nutritional value. In this dimension, the importance of strategies linked to cities' climate action plans and the socio-economic benefits of the circular economy applied to urban food systems becomes clear (Henderson, 2023).

A structured approach to food needs to be the foundation of all government initiatives and programs and requires an integrated and cohesive methodology. Waste from a program, such as farmers' markets, has the potential to be transformed into resources for school gardens. Food banks are able to connect with fairs, markets, and commerce through urban food rescue initiatives and the promotion of food as donations. Leftovers from food banks, educational institutions, and popular restaurants can be reconnected to the system through compost for gardens.

Social food trade, a prominent aspect identified in the analysis of data from Maricá and Curitiba and observed in European municipalities, involves offering food at affordable prices, as evidenced in the Caminhão do Peixe, Sacolão da Família and Armazém da Família programs. This measure aims to mitigate the issue of food deserts in regions with restricted access to healthy food. Municipalities should improve their management of the quality of public Food and Nutrition Security facilities and prioritize guaranteeing the safety of food made available in municipal markets and open-air fairs. Regulations such as those practiced in Curitiba, which stipulate that animal protein can only be sold on refrigerated shelves, should be followed by other localities.

Ultimately, the effective management or orchestration of information for the development and proper analysis of regional food policies emerges as a critical factor in this synchronization between different spheres of government. It is, therefore, essential that the initiatives and strategies implemented are accompanied by clear performance measures. The evaluation of results represents a fundamental pillar for achieving objectives that show the evolution of an initiative from a pilot phase to a consolidated public policy in the region. Continuous monitoring of food policies is an indispensable component of their effectiveness.

Theoretical Model

The result of the research reinforces that urban food systems face complex challenges, such as food insecurity, disparity in access to healthy food, and environmental deterioration. Based on the unified vision, the following theoretical model was constituted to assist in the constitution of more sustainable and equitable food systems, to guide the design and implementation of public policies. This study proposes a framework that integrates four interdependent topics:

1. People, 2. Quality Management, 3. Intersectorality and Systemic Vision of Food, and 4. Multilevel and Democratic Governance. Table 2 presents the proposed model, which highlights the interconnection between these elements, which are also seen as antecedents of circularity. The aim is to provide a comprehensive framework for analyzing and intervening in urban food systems as a way of promoting population health, environmental sustainability, and social justice.

Tabela 2. Main results

Success factors	Practices observed in the cities	Additional practices identified in the EU	Proposals for action
People	Mostly technical teams; Career plans; Multidisciplinary teams; Training and participation in city networks.	Technicians in strategic and permanent positions.	Train more staff to work on urban food public policies; appoint technical staff to management positions.
Quality management	Guidelines and standards for fairs and markets; focus on food safety; regulations for social retail permission holders; involvement of nutritionists in the management of FNS facilities.	Inspection and guidance on food quality and safety for market traders and public market owners.	Strengthen regulations to guarantee the safety of fish and other perishable foods sold in public spaces.
Intersectorality and a systemic view of food	Interconnection between municipal programs and actions; strategic planning; coherence between food policies; multifunctionality of FNS equipment.	Agriculture - food and tourism nexus worked on in specific programs; municipal councils with actors from various links in the production chain.	Strengthen the governance model with the participation of various secretariats; analyze the trade-offs between the links in the production chain and the potential impacts of policies.
Multi-level governance	Legal milestones; feeding into the municipal agenda; social control and participation; municipal-state-federal dialog; joint decision-making with municipalities in the metropolitan region.	Focal points with autonomy and direct dialogue with the deputy mayor; frequent social listening for program planning.	Expand efforts to ensure that there is political will to promote the urban food agenda.
Circularity	Connection between FNS initiatives; waste management; interaction with collectives and "Sistema S".	Fostering innovation through challenges for startups; city labs with the participation of academia and S&T institutions; zero carbon strategy; Km 0 strategy (short production and consumption chains); labels for local products; hubs for the collection and distribution of surplus food in supply centers.	Expanding partnerships with "Sistema S", S&T institutions and academia to foster new circular economy solutions based on research and strengthening social impact entrepreneurship; raising awareness among local retailers about donating surplus food and cooperating with retail associations.

CONCLUSION

This study makes theoretical contributions through the application and extension of Stakeholder Theory in the context of urban circular food systems. Although widely used in sustainability literature, the complex and multifaceted arena of urban food systems proved to be fertile ground for this theoretical perspective. The value of adopting a stakeholder perspective in the analysis of the transition to more circular urban food systems includes the diverse range of actors involved, including policymakers, civil society organizations, and citizens. Furthermore, the research moves beyond the mapping of stakeholders, examining the dynamic and interconnected nature of their relationships and how these shape the governance and implementation of circular food systems initiatives in different macroeconomic contexts. The emphasis on quality management, systemic vision, and multi-level governance as key enabling factors reflects the need for coordinated and collaborative action between stakeholders with different degrees of influence and sometimes conflicting priorities. This theoretical framework also reveals the inherent tensions and trade-offs that can arise when pursuing circular economy principles at the city level. Balancing economic, social and environmental objectives, as well as addressing power imbalances between stakeholders, are critical challenges that must be overcome.

The debates on urban food systems and the circular economy (CE) point to the need to re-evaluate the method by which food is grown, produced, and used. The CE suggests a development model that seeks to separate economic development from the exploitation of finite resources and environmental compromise. When applied to food, this model results in significant transformations along the entire food chain, from cultivation to consumption and waste disposal. The expansion of CE in food faces the challenge of a paradigm shift. The traditional model, based on the produce, consume, and dispose of the triad, must give way to the cyclical model, which keeps resources in continuous circulation, similar to natural ecosystems.

The implementation of long-lasting public food programs and policies, framed as state policies, requires technical management equipped with leadership skills and committed to ongoing training. In the context of food policy administration, defining roles and capacities at different levels is as important as managing different sectors and coordinating agendas. Effective interaction and cooperation with state and federal government spheres promote progress and dynamism in local initiatives through funding information exchange and the provision of training.

Social mobilization can be expanded through campaigns and successive dialogues with the population and groups of relevant agents and aims to foster community involvement and oversight of public policies. For the efficient management and implementation of the urban food strategy, specific budget allocations, legal frameworks and institutionalization of the programs are essential to ensure their durability. Although initial initiatives are important, successful public policies are those that are consolidated as community assets and take responsibility for

the continuity of actions, ensuring their persistence beyond political transitions. This process of co-creation adds authenticity to government actions and boosts the effectiveness of public policy.

The results show that the cities analyzed are different territories, with variations in size - both in population and geography - socio-economic situations and, consequently, demands and opportunities. There are different conceptions of the role played by the public administration (sometimes interventionist, sometimes articulator), and heterogeneous training of public management. However, they all implement similar programs, albeit at different stages of development and structuring. Some common denominators, found in such disparate contexts, are indicators of the potential in almost all Brazilian cities.

The proposed theoretical model may have limitations. There may be divergent interests among stakeholders when reconciling short-term objectives (economic, political, etc.) and long-term sustainability objectives in the cities analyzed. The extensive network of actors in urban food systems makes it difficult to converge arrangements, and Stakeholder Theory and the Circular Economy do not provide guidelines on prioritizing interests. Similarly, contextual limitations (city infrastructure, social inequalities and city-specific regulations) can affect the generalizability of the proposed model. In addition, this research has limitations that could be mitigated in future studies. The initial choice of cities participating in Luppa directed the study towards those with the greatest awareness of urban food systems. Future studies could broaden the heterogeneity of the participating cities. Similarly, the group discussions included different hierarchical levels and interviewees in a condition of interdependence, which may have led to a blocking of the disclosure of difficulties in the implementation processes. Individual interviews and ethnographies would help to reduce this impact.

Future research could evaluate the impact of different interventions on urban food systems that have not been observed in these cities, such as the implementation of large-scale home composting programs, hydroponics and vertical farming. Similarly, modeling secondary data would make it possible to assess to a greater degree the effective impact of these measures on citizens' quality of life, such as measures of the impact on the health and income of the populations served. Also relevant would be studies on the behavior of consumers who are not yet aware of circularity in food systems, which could help identify the best strategies for promoting demand for foods and systems that use the concept of circularity. In this way, a possible theoretical consolidation could occur in the face of robust evidence on sustainable urban systems, using multidisciplinary collaboration and a systemic approach.

The transition to circular food systems requires the strengthening of the axes presented, collaboration between actors from field to fork, the adoption of sustainable practices with social engagement, and the implementation of coherent public policies in the areas of education, health, and agriculture, among others. This research contributes to the advancement of knowledge about urban food systems, providing insights into possible strategies that promote sustainability and urban food equity.

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