Food security and sustainable urban planning for resilient and healthy cities: a multiple case study

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Abstract: Food security strategies are essential for cities to respond to stresses and shocks while promoting urban health and quality of life. In Brazil, twenty-seven million city dwellers face severe food insecurity. Urban planning, local climate action and food security promotion are within Brazilian cities' legal scope of action, providing opportunities to strengthen urban resilience. In this context, the proposed investigation aimed to verify if and how Brazilian cities coordinate these public policies to promote urban resilience and what accomplishments stem from this coordination. The investigation developed as a multiple case study covering ten Brazilian cities. It comprised the qualitative analysis of public policy documents using NVivo for data treatment, quantification, and categorisation. The results showed a wide variety in the breadth and depth of policy measures, indicating diverse maturity levels and implementation and pointing out opportunities for future investigation and policy improvements.

Keywords: Food security; local climate action; sustainable urban planning; urban resilience; urban health.

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Introduction

Urban resilience, or a city's ability to keep functioning while facing shocks and stressors (Leichenko, 2011), is essential for urban sustainability (Buckeridge; Philippi Jr., 2020). Resilience allows cities and urban systems to absorb damages, reduce impacts, adapt to change, and transform otherwise limiting systems (Ribeiro; Gonçalves, 2019). In the face of the climate emergency, cities must increase resilience by reducing exposure and mitigating vulnerability to climate hazards (Valencia et al., 2021, p. 3).

Food security is a crucial element of urban resilience (Barthel et al., 2013; Gunilla; Olsson, 2018; Filippini et al., 2019). The Rome Declaration defines food security as a situation where people can meet their dietary needs and preferences for an active and healthy life (United Nations, 1996). Food security encompasses food safety, nutritious quality, availability, and accessibility (Walls et al., 2019, p. 69). In line with SDGs 2 – Zero Hunger and 11 – Sustainable Cities and Communities, cities must develop strategies to promote local food production and distribution to efficiently respond to stressors and shocks while enhancing public health and urban quality of life (Aquino; Assis, 2007; Olsson et al., 2019; Maas et al., 2020).

Food insecurity is a complex phenomenon whose causes at the city level go beyond socio-economic vulnerabilities. Socio-spatial segregation and deficiencies in the food production and distribution systems also contribute to food insecurity at the local level (Lopes et al., 2017; Ribeiro et al., 2018). Global warming, changing precipitation patterns, and greater frequency of extreme climate events have already affected food security globally (IPCC, 2019, p. 10). Extreme climate events oppose significant risks to food security in cities: droughts, heatwaves and floods can destroy crops, disrupt distribution routes, destroy food supplies, and increase both storage and transportation costs (Filippini et al., 2019; Olsson et al., 2016; Toth et al., 2015).

Integrating local climate action, urban planning, and food security promotion can increase cities' resilience to climate stressors and shocks, with cross-benefits in all sectors. Food production in intra-urban green spaces and peri-urban rural zones can benefit local climate change adaptation (Lwasa et al., 2014). Reduced food wastage is an urban mitigation option displaying high mitigation feasibility (Bazaz et al., 2018). Low-carbon agriculture, reforestation, and forest conservation are land-use mitigation options synergic with the SDGs, which can enhance sustainable agricultural productivity and food security (IPCC, 2022, p. 53). Shifting to healthy diets, including sustainability considerations, can reduce GHG emissions' direct and indirect health and social costs by 97% and 40% until 2030 (FAO et al., 2021, p. 25).

The COVID pandemic increased food insecurity globally: in 2020, around eight hundred million people faced hunger, and over two billion people did not have access to adequate food in the world (FAO et al., 2021- p. 8). Due to higher levels of poverty and income inequality, healthy diets are unaffordable for around three billion people worldwide (FAO et al., 2021, p. 8).

In Brazil, the largest country in South America, 87% of the population lives in cities (United Nations, 2019, p. 37). The country faces significant climate hazards (Perez et

al., 2020; Avila-Diaz et al., 2020), structural social inequities, and economic and political instability. Pre-pandemic data estimated that 68.9 million people in Brazilian cities faced food insecurity (IBGE, 2020, p. 29). The COVID-19 pandemic has significantly worsened this situation (Ribeiro-Silva et al., 2020). In 2021, around 105.6 million urban dwellers faced food insecurity, and 27.4 million were food deprived (Rede PENSSAN, 2022, p. 37).

Brazilian municipalities have the power to adopt local climate policies and plans. The National Climate Change Policy (Brazil, 2009) encourages the development of local climate policies. Still, the national government offers no permanent funding or technical support for local climate action (Zengerling et al., 2022). As a result, significantly few Brazilian municipalities have developed emission inventories or climate policies and plans, usually with the support of NGOs and international city networks (Di Giulio et al., 2019; De Macedo; Jacobi, 2019).

The human right to adequate food and nutrition is legally secured by the 2006 National Food Security Policy Law (Brazil, 2006) and Constitutional Amendment n. 64 (Brazil, 2010). Food security is legally defined as regular and permanent access to quality food, in sufficient quantity, without compromising access to other essential needs (Brazil, 2006). To cope with the country's continental dimensions and regional heterogeneity, the National Food Security Policy is firmly grounded in decentralisation and the construction of local food security systems (Palmeira et al., 2020). As such, the National Food Security Policy Law expressly recognises food security promotion as an intersectoral public policy (Maluf et al., 2015) to be developed and implemented by the public and private sectors and civil society as participants of the National Food Security and Nutrition System - SISAN.

SISAN is a participatory, multi-level governance framework (Sonino et al., 2014), integrated by the Union at the national level, the states at the regional level, and the municipalities at the local level. Within this framework, the Union, the states, and the municipalities must set up the same core of institutions at their respective level. As shown in Figure n. 1, these institutions encompass an *advisory council*, integrated by representatives of the public and private sectors and civil society, and an Interministerial or Intersecretarial *Chamber*, an executive body composed of governmental executives.

The Interministerial or Intersecretarial Chambers oversee policy management and implementation according to *food security plans and policy* guidelines. They work with the support of *thematic chambers*, *working groups* and collaborating *private entities*. *Quadrennial Food Security Conferences* are convened by the National Food Security Council - CONSEA to provide policy guidelines. They are held bottom-up, from local to state and national levels, with the participation of all implicated actors: public and private sectors and civil society.

As a multi-level governance scheme, SISAN aims to facilitate policy development and integration (Newig; Fritsch, 2009) through decentralisation and intersectoriality. However, as Vasconcellos; De Moura (2018) point out, decentralisation and sectoral integration are still incipient at the municipal level: less than half of Brazilian municipalities have adhered to SISAN, indicating the need for a local agenda prioritising sustainable food production and a fair, agroecological food system.

The Provisional Measure n. 870/2019 (Brazil, 2019), edited in January 2019, extinguished the National Food Security Council - CONSEA[1], posing severe obstacles to the articulation between civil society and the public sector (de Oliveira et al., 2022) and threatening the whole SISAN governance framework (Ramos et al., 2022). Given the progressive dismantling of public policies and participatory instances at the national level, states and municipalities affirm themselves as spaces of institutional resistance with the joint efforts of civil society, academia, and the private sector.

Figure 1 – National Food Security and Nutrition System - SISAN.
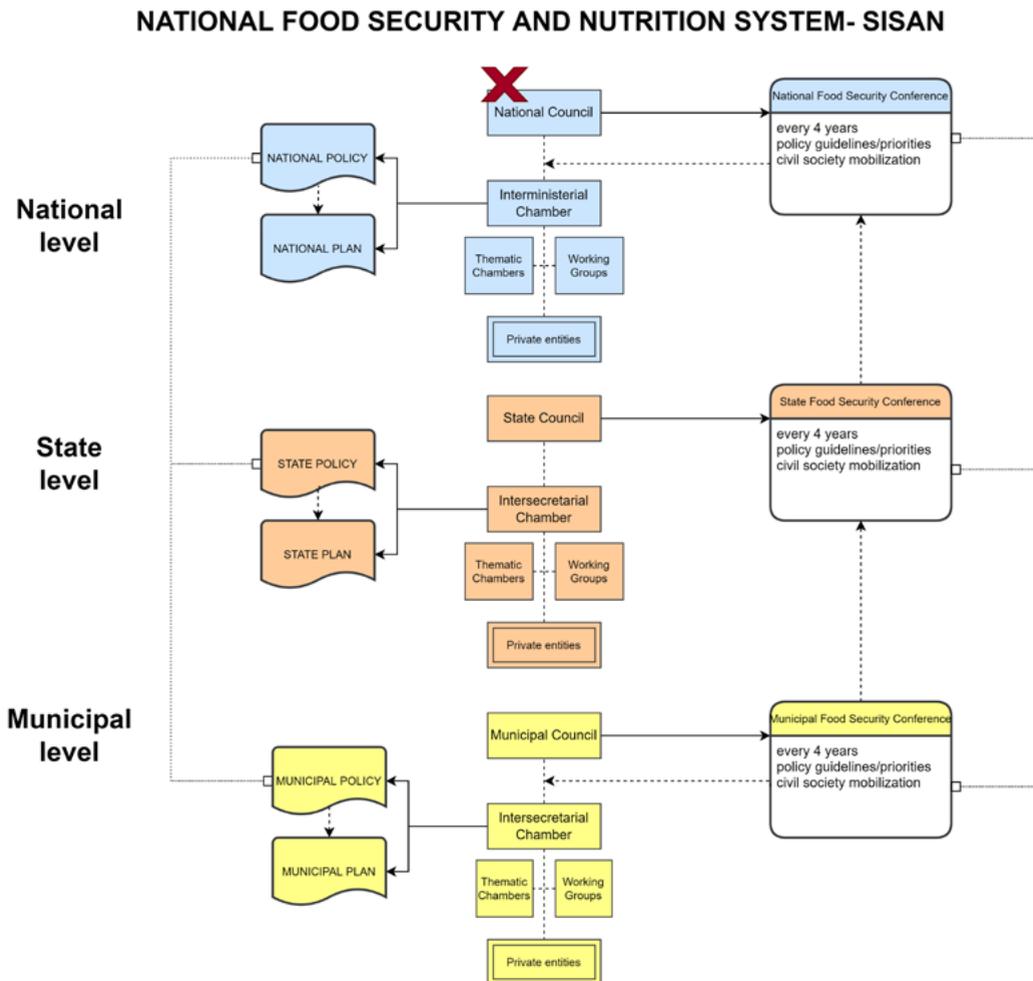
Source: elaborated by the authors, 2023.

Brazilian cities are under the authority of municipalities. As holders of political,

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1 - CONSEA was reinstituted by the Federal Government in January 2023, after the conclusion of this investigation.

administrative, executive, and fiscal autonomy, municipalities can adopt local laws, set up and manage their administration, collect local taxes, and manage their budget. According to the 1988 Brazilian Constitution, food security promotion, urban planning, and local climate action are within the municipalities' legal scope of action (Brazil, 1988). As such, municipalities should introduce resilience strategies in urban planning and management to provide all their inhabitants with a safe, healthy, and sustainable environment. But how can Brazilian cities coordinate their urban planning, food security, and local climate action to reduce urban stressors and enhance preparedness against potential shocks?

To answer this question, this investigation aimed to verify if and how Brazilian cities coordinate their urban planning, climate action, and food security strategies to promote urban resilience and what accomplishments stem from this coordination. The investigation unfolded as a multiple case study (Yin, 2003) covering ten Brazilian cities. It encompassed the thematic analysis of the content of public policy documents (Bardin, 2011; Richardson, 2012), employing NVivo© for data treatment, quantification, and categorisation (Welsh, 2002; Giacomini et al., 2004; De Paula et al., 2016; Vinke-de Kruijf, 2020).

Materials and methods

To cover Brazil's main geographies and co-related social, economic, and environmental vulnerabilities, the investigation comprised ten Brazilian cities, selected at the ratio of five large cities (over 500,000 inhabitants) and five medium-sized cities (between 100,000 and 500,000 inhabitants), distributed in the country's five geographical regions. Availability of local public policy documents in open-access digital repositories was a precondition for case study selection, as the investigation did not comprise fieldwork. Also, two additional selection criteria were applied to ensure opportunities to explore urban resilience: population living in risk areas, as exposure to disasters is a significant urban stressor, and participation in at least one international city network, as these organisations operate as drivers of urban sustainability innovation (Heikkinen et al., 2020; Papin, 2019; Castán-Broto, 2019).

As observed by Yin (2003, p. 75), multiple-case study designs should follow a replication logic rather than sampling. In this sense, the selection criteria were explicitly targeted at mirroring the diversity of Brazilian municipalities to capture the general trends on how Brazilian cities can coordinate their urban planning, climate action and food security strategies to promote urban resilience and what accomplishments stem from this coordination.

Brazilian municipalities with more than 20,000 inhabitants must follow the same institutional framework. Therefore, the differences between case studies regarding population size, location, and socio-economic indicators should not distort or affect the investigation results, as all the selected cities could be expected to exercise the same competencies. To avoid unequal treatment and cross-references biases, the same procedures were applied to data collection and qualitative analysis in all case studies (Yin, 2003, p. 184).

To inform the case studies' selection and establish their current socio-economic

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development, the investigation included the collection of indicators from secondary data sources, such as official digital repositories and grey literature. After the case study selection, public policy documents were collected in official digital repositories. The documentary search was concluded in April 2021 and comprised documents legally in force, edited from the enactment of the Brazilian Constitution, in 1988, until December 2020.

In preparation for coding, all documents were collected in PDF files with OCR - optical character recognition. The files were sorted per case study and organised into five separate sets: Set 1 - Municipal Organic Laws; Set 2 - Master Plans; Set 3 - Land Use Regulations; Set 4 - Local climate change policies and plans, whenever available; and Set 5 - Local food security policies, plans and regulations.

All the collected files were subjected to at least two coding rounds using NVivo, to identify references to food security promotion through Word Searches. Fifty-six files presented a total of 1708 coded references. Coding was organised into eight blocks (Table n. 4 below). The first blocks encompassed references to the three axes of food security promotion: food consumption, food distribution (including commercialisation and supply) and food production. The fourth block grouped references to the five sustainability dimensions of food security promotion, expressly referred to by the 2006 National Food Security Policy Law: cultural, economic, environmental, political, and social. The fifth block encompassed references to the SISAN governance framework. The sixth and seventh blocks encompassed references to climate change and urban planning. Lastly, the eighth block encompassed references to urban resilience, except for disaster management and urban climate resilience, included as climate change sub-nodes.

Within each block, coded references were grouped into nodes and sub-nodes, containers within the NVivo framework, used to store all coded references about a particular concept or category (Bazeley; Jackson, 2013, p. 18). All nodes and sub-nodes were further explored with matrix coding queries to identify cross-sectoral contributions to urban resilience through coding intersections. These queries also aimed to identify synergies between the implicated public policy in each investigated city. Set 5 was analysed to establish what food security governance instances were implemented by the case studies, if local food security plans were edited, and what complementary policies, plans and projects were developed.

Findings and interpretation

Selected case studies

As shown in Table n.1, the selected case studies constitute highly urbanised population units. They are either regional services or industrial centres, where agriculture makes a low contribution to the local economy, less than 2% of added value in nine of the ten case studies, except for Três Lagoas, where agriculture contributes to 8.5% of added value (IBGE, 2017).

All ten cities have populations living in risk areas, lacking proper urban infrastructure and prone to disasters (IBGE, 2018). Salvador presents the worst scenario: more

than 1.2 million people live in risk areas, half the city's population. São Paulo, the largest city in Brazil, with more than twelve million inhabitants, also has impressive numbers: more than 670.000 people living in risk areas. These numbers may have worsened with the COVID-19 pandemic (Dos Santos et al., 2021).

Official data are seldom representative of the municipal level in Brazil, and whenever available, local data is usually restricted to the main capitals (Norde et al., 2023, p. 106). National surveys provide accurate information about food insecurity at the national and regional levels, but not at the municipal level (Vianna et al., 2012). Not surprisingly, no local food security data was available for any case studies. In this setting, the 2017-2018 National Survey on Households' Budget (IBGE, 2020), which provides households' food security situation at the state level, can shed some light on the approximate food security situation at the local level.

Manaus, Rio Branco, and Sobral, located in the northern and north-eastern states of Amazonas, Acre, and Ceará, present lower Human Development Index scores (PNUD, 2013) and higher food insecurity percentages (IBGE, 2020). In contrast, Florianópolis, located in the wealthy southern state of Santa Catarina, presents the highest human development score (PNUD, 2013) and lowest state food insecurity percentage among all ten case studies (IBGE, 2020).

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Table 1 – Selected case studies' socio-economic indicators.

CITY State *Region*	Estimated population (2019)[1]	Population in risk areas (2018)[2]	Cities' networks	Economy - % of added value per activity (2017)[3]				HDI (2010)[3]	% of population in food insecurity at the state level (2017-2018)[5]
				Agriculture	Industry	Services	Public sector		
CUIABÁ Mato Grosso *Centre-West*	612,547	970	ICLEI[6]	0.15	13.38	67.54	18.93	0.785	33.40
FLORIANÓPOLIS Santa Catarina *South*	500,973	23,105	ICLEI, ESCI[7]	0.28	8.77	75.76	15.18	0.847	13.10
MANAUS Amazonas *North*	2,182,763	55,851	ICLEI	0.33	41.79	43.75	14.12	0.737	65.50
NITERÓI Rio de Janeiro *Southeast*	513,584	33,822	ICLEI	0.05	43.57	45.68	10.70	0.837	32.20
PORTO ALEGRE Rio Grande do Sul *South*	1,483,771	10,706	GRCN	0.04	8.33	80.79	10.84	0.805	23.50
RIO BRANCO Acre *North*	407,319	33,767	ICLEI	1.96	10.47	55.08	32.50	0.727	58.70
SALVADOR Bahia *Northeast*	2,872,347	1,217,527	C40[8], GRCN[9], ICLEI	0.08	12.54	71.94	15.44	0.759	45.30
SÃO PAULO São Paulo *Southeast*	12,252,023	674,329	C40, ICLEI	0.01	9.88	82.62	7.49	0.805	30.80
SOBRAL Ceará *Northeast*	208,935	10,494	ICLEI	0.78	25.99	55.23	18.00	0.714	46.90.

Source: [1]IBGE (2019); [2]IBGE (2017); [3]IBGE (2018); [4]PNUD, (2013); [5]IBGE (2020). Notes: [6]ICLEI – Local Governments for Sustainability; [7]ESCI – Emergent and Sustainable Cities Initiative; [8]C40 – C40 Cities; [9]GRCN - Global Resilient Cities Network.

Coding results per Document Set and Case

The number of references obtained in the coding rounds, sorted per case study and document set, are specified in Table n. 2.

Regarding document **Set 1**, it is noteworthy to highlight that every Brazilian municipality must approve municipal organic laws - MOLs to structure its political and administrative organisation. MOLs establish basic guidelines, principles, and goals for all sectoral public policies at the local level. All the case studies presented coded references to food security promotion in their MOLs. All the examined MOLs were edited in the early 1990s when food security promotion was not an autonomous public policy in Brazil. Therefore, food security references integrate other local public policies, such as education (gratuity of school meals), agriculture (policy guidelines), and public health (healthy nutrition and food quality control/food safety).

Table 2 – Number of coded references per case study and document set.

Case study	Set 1 Municipal Organic Law	Set 2 Master Plan	Set 3 Land Use Regulations	Set 4 Climate Change	Set 5 Food Security
Cuiabá	11	14	0	0	3
Florianópolis	8	1	7	30	32
Manaus	61	1	1	0	3
Niterói	12	14	0	0	2
Porto Alegre	4	0	27	4	6
Rio Branco	3	3	0	0	1
Salvador	18	13	4	24	1
São Paulo	2	26	1	42	68
Sobral	9	7	1	0	5
Três Lagoas	4	0	3	0	3

Source: elaborated by the authors, 2023.

In Brazil, Municipalities with 20,000 inhabitants or more must enact Master Plans – MPs, examined in document **Set 2**. These are comprehensive urban development plans intended to connect and integrate spatial planning with sectoral policies, following national guidelines established by the Statute of the City (Brazil, 2001). Five case studies stand out with more coded references for their MPs: São Paulo, Niterói, Cuiabá, Salvador and Sobral. The MPs of Salvador and São Paulo were the only ones to regulate food security promotion. These two MPs, alongside Cuiabá and Sobral, acknowledged the human right to food security as an urban development guideline. Niterói's MP presented detailed provisions on food production, setting guidelines for family, ecological, and organic farming, and pesticide control, a topic also approached by Florianópolis.' Manaus and Rio Branco presented references pertaining only to rural zoning. Porto Alegre's and

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Três Lagoas' MPs presented no coding results.

All Brazilian Municipalities have the powers to approve land-use regulations, including zoning laws and building codes, with grounds on their respective MPs. These documents were examined in **Set 3**. The documentary search located sustainable development plans and resilience strategies resulting from decentralised cooperation initiatives developed by four case studies: Florianópolis, Porto Alegre, Salvador, and Três Lagoas. These documents were included in Set 3, as they contained significant land-use provisions. Florianópolis and Três Lagoas approved their Sustainable Action Plans within the Emergent and Sustainable Cities Initiative - ESCI, developed by the Interamerican Development Bank – IADB. Porto Alegre and Salvador's Resilience Strategies, in turn, stemmed from their engagement with the 100 Resilient Cities Network, currently the Global and Resilient Cities Network - GRCN.

Coding rounds for document Set 3 showed that only three case studies did not reference food security promotion in their land-use regulations: Cuiabá, Niterói, and Rio Branco. Manaus' and São Paulo's presented only one coded reference each, both related to the delimitation of rural zones. Sobral's only coded reference, in turn, acknowledged the contribution to the city's socio-spatial development made by rural migrants who fled hunger and droughts in the early 1900s. This result was the only reference to famine and droughts found in Sobral's policy documents despite the city's location in the semiarid region, where droughts are a dominant stress factor (Marengo et al., 2022). Porto Alegre, Florianópolis, Salvador, and Três Lagoas presented the highest numbers of coded references in Set 3, which can be credited to their active engagement in international city networks.

Within GRCN, Porto Alegre launched its Resilience Strategy in 2016. The document acknowledges the city's potential in agriculture. It pledges to foster both organic and family farming to meet Porto Alegre's needs in terms of food supply, taking advantage of the city's recently demarcated rural zone. Salvador launched its Resilience Strategy in 2019. The document stresses the importance of urban farming to foster food security and engage popular participation. Florianópolis' 2015 Sustainability Action Plan, established under ESCI, highlights the coordination of green infrastructure and low-carbon agriculture as strategies to support the city's sustainable development. Três Lagoas' Sustainability Action Plan, launched in 2016, underlines the city's advantageous position in agriculture and recommends the expansion of the city's food supply infrastructure and encouraging urban and family farming in urban and peri-urban green areas.

Four case studies presented coded references in policy documents included in **Set 4**: Florianópolis, Porto Alegre, São Paulo, and Salvador. In this respect, engagement in cities' networks was also a significant factor. In addition to ESCI and GRCN, São Paulo and Salvador integrate the C40 Cities group, a network of nearly 100 world-leading cities dedicated to confronting the climate crisis. São Paulo and Salvador were the only case studies to launch climate action plans. Both plans, enacted in 2020, aim to reach net-zero emissions by 2050. The documentary search did not locate any climate change policy documents for Três Lagoas, even though, as an ESCI participant, the city must have commissioned a preparatory study on climate change impacts. The search also failed to

locate climate change policy documents for the cities of Cuiabá and Sobral. The climate change policy documents belonging to the cities of Manaus, Niterói, and Rio Branco showed no coding results.

Lastly, about **Set 5**, the analysis aimed to verify to what extent the case studies have implemented the SISAN governance framework. According to Brazilian Law, all municipalities should implement the local governance instances part of SISAN, including local food security policies and plans. As shown in Table n. 3, all the case studies edited regulations on food security promotion in line with the national guidelines and installed Municipal Food Security Councils. However, only São Paulo and Florianópolis implemented the whole SISAN governance framework. São Paulo was the only city to approve a specific Local Food Security Plan.

Table 3 - Food security governance instances implemented by the case studies.

City	Regulation Issued in	Municipal Food Security Conference	Municipal Food Security Council	Inter-secretarial Chamber (CAISAN)	Food Security Local Plan
Cuiabá	2004	✖	✔	✖	✖
Florianópolis	2013	✔	✔	✔	✔ *
Manaus	2017	✔	✔	✔	✖
Niterói	2013	✔	✔	✖	✖
Porto Alegre	2007	✔	✔	✔	✖
Rio Branco	2005	✔	✔	✖	✔ *
Salvador	2004	✔	✔	✖	✔ *
São Paulo	2013	✔	✔	✔	✔
Sobral	2015	✔	✔	✔	✖
Três Lagoas	2014	✔	✔	✔	✖

Note: * Budgetary Program, as a proxy to a Local Food Security Plan.

Source: elaborated by the authors, 2023.

Coding results per Node and Case Study

Table n.4 shows coding results sorted by nodes, sub-nodes, and cases. Results are coloured on a scale varying from yellow (below ten results) to green (above ten results). Nodes without results are coloured in red. Only five nodes presented coding results for all ten case studies: (1) Food Consumption, (3) Food Production, (4) Sustainability Dimensions - (4.3) Environmental Dimension, (5) SISAN governance framework, and (7) Urban Planning. However, at the sub-node level, only three sub- nodes presented

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coding results for all ten case studies: (4.3.1) biodiversity conservation, (4.3.5) sustainable use of natural resources, and (5.3) Municipal Food Security Council.

These findings indicate, firstly, that there is a wide variety in the breadth and depth of the policy measures developed by each city regarding food security promotion, revealing diverse levels of policy maturity and implementation. All cities referenced food consumption due to the MOLs' provisions on the gratuity of school meals and health promotion through adequate nutrition. Regarding food production, all case studies, except Rio Branco, presented references to agriculture, encompassing policy guidelines for commercial agriculture and urban farming.

Matrix coding queries evaluated synergies between the investigated public policies. Food production intersected most with local climate action and urban planning nodes. This finding highlights the importance of exploring agriculture's multifunctionality in urban and climate planning to address food security risks and build resilience (Steemkamp et al., 2021).

Table 4 - Coded references per node, sub-node, and case study.

Nodes	Cuiabá	Florianópolis	Manaus	Niterói	Porto Alegre	Rio Branco	Salvador	São Paulo	Sobral	Três Lagoas
1. Food consumption	10	17	13	7	5	2	28	30	5	3
1.1. School meals	2	3	6	3	1	0	9	4	3	1
1.2. Hunger relief	4	1	2	0	0	0	8	4	1	0
1.3. Healthy practices and habits	3	4	1	0	3	0	7	11	0	0
1.4. Health promotion	6	4	9	3	0	2	3	11	1	1
1.5. Quality control	0	0	3	1	1	1	3	3	0	1
1.6. Food Waste	0	7	0	1	1	0	4	4	0	0
2. Food Distribution	5	5	16	2	4	0	12	40	4	3
2.1. Distribution	0	3	10	1	2	0	6	36	1	1
2.2. Regulatory stocks	1	0	5	0	0	0	1	0	0	0
2.3. Supply	5	2	10	2	2	0	6	35	3	3
3. Food Production	17	59	38	17	17	2	34	53	9	13
3.1. Agriculture	15	58	31	16	16	0	29	50	8	12
3.1.1. Commercial agriculture	9	9	21	1	6	0	3	5	3	9
3.1.2. Ecological farming	0	22	0	3	3	0	1	14	0	0
3.1.3. Family farming	3	3	9	4	4	0	10	16	4	5
3.1.4. Low carbon agriculture	0	17	0	0	1	0	0	0	0	0
3.1.5. Organic farming	0	12	0	4	5	0	4	15	0	0
3.1.6. Pesticides control	0	7	2	2	0	0	0	2	0	0
3.1.7. Urban farming	4	17	1	7	1	0	20	20	2	3
3.2. Fishing sector	0	6	7	1	1	1	0	2	0	1
3.3. Food Industrialization	1	0	3	0	0	0	1	2	0	2
3.4. Food processing	0	1	1	0	0	0	0	4	0	0
3.5. Food quality control	2	1	4	0	1	1	4	0	1	1
4. Sustainability Dimensions	18	64	25	17	22	3	41	104	13	8
4.1. Cultural dimension	1	3	2	2	1	1	2	9	0	0
4.1.1. Respect for diversity	1	2	2	2	0	1	2	9	0	0
4.1.2. Valuing culture	0	1	0	0	1	0	0	0	0	0

Nodes	Cuiabá	Florianópolis	Manaus	Niterói	Porto Alegre	Rio Branco	Salvador	São Paulo	Sobral	Três Lagoas
4.2. Economic Dimension	6	23	12	5	7	0	20	38	6	5
4.2.1. Associativism	1	3	3	0	1	0	3	6	0	0
4.2.2. Circular Economy	0	0	0	0	0	0	1	3	0	0
4.2.3. Employment generation	0	2	2	0	0	0	6	8	0	0
4.2.4. Entrepreneurship	0	0	0	0	0	0	0	3	0	0
4.2.5. Green Economy	0	1	0	0	0	0	0	2	0	0
4.2.6. Incentives	5	16	7	4	5	0	10	19	6	3
4.2.7. Innovation	0	0	0	0	0	0	1	2	0	0
4.2.8. Regulation	0	0	1	0	3	0	2	2	0	0
4.2.9. Tourism	0	5	2	1	1	0	0	8	0	2
4.3. Environmental Dimension	3	24	4	9	7	2	6	20	2	4
4.3.1. Biodiversity Conservation	2	19	4	7	4	2	6	8	2	4
4.3.2. EbA	0	0	0	0	0	0	1	1	0	0
4.3.3. Environmental services	0	3	0	0	1	0	2	11	0	0
4.3.4. NbS	0	0	0	0	0	0	1	0	0	0
4.3.5. Sustainable use of resources	2	14	2	8	5	2	5	5	2	4
4.4. Political dimension	9	28	8	3	10	0	18	51	4	1
4.4.1. Cooperation	2	2	0	0	4	0	2	6	0	1
4.4.2. Information	2	7	2	2	2	0	4	28	0	1
4.4.3. Institutions	4	9	0	0	0	0	0	10	0	0
4.4.4. Knowledge production	2	8	5	0	5	0	1	13	0	0
4.4.5. Local Food Security Policy	0	0	0	0	0	0	6	2	0	0
4.4.6. Participation	1	14	1	1	0	0	10	18	4	0
4.5. Social dimension	3	6	4	2	2	1	17	32	3	0
4.5.1. Human right to food	3	2	1	1	1	1	5	12	3	0
4.5.2. Income and wealth redistribution	0	2	2	0	1	0	10	8	0	0
4.5.3. Social inclusion	0	2	1	1	0	0	9	20	1	0

Nodes	Cuiabá	Florianópolis	Manaus	Niterói	Porto Alegre	Rio Branco	Salvador	São Paulo	Sobral	Três Lagoas
5. SISAN	2	7	6	7	10	6	6	23	8	7
5.1. CAISAN	0	2	3	0	3	0	0	11	4	3
5.2. Municipal Food Security Conference	0	1	1	1	2	1	1	3	2	1
5.3. Municipal Food Security Council	2	3	1	7	3	6	6	10	2	2
6. Climate Change	0	26	1	0	4	0	25	48	0	2
6.1. Adaptation	0	8	0	0	2	0	11	19	0	0
6.2. Disasters	0	1	1	0	2	0	2	9	0	0
6.3. Mitigation	0	26	0	0	3	0	12	10	0	2
6.4. Urban Climate Resilience	0	3	0	0	0	0	16	30	0	0
7. Urban Planning	4	25	8	9	8	3	15	23	3	6
7.1. Agrarian Reform	0	0	1	0	0	0	0	0	0	0
7.2. Buildings	0	3	0	2	1	0	0	1	0	0
7.3. Green Infrastructure	1	12	0	2	0	0	9	1	1	6
7.4. Land regularisation	0	0	2	1	1	0	0	1	0	0
7.5. Land use	0	10	3	6	2	0	1	1	1	0
7.6. Rural Zoning	2	0	0	2	5	3	0	11	0	0
7.7. Urban voids	1	3	0	0	0	0	5	7	0	0
7.8. Urban Zoning	0	0	2	1	0	0	0	4	1	0
8. Urban Resilience	4	4	1	1	4	0	5	7	1	0
TOTAL	30	78	69	33	45	12	65	142	25	22

Source: elaborated by the authors, 2023.

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Food distribution and consumption presented meaningful intersections with local climate action rather than with urban planning. The lack of connection with spatial planning strategies highlights the need to include food distribution and consumption strategies in land-use policies and plans. Such an approach would allow the investigated cities to tackle urban food deserts and promote healthy food habits for the vulnerable population (Giatti et al., 2019; Rocha; Lessa, 2009).

Regarding food production, the allocation of urban or peri-urban green spaces to low-carbon, organic, ecological farming stands out as a critical strategy to reduce emissions, boost adaptive capacities, and mitigate the adverse effects of heat islands, floods, and droughts. In this respect, Vannozzi-Britto; Borelli (2020) highlight the potential of urban forestry to tackle food insecurity in Brazilian cities due to the excellent availability and variety of edible species. The intersections between food distribution and local climate action recognise the need to increase the adaptive capacity of the food distribution network in response to climate-related shocks and stressors. Subsequently, the intersections between local climate action and food consumption encompass mitigation strategies focused on sustainable nutritional habits, adequate waste management and composting, and adaptation strategies focused on hunger relief.

Regarding the environmental dimension of food security promotion, results indicate that allocating green spaces and rural zones for organic and ecological food production were crucial strategies for urban climate adaptation, carbon sequestration, and resilience building. Concerning the economic dimension, results highlight the role played by incentives, such as tax exemptions, in alleviating vulnerabilities. Regarding the social dimension, the findings underline how urban, organic, and ecological farming, as sources of jobs and revenue, can contribute to social inclusion and income redistribution. As for the political dimension, results emphasised that access to information and public participation in decision-making are central policy elements.

Diversity issues, classified within the cultural dimension of food security promotion, could have been better explored by most case studies, signalling opportunities for all the case studies to deepen intersectional approaches to tackle vulnerabilities and enhance urban resilience. Addressing context-specific inequities, such as gender, ethnicity, disability, age, location, and income, is essential to reduce vulnerabilities and climate risks (Pörtner et al., 2022, p. 30).

The results indicate a wide variety in the breadth and depth of the case studies' policy measures, which signals different maturity and implementation levels. A comprehensive policy assessment proved unfeasible due to the lack of official data. Despite its limitations, the investigation could point out opportunities for future investigation and policy improvements.

3.4. Highlights from Florianópolis, Salvador, and São Paulo

Florianópolis, Salvador, and São Paulo offered the best opportunities to explore how coordinating local climate action, urban planning, and food security strategies can foster

urban resilience. These three case studies presented higher results for Urban Planning and Climate Change than the remainder of the investigated cities. They were also the only cities to present coded references in all sub-nodes about resilience promotion. Matrix coding queries, crossing coding results on resilience and food security promotion, showed significant differences between the three case studies. The findings strongly emphasise food production in Florianópolis and Salvador's results. São Paulo's, in turn, is balanced between the three axes of food promotion, with some emphasis on food distribution.

As members of the C40 Cities and the only case studies to edit climate action plans, São Paulo and Salvador stand out with the most remarkable results on local climate action. Both local climate plans commit to fostering the consumption of locally produced organics, employing digital platforms to bring together organic producers and consumers. They encompass measures to diminish emissions related to food waste, such as composting, and food distribution, fostering local purchases for school meals. Also, both plans acknowledge urban and peri-urban farmers as ecosystem services providers, integrating green infrastructure strategies with local food production.

Salvador's Climate Action Plan focuses on urban and peri-urban farming to reduce emissions, protect biodiversity and the microclimate, generate income, and educate for sustainability. Community gardens are incentivised to transform vacant or under-used land into productive spaces and provide income for vulnerable families. The Plan also acknowledges the contributions that nature-based solutions - NbS and ecosystem-based adaptation - AbE can provide for food security promotion.

São Paulo's Climate Action Plan - PlanClimaSP builds on the city's policies and plans on food security and agriculture, encompassing the 2004 Urban and Peri-Urban Agriculture Program, 2014 Master Plan, and 2016 Food Security Plan. São Paulo's MP has reinstated rural zones to support local food production and supply, in line with the city's Urban and Peri-Urban Agriculture Program. The latter provided the legal basis for "Connect the Dots," a multidimensional project aimed at fostering organic family farming in the urban fringes to control urban sprawl, preserve natural resources, and protect biodiversity (Hearn et al., 2020; Moreira et al., 2022). Awarded the 2016 Global Mayors Challenge prize, the project's basic features and strategic actions informed the city's 2016 Food Security Plan and 2020 PlanClimaSP.

São Paulo's Food Security Plan aims to provide meals in public facilities and distribute food to vulnerable families and individuals. It also approaches the risk of aggravated water supply shortages, calling for systemic measures to protect water sources, promote water efficiency, and universalise sanitation services. PlanClimaSP aims to foster urban community gardens as a key adaptation strategy. It also supports peri-urban family farmers, encouraging their conversion to organic and agroecological practices. To tackle climate risks to the food supply, the Plan proposes to optimise distribution channels and routes and diminish food losses. It also encourages food donations to the municipal food bank.

Regarding Florianópolis, the 2015 Sustainability Action Plan encompasses mitigation and adaptation strategies aimed at sorting and diminishing food waste, promoting low-carbon agriculture, and expanding green infrastructure. Accordingly, Florianópolis

has enacted complementary public policy programs to implement these strategies. The city's land use regulations aim to foster the cultivation of vegetable gardens in private buildings, on rooftops or in common-use areas, and rainwater collection, storage, and use systems are mandatory for buildings with more than two hundred square meters. The 2017 Urban Agriculture Program aims to provide access to healthy and low-cost food locally produced by urban farmers, fostering community gardens on public and private vacant land, urban afforestation, and composting. In 2018, the city joined the Zero Waste Initiative, committing to compost all organic waste by 2030. The 2018 Municipal Policy for Agroecology and Organic Production aims to support urban and peri-urban organic and ecological farming. To this end, the city abolished the use of pesticides in its insular territory in 2019.

Conclusions

The findings demonstrate a significant variation in the breadth and depth of the policy measures, indicating diverse levels of policy maturity and implementation by the case studies. Uncovering the causes for these disparities would demand extensive field-work, exceeding the investigation's scope.

The results indicate that the most innovative approaches combine organic and ecological farming, green infrastructure strategies, and food waste management. Including food distribution and consumption measures in land-use policies and plans, in line with adaptation strategies, would allow the investigated cities to strengthen urban resilience by tackling urban food deserts and promoting healthy nutritional habits for the most vulnerable population.

The case studies most homogeneously explored the environmental dimension of food security promotion. Results acknowledge the allocation of green spaces and rural zones for organic and ecological farming, and their role in biodiversity protection and natural resources preservation, as crucial strategies for resilience building and local climate action. Strategies about the economic and social dimensions of food security promotion were closely intertwined due to their focus on generating jobs and income. As for the political dimension, adequate access to information and public participation were appointed as central policy elements. However, diversity issues were poorly explored, signalling opportunities for all the case studies to deepen intersectional approaches to tackle vulnerabilities and enhance urban resilience.

All ten cities have the minimum institutional basis required to coordinate urban planning and food security strategies successfully. Local climate action, in turn, is an emerging policy field underexplored by most case studies. Developing local climate poli-cies and plans and fully implementing the local SISAN framework may provide Cuiabá, Niterói, Porto Alegre, and Três Lagoas with alternatives for policy improvements. Manaus, Rio Branco, and Sobral, all cities with critical social indicators, fail to use the available institutional resources to improve food security and build urban resilience. Urgent in-stitutional changes are pivotal to enable the latter to face the pressing challenges of the

climate crisis and the pandemic.

The qualitative analysis identified meaningful connections between local climate action, spatial planning, and food security promotion in only three case studies: Florianópolis, Salvador, and São Paulo. Two key factors can explain this. The first factor is their active engagement in international city networks, a significant driver for urban policy innovation. The second factor is multi-level governance, as the insertion in the SISAN framework facilitates policy development and integration. Salvador, Florianópolis, and São Paulo provide a set of good practices that other Brazilian cities can replicate to build resilience and improve urban health and liveability. São Paulo was the most successful in integrating urban planning, local climate action, and food security promotion to enhance urban resilience, resulting from the city's engagement with C40 Cities and the Global Mayors Challenge Award.

As final remarks, a comprehensive policy assessment of the case studies proved to be unfeasible due to the lack of official data on policy implementation and monitoring, areas in which all the investigated cities need to make urgent improvements. Only extensive fieldwork could overcome this obstacle, pointing out future research opportunities.

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Segurança alimentar e planejamento urbano sustentável para cidades resilientes e saudáveis: um estudo de casos múltiplos

Debora Sotto
Arlindo Philippi Jr.

Resumo: Estratégias de produção e distribuição de alimentos são essenciais para a resiliência e promoção da sadia qualidade de vida urbana. Nas cidades brasileiras, 27 milhões de pessoas estão em grave insegurança alimentar. O planejamento urbano, a ação climática local e a segurança alimentar incluem-se no escopo legal de ação dos municípios brasileiros, oferecendo oportunidades valiosas para fortalecer a resiliência urbana. Nesse contexto, a investigação buscou verificar se e como os municípios brasileiros coordenam políticas públicas para a resiliência urbana e com que resultados. Desenvolvido como um estudo de caso múltiplo abrangendo dez cidades brasileiras, o estudo compreendeu a análise qualitativa do conteúdo de documentos de políticas públicas utilizando o NVivo como ferramenta de tratamento, quantificação e categorização de dados. Os resultados mostraram grande variedade na amplitude e profundidade das ações de política pública, com diferentes níveis de maturidade e implementação, apontando oportunidades para futuras investigações e aprimoramentos de política pública.

Palavras-chave: Ação climática local; segurança alimentar; planejamento urbano sustentável; resiliência urbana; saúde urbana.

Seguridad alimentaria y planificación urbana sostenible para ciudades resilientes y saludables: un estudio de caso múltiple

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Resumen: Las estrategias de seguridad alimentaria son esenciales para la resiliencia, la promoción del bien vivir y de la salud urbana. En las ciudades brasileñas, 27 millones de personas padecen inseguridad alimentaria grave. La planificación urbana, la acción climática local y la seguridad alimentaria están incluidas en el ámbito de acción de los municipios brasileños, ofreciendo oportunidades para fortalecer la resiliencia. En este contexto, la investigación buscó verificar si y cómo los municipios brasileños coordinan políticas públicas para la resiliencia y cuáles son los logros resultantes. Desarrollada como un estudio de caso múltiple con diez ciudades brasileñas, la investigación comprendió el análisis cualitativo de documentos de política pública utilizando NVivo como herramienta para el tratamiento, cuantificación y categorización de datos. Los resultados mostraron una gran variedad en la amplitud y profundidad de políticas, con diferentes niveles de madurez e implementación, señalando oportunidades para futuras investigaciones y mejoras de política pública.

Palabras-clave: Acción climática local; seguridad alimentaria; planificación urbana sostenible; resiliencia urbana; salud urbana.