A bottom-up approach to sustainable and inclusive urban food and waste management systems development: human-centered smart city projects

Un approccio dal basso allo sviluppo di sistemi alimentari e di gestione dei rifiuti urbani, sostenibili e inclusivi: progetti di smart city incentrati sull'uomo

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Abstract. The term "smart city" is a semantic jungle where a diversity of topic and subtopics fight to make part of it. Notably, recent scholarly discourse has expanded beyond the customary technological facets to encompass concerns related to environmental sustainability and societal issues. Within this expanding arena, the notion of food justice and the adverse side effects of food production have come to the fore. Adopting a bottom-up approach to urban development, we selected six cases regarding urban food and food-waste management systems which can serve as exemplary models for future smart city implementations. In conclusion, it becomes evident that the active involvement of citizens, spanning from "favelas" to universities, holds a pivotal role in the journey towards building sustainable and inclusive smart cities.

Abstract. Il termine "smart city" è una giungla semantica in cui una diversità di argomenti e sottoargomenti lottano per farne parte. Recentemente, la letteratura accademica, oltre ad aspetti tipicamente tecnologici, ha iniziato a considerare quelli legati alla sostenibilità ambientale e alle questioni sociali, con un sempre più rilevante spazio di crescita. Uno dei temi è la giustizia alimentare e le esternalità negative della produzione alimentare stessa. Sulla base di un approccio bottom-up allo sviluppo urbano, abbiamo selezionato sei casi riguardanti i sistemi di gestione del cibo e dei rifiuti alimentari per evidenziare alcune pratiche da considerare come punto di riferimento per la futura implementazione delle città intelligenti. In conclusione, è stato possibile osservare che la partecipazione dei cittadini, dalle favelas alle università, è fondamentale nella transizione verso città intelligenti sostenibili e inclusive.

Keywords: Smart city, Sustainability, Food system, Waste management, Bottom-up

1. Introduction

The term "smart city" (SC) is a semantic jungle. There is no globally agreed-on definition (Angelidou, 2014; Baron, 2012; Cocchia, 2014), which is surprising, given the increasing importance and maturity of the topic (Reichental, 2020). It is associated with a variety of concepts, evolving through the years from an overall centrality of the information technology (IT) dimension (Carvalho, 2015; Mora et al., 2017) where the benefits of massive implementation of "intelligent" technologies to gather data and manage assets, resources, and services more efficiently, appeared to be the way to improve the lives of the citizens (Cretu, 2012), to the adoption of innovative, collaborative governance styles (Caragliu et al., 2011; Kitchin, 2014), up to a more comprehensive understanding of the importance of designing urban policies aimed at improving citizens' quality of life while promoting environmental, economic, and social sustainability (Nesti, 2021; Zheng et al., 2020).

If the term itself remains unclear in its specifics and, therefore, open to many interpretations, some argue that the smart city revolutionary utopia (Grossi et al., 2017) promoted by private companies and municipalities are just an expression of a neoliberal ideology to serve the interests of business elites (Hollands, 2015), and divert the attention away from urgent urban problems through business-led technological solutions rather than political and long-term urban planning. If growing critical literature has countered the optimistic rhetoric and celebratory tones of the SC (Hollands, 2015, 2008; Greenfield, 2013; Vanolo, 2014; Kitchin, 2015), some argue that the technologically grounded model of city development is generating several social and environmental concerns, whose impact and meaning are often overlooked (Hollands, 2008)

In Shakespeare's play, Coriolanus Sicinius states: "What is the city but the people?". After all, cities are defined by the human experience. They exist for the people, are the invention of people, and deeply reflect a people's culture (Reichental, 2020), so there is no one-size-fits-all solution. In Calvino's Invisible Cities, Marco Polo makes it even more evident: "You don't enjoy the seven or seventy-seven wonders of a city, but the answer it gives to your question" (Amendola, 2010). Then, the goal of the present article is to invert the top-down perspective and, within a market-fit (more than a market-efficient), human-centered fashion approach, adopt, listen, analyze, and collect insights from the point of view of the city actors, the people who, thanks to the daily practice of the city, ultimately place themselves at the center of its development. In this regard, the pivot of the investigation will revolve around the urban food and food waste systems.

Thinking about delivering that answer to the demand of citizens, city users, and stakeholders in alternative to the mainstream SC top-down, competitive, corporate, market efficient, tech-driven approach, within the present study, we intend to explore in a multiple case study qualitative analysis, the experiences that are shaping the new urban and sustainable development of cities around the world. The cities' selection is based on the authors' familiarity with cases that intend to deviate from the path of the uncontrolled growth of the twentieth century, with all its consequences, and become the engine of a new development that puts sustainability, circular economy, and waste reduction at the center of a new paradigm of human societies.

The cases have different actors as protagonists: 1) Karlovac Eco-Gate, a city in Croatia that uses IT to help citizens with municipal solid waste management; 2) Lemobs, a startup from Brazil that deals with technologies for smart cities and made a project for food waste in an indigenous community; 3) Minhoca na Cabeça, a program from a city in the south of Brazil to help citizens to do their own food waste composting; 4) Revolução dos Baldinhos, an initiative from a favela in Brazil to do community composting and urban food system; 5) Food Recovery Network, a student movement initiated by five students at the University of Maryland, USA; and 6) an urban farm project promoted by Urban Ventures in Minneapolis.

Finally, this article is organized with this introduction, immediately followed by the theoretical background that aware of the bottom-up approach in smart cities context, food in the urban discourse, food systems, and food waste for smart cities. The third section includes the methodology, followed by the fourth section of results and analyses that explore the selected cases, and a fifth and final section of conclusions. Our findings suggest that the approach of human-centered theoretical lines to explore smart cities discourse is paramount to demystifying the idea that smart cities are exclusive to wealthy developed countries. In parallel, we develop good practices for alternative ways of co-creating an inclusive and sustainable smart city, specifically using urban food management strategies.

2. Theoretical Background

2.1. Bottom-up approach in smart cities context

One of the questions raised by the smart city implementation is: how neoliberal urban redevelopment might be shaped to leave room for the social? That said, would it be possible to find common answers (patterns between cities) and provide the new open governances with new applicable framewor-

ks, given the growing subjectivization of contemporary culture for which everything must be traced back and measured on the subject (Amendola, 2010)?

The limits of a "smart" model of urban development that focuses only on market efficiency and competitiveness are widely acknowledged by scholars and policymakers and lead to a general rethinking of their understanding of smart cities (Almirall et al., 2016; Capdevilla and Zarlenga, 2015; Hsu et al., 2018; Gadecki, 2018). Corrective actions are expected even among the leading proponents and admirers of the high-tech model of cities (Florida, 2017) since smart city strategies produce inequalities, gentrification, segregation, and progressive deterioration. All these reflections raise doubts about who will be responsible for these interventions? Should the same entities that allowed the uneven urban development and accentuated polarization (Harvey, 2006; Sager, 2011), namely policymakers and city managers, facilitate a more responsive and democratic urban development? If not wholly illogical, is it actionable, given the growing importance of the private sector in dealing with historical policy issues, an example being the caring system with the question of who is responsible for caring for disadvantaged populations in cities where welfare-based care is being eroded by neoliberalism (Cloke et al., 2020; Williams, 2017)?

The United States urban development policies path well represents the criticalities of this responsibility-shifting scheme. In 1959, a government-funded model, the so-called "urban renewal" movement (Gans, 1965b), began to spread around the country. Despite improving the infrastructure, urban renewal's social outcomes were controversial. According to critiques, it led to the displacement of millions of people, mainly of black and Latino origin (Anderson and Kelly, 1976; Jacobs, 1961) and highlighted social and spatial inequality along racial lines that is still observable today (Altshuler and Luberoff, 2004; Nelson, 2018). The lessons of "urban renewal" led to the community development approach based on the idea of empowerment from within (Halpern, 1995; Kelly, 1976). With a straightforward political activist approach, it was built on the assumption that sustainable communities can be developed by augmenting and nurturing their own natural, physical, economic, human, social, and cultural resources (Hendrickson et al., 2011, p. 154).

In contrast to the policy of urban renewal, the emphasis here was not only on providing housing units but also on the well-being and social benefits of the residents (Bratt, 1989). Due to the dismantling of federal aid programs, deindustrialization, mounting poverty, and the flight to the suburbs, by the mid-1970s, most large cities encountered severe fiscal problems, and New York City itself was on the verge of bankruptcy. To overcome the crisis, the

concept of the entrepreneurial city was put into action. Neoliberal urban development implies a shift from the initial government-led, the following municipality-led, to private strategies, which favor efficiency, competitive capitalism, and market-based solutions and focuses on development strategies that create profitable investment opportunities (Sager, 2011) as well as the highlighted tensions. So, how do we balance market-led neoliberal urbanism on the one hand and urban development that prioritizes social issues and community resilience on the other? We argue that only by developing a better understanding of the way in which these tensions manifest in the local context through the voices of local actors can we develop alternatives to a top-down market approach (Joy, 2021, p.7).

Recent research highlights not only the top-down approach but also the environmental (Macke et al., 2018; De Guimarães et al., 2020) and inclusiveness (Nunes et al., 2021) aspects of smart cities. Between many topics that coexist for smart cities and sustainability debates, food is paramount to human living. It demands constant solutions once it is the protagonist of negative externalities worldwide. Therefore, we elucidate about food in the urban discourse in the next section.

2.2. Food in the urban discourse

According to the most recent estimates by the United Nations (UN) Population Division, the UN department dedicated to demographic studies, 55.7 percent of the planet's inhabitants live in urban areas. This fraction will increase to 68 percent by 2050. In addition, cities today occupy just 3% of the earth's surface but consume 80% of our food resources. The vulnerability and fragility of urban systems have emerged in all its evidence with the Covid19 pandemic (Marino et al., 2020). Many are the impacts the pandemic already produces on the entire food supply chain. From the greater exposure to the insecurity of the poorest sections of the population to the limitations on free trade, the increase in the prices of raw materials, up to the distribution of humanitarian aid, from the alternating restrictions on the movements of more than half of the world population (Glauber et al., 2021) to the attacks on supermarkets for the fear that, once the supplies were interrupted, people could run out of food (Fattibene, 2020).

In addition, there are the difficulties of feeding a megalopolis of more than 10 million inhabitants like Wuhan in a phase of total lockdown and the effects this had on public health and nutrition. The Chinese Government launched a series of actions and policies to maintain an adequate food supply for the urban population and support producers in peri-urban and rural areas. This initiative required a great deal of collaboration and coordination betwe-

en the different levels of government (municipal, regional, and national) and with many actors. In this context, new digital technologies and food distribution services have quickly become essential channels for promoting and selling food products and ensuring the supply chain complies with central health directives (Zhang, 2020). By looking at the cities from this domain, the challenge we face is to rethink urban food systems, looking for sustainable solutions to produce, distribute, and consume healthy and safe products for all (Cattaneo, 2021).

Another phenomenon related to the absence of efficient food management in cities is the food deserts. A food desert refers to an area or community in an urban settings where access to affordable and nutritious food is limited or nonexistent. These areas lack grocery stores, farmers' markets, and other fresh and healthy food sources. Instead, residents often rely on convenience stores or fast-food outlets that offer mainly processed and unhealthy food options. Food deserts disproportionately affect low-income neighborhoods, leading to nutritional deficiencies, health disparities, and limited food choices for the residents (Dutko et al., 2012).

Indeed, cities are fundamental for the achievement of the sustainable development goals (SDGs). According to the SDG Index for European Cities, which mapped 45 European cities, no European metropolitan area is close to achieving the SDGs while reaching the targets set for Goal 2 can have a significant impact not only on the Goal itself but also perhaps above all due to the synergies with numerous other SDGs. Fighting hunger and promoting sustainable agricultural systems and food chains means fighting poverty (SDG1) but also preserving health (SDG3), protecting natural resources (SDG6, SDG12, SDG13, SDG14, SDG15), creating an innovative and less impactful agricultural system from an energy point of view (SDG7, SDG9), reduce inequalities (SDG5, SDG10), allow everyone to have an adequate level of education and employment (SDG4, SDG8), to maintain peace and political stability (SDG16) and to ensure sustainable rural and urban development (SDG11), for example by strengthening partnerships at various levels (SDG17) (Marino et al., 2020). It is a complex challenge that some cities have begun to face.

The carbon emissions generated by the entire supply chain and post-consumption are intrinsic to the food problem. The most significant emissions reduction in the food sector can be achieved through interventions focused on diets and waste management. Enhancing the availability of sustainable, nutritious, and locally suitable diets aligned with ambitious targets can significantly decrease emissions (Röös et al., 2022). Moreover, by effectively addressing household and supply chain waste, emissions can be reduced by 10% and 5%, respectively. Acting on food-related challenges requires colla-

boration with all stakeholders involved in the urban food system, including farmers, delivery services, restaurants, canteen cooks, businesses, and grassroots organizations. Local governments are vital in driving impactful change by working alongside these stakeholders (WWF, 2023).

2.2.1. Food Systems for Smart Cities

In discussing urban food system transformations, they are often categorized in the dichotomy between consumers and producers. However, this production/consumption dichotomy is unhelpful in understanding real-world dynamics. This is, for instance, elaborated in the literature on food citizenship, where the common denominator goes beyond the one-dimensional and rather passive end-user/consumer perspective (Johnston, 2008). In this regard, we look at city users as experts in their own daily life (Brons et al., 2021).

Rather than viewing the city users as passive or ignorant, they are best seen as experts on food in their own daily life simply because they perform their food routines daily or at least frequently (Krom et al., 2020). This understanding of consumers as skilled and knowledgeable rather than as ignorant in interacting with the food environment is built on social practice theories (Cohen and Ilieva, 2015; Hasselkuß et al., 2017; Shove et al., 2012; Warde, 2005). Within this approach, consumers are viewed as carriers of practices (e.g., food shopping, cooking, working) that take place within a socio-material context (Reckwitz, 2002), rather than as either fully rational and reflexive individuals or as incompetent and passive persons. When citizens are viewed as experts in their own daily food habits, it also follows naturally that it is essential to consider them experts in developing experiments or interventions in their own everyday food routines to successfully transform towards healthier and more sustainable food consumption (Krom et al., 2020).

Nevertheless, even if great knowledge about food is spread in academic and practical spheres, people still produce catastrophic amounts of food loss. Food waste is the first concept regarding food that is not consumed in the first stages of the supply chain, and the second concept is when food has already reached consumer's houses. More about this dynamic is in the following subsection.

2.2.2. Food Waste for Smart Cities

Smart cities aim to enhance people's quality of life by leveraging technology and data-driven infrastructure. However, to truly impact people's lives, smart cities must prioritize natural resources and urban environmental sustainability (Macke et al., 2018; De Guimarães et al., 2020). The concept of a smart city emerged to address challenges by implementing innovative tech-

nologies that preserve the urban environment and promote the well-being of residents (Nunes et al., 2021).

With the rapid growth of urban populations, waste production and its associated negative externalities are increasing (Ackerman et al., 2014). Future smart cities will require efficient logistics and technologies to address waste management. Innovations such as wireless, solid waste management systems allow municipal corporations to remotely monitor dustbins' status via web servers, optimizing cost and time efficiency (Nirde et al., 2017).

Focusing on specific solutions for managing organic waste is crucial, considering its growth alongside population expansion. Information and Communication Technology (ICT)-based platforms, mainly handheld device apps, can be pivotal in facilitating efficient food redistribution in urban and rural areas. While this approach may not target 100% of food waste, it can significantly reduce diversion from landfills and benefit underprivileged populations (Sanyal et al., 2021, p. 19). Incorporating technology into waste management solutions is a desirable objective for establishing a smart city.

Four key primary strategies are interconnected to transform smart cities into zero-waste sustainable towns. These strategies include waste prevention, upstream waste separation, on-time waste collection, and appropriate value recovery from collected waste (Esmaeilian et al., 2018).

3. Methodology

This study presents findings from a multiple case study analysis to bridge the knowledge gap arising from the conflicting perspectives in smart city research considering social aspects. The aim is to offer valuable insights regarding food systems and food waste when designing and implementing strategies for smart city development. For this, we made an exploratory-descriptive study of qualitative approach using a multiple-case study strategy. According to Richardson (1999), the qualitative approach prioritizes a detailed understanding of the meanings and characteristics of the situations presented by the people involved in analyzing temporal cuts. In this approach, the researcher has a broader focus on understanding the phenomena from the perspective of the researched actors (Gil, 2002). Besides this, descriptive research "exposes characteristics of certain populations or phenomena. It can also establish a correlation between variables and define their nature." (Vergara, 2000, p.47).

The criteria selection of the cases is due to their diverse natures in practice and the authors' familiarity with most of them because of their active participation in some of the initiatives, such as the ones in Brazil and the United

States. As the development of each case has different levels of deepness, there is no standard set of analysis steps. Two use only secondary data, one interview, and passive observation, and the other three participative observations as better described below.

The next chapter starts with Karlovac Eco-Gate in Croatia to show a traditional example of combining technology and waste management in a public-private partnership (PPP), where only secondary data was utilized to discover the case. The second case concerns the startup Lemobs's participation in the Ecco Communities program developed by the business accelerator Quintessa, in Brazil. With Lemobs, it was possible to interview one of the CEOs to understand better their participation and attend the online event about the results of the startups' acceleration process. In the third and fourth cases, there are the examples from Florianopolis, a city in the south of Brazil that is compromised to become a Zero Waste municipality until 2030, where one of the authors is inserted as Zero Waste ambassador and has seen fruitful results from these initiatives reported in field events, secondary data was used to precise the numbers. The fifth case brings American universities as the main protagonists in the implementation of a food recovery and redistribution system, a movement started from the students at the University of Maryland, USA, where we only used secondary data to explore it. The sixth example is the urban farm of Minneapolis in the United States to illustrate the urban food system dynamic, where the other author of this article has been there in person to better understand this endeavor's dynamic. Those different profiles of cities bring up a myriad of practices regarding the valorization of food and food waste that may be implemented in other places.

4. Results and Analyses

4.1. Karlovac Eco-Gate

One of the most potent ideas regarding sustainability management or balancing the interests of various actors in a particular territory, such as businesses, territorial ecosystems, and stakeholders, is that of the circular economy. Governments, companies, and society recognize it as an alternative to the linear economy, in which the economy and the environment should coexist in balance (Boulding, 1966). The take-make-dispose model, typical of linearity with its known externalities, is reimagined in a circular cycle that requires a radical redesign of industrial systems, thus implying profound institutional and cultural changes (Kopnina, 2021).

In this direction, the city of Karlovac in Croatia has embarked on a public-private partnership (PPP) following a productive trend of collaboration between companies, institutions, and citizens to achieve the significant and profound changes mentioned above, in this case for the redevelopment of waste management in the county of Karlovac (Blasi and Sedita, 2023). The proposal is to comprehensively reorganize the waste management system concerning recyclable and non-recyclable components. The project aims to: 1) make waste management ecologically and economically sustainable, resulting in the elimination of landfills in the county of Karlovac; 2) strengthen recycling activities and align them with European sector regulations; 3) implement a plan for the production and distribution of energy, both electric and thermal, through biogas and an oxidative plant (using technologies with minimal environmental impact); 4) manage recycling system telematically through Eco-Gates and the related tariff system; 5) protect and restore natural ecosystems; 6) contribute to the fight against climate change; and 7) promote social inclusion, poverty reduction, and economic development.

Concretely, to achieve these objectives, material recycling will involve collecting, with active citizen involvement, the recyclable portion of urban waste (metal, wood, paper, glass, and PET) at specially equipped "Eco-Gates." The non-homogeneous organic waste components (bones, skin, household organic waste, animal excrement, and agro-industrial waste) will be collected at a biogas plant to produce electrical and thermal energy, thus implementing energy recycling. The remaining hardly recyclable waste (synthetic fabrics, plastic materials, etc.) will be sent to a low-impact oxidative plant.

Of the three directions in which the project is structured, for this research, we intend to explore the functioning of the so-called Eco-Gates, which are actual hubs for the collection and differentiation of urban waste. They are built based on incentives and "nudging" the virtuous behaviors of citizens. This innovative solution allows for raising awareness in the community about recycling, thus enabling greater material reuse and lower costs for the State. Thanks to these centers, the recyclable portion of solid urban waste is integrated into a recycling system, where citizens personally handle the differentiation and delivery to the Eco-Gates, organized to make these actions quick, simple, and effective. By taking care of the transportation and differentiation of their share of recyclable material, citizens will receive the equivalent monetary value of the material deposited in the recycling system. This compensation will be credited to a dedicated digital card provided to each household. This card will be able to communicate in real-time, through a centralized system, both the status of accumulated economic value and the rate of payments due, based on the tariff for the collection, storage, and disposal service of the non-recyclable portion of solid urban waste. The corre-

sponding economic value can be used as a "credit" for purchasing consumer goods. The Eco-Gates will be strategically located throughout the territory of Karlovac, in areas adjacent to supermarkets, allowing the use of the provided card for product purchases.

For the first five years of operation, the European Union will provide funding of 0.50 Euros for every kilogram of recycled material. Assuming an annual recycling quota of 150 kg per person, the financing will amount to 11,250,000 euros. Almost one-third of the funding will cover the management costs of the entire Eco-Gate, while the remaining 70% will cover the reward for active participation by users. Therefore, the average reward per person will be approximately 52.5 Euros per year. Thus, households can cover the annual amount for waste collection system management. Starting from the sixth year, the portion of European funding that previously covered the Eco-Gate's management costs will be covered by a tax on packaging production.

4.2. Ecco Comunidades from Quintessa – Lemobs case

The Ecco Comunidades Program is a collaborative initiative involving the BRF Institute, Quintessa, and Prosas. It aims to foster territorial development by implementing solutions that reduce food losses and waste in Brazil. The inaugural edition of the program took place in 2021 and concentrated on selected rural municipalities where BRF, one of the largest food producers in the world, has a presence.

Founded in 2009, Quintessa has catalyzed over 110 startups, offering entrepreneurial solutions to significant social and environmental challenges. Their official website describes Quintessa as an ecosystem that combines profitability with the potential to tackle pressing social and environmental issues. Guided by a partnership-oriented culture and a positive mindset, the company strongly emphasizes the humanistic perspective. Quintessa's mission is to foster impact businesses in Brazil that address socio-environmental concerns. They achieve this by supporting enterprises that prioritize social and environmental impact as core aspects of their activities while striving for financial returns through market-oriented business models.

One of the participant startups of the Ecco Comunidades program in 2021 was Lemobs. Lemobs is a GovTech that is part of the innovation ecosystem at the Federal University of Rio de Janeiro Technological Park and has the mission of making cities smart using innovative technologies. Their products and services include the areas of inspection, citizen service, management and analysis, environment, collection, direct and indirect works, human rights, education, nutritional monitoring of students, and health. The technology

enables the public manager to access crucial data for management based on transparency, cost reduction, qualified decision-making, and citizen focus (Lemobs, 2023).

The software developed by the company was chosen for the acceleration program due to its ability to facilitate the management of school meals in compliance with the guidelines of the National School Feeding Program (PNAE). The software encompasses various features such as menu and preparation sheet management, inventory control, approval of orders, food acceptability, quality testing, and a tool for monitoring the nutritional status of students.

Lemobs implemented its project at the Tengatuí Marangatú Indigenous Municipal School, catering to 970 students from the Guarani Kaiowá, Guarani Ñandéva, and Terena ethnicities in the Jaguapiru village of Mato Grosso do Sul. Due to the distinct dietary preferences of the indigenous population compared to the broader Brazilian population, Lemobs had to customize its menu automation solution. The application prioritizes nutritional adequacy and emphasizes including products from family farming in food shopping lists. The implementation resulted in a 20% decrease in food request errors, reduced menu assembly time from 4 hours to 5 minutes, and a 95% reduction in the time taken to generate orders from family farming. Waste reduction is also achieved through acceptability tests conducted with the children, ensuring that the food is enjoyable to them, and facilitating ongoing evaluations of new foods and preparations.

4.3. Minhoca na Cabeça

The Minhoca na Cabeça project encourages domestic organic waste recycling by donating worm casting kits by the Florianopolis City Hall. Enrolling and participating in a training workshop is necessary to receive the kit. During this workshop, the public-private company responsible for the waste management of Florianopolis, called Companhia Melhoramentos da Capital (Comcap), delivers the worm-casting boxes. The vermicomposting can be managed at home or in an apartment, and its operation is not complex but requires some previous knowledge. It is necessary to separate the organic residues and have a bit of dry material, such as leaves or sawdust, to regulate the humidity. Then, the vermicomposting box operator builds layers inside to feed the worms and other good microorganisms that will transform this material into humus and liquid bio-fertilizer.

The Minhoca na Cabeça project is exclusive to residents of Florianopolis. By the adhesion term, the participant must commit to a capacity-building workshop where he/she will build his/her own compost bin. The compost

bin will then be donated to him/her and should be used for home treatment of organic waste. The participant will provide information on the amount of waste recovered and return the equipment in case of disinterest in the project (PMF, 2023).

The program has already distributed 1,100 vermicomposting kits. Its beneficiaries have been trained and have been operating the home compost bin, treating about 400 tons of waste annually. Continuing the program, 2,000 more kits will be distributed. Thus, based on the average monthly production of 30 kilos of organic waste per family of four people, the 3.1 thousand users will divert 1,116 tons of organic waste annually in Florianopolis, with annual savings of about R$250,000 in transportation and landfills. By recycling the total organic waste, food waste, and green waste (in the different forms of treatment) in 2022, the city will save about R$1,300,000 with landfill. If it meets the zero waste targets, in 2030, there will be R$17 million in gains between what it stops spending on landfill and the value of the compost. Besides the economic gains, there is an improvement in the quality of life in general.

4.4. Revolução dos Baldinhos

The Monte Cristo neighborhood is a favela located on the outskirts of Florianopolis in a conurbation bordering the municipality of São José, and it has a population of 26,000 inhabitants according to the 2000 Census of the Brazilian Institute of Geography and Statistics (IBGE). It is estimated that the neighborhood is currently inhabited by approximately 3,800 families, totaling more than 30,000 inhabitants. It presents remarkable characteristics such as most of the black and impoverished population, low levels of schooling, territorial disputes over drug trafficking, and high rates of violence. The neighborhood comprises nine communities, three of which represent the so-called Chico Mendes Complex, the leading region of Project Revolução dos Baldinhos's (PRB) coverage. The experience of the PRB was born and developed from the need to build integrated actions to solve an outbreak of leptospirosis that caused two deaths among the residents, a situation that resulted from a strong epidemic of rats resulting from the accumulation and dispersion of garbage in the streets of the neighborhood communities (Fabrin, 2019).

The community and decentralized management consist of separating organic waste by the residents who participate in the PRB in their homes, selective collection of waste, and disposal for composting. The compost produced is returned to the families for the practice of urban agriculture in the homes and community entities. The experience involves more than 150 families and different educational institutions that no longer dispose of their

solid residues as waste, valuing the organic fraction. This model consists of the self-organization of people in their places of residence, work, and study, bringing them together around a collective activity that benefits the environment. It represents a concrete alternative to the conventional solid waste management model and significantly contributes significantly to reducing socio-environmental impacts from the traditional model. It is possible to see that the PRB presents several aspects of change for the better in the lives of the people directly and indirectly involved. It is a concrete example of environmental protection because it involves the care of the environment and, above all, the health of the people who live in it, the central objective of the PRB. Besides solving a public health problem resulting from the proliferation of rats in the community, the experience also enables and stimulates the practice of agroecological urban agriculture with local production of quality food, directly reaching thousands of people and aiming to promote food sovereignty.

The PRB also increases soil fertility, works as an experience of sensitization through environmental education, and serves as an alternative for generating work and income with the production and commercialization of organic compost. With more than ten years of operation, the PRB has already treated more than 1,200 tons of organic residues and contributed to producing healthy food for the participating families. Currently, six to seven tons of organic residues are composted monthly, generating approximately three tons per month. Several workshops and environmental education activities are also held with various audiences and, recently, its activities have been expanded with the receipt of burnt cooking oil to make soap, which also returns to the people who participate in the project, and with the promotion of a community thrift store with the donation of clothes.

Another relevant aspect of the PRB is that the experience was not coordinated and implemented by the State, from top to bottom, hierarchically, but was instead led by the local agents involved in the community's daily life on a micro-local scale. Despite the contradictions, an effort was made to decentralize planning and decision-making through organizational forms that tend toward horizontality, as opposed to vertical and hierarchical organizations. Numerous agents, organizations, and institutions have been directly or indirectly involved in the experience, manifesting different levels of involvement and commitment and different interests, in some cases complementary and in others antagonistic or contradictory.

4.5. *Food Recovery Network*

Universities are becoming increasingly sensitive to their impact on the respective urban food systems to the extent that waste management and sustainability have become critical issues for them worldwide. To address this problem, many student-led initiatives have emerged as catalysts for change.

One of the most relevant is the Food Recovery Network (FRN), a student movement initiated by five students at UMD (University of Maryland, USA) back in 2011 who noticed that good food was going to waste in their campus and decided to redistribute it to people in need. FRN is a remarkable organization that addresses the critical issues of food waste and food insecurity in communities across the United States, with more than 200 active chapters. Envisioning a future where no one in the U.S. is hungry, the FRN has made significant strides in mobilizing students, volunteers, and local businesses to create a more sustainable and equitable food system. Moreover, they believe that effective action requires getting to the root of the problem by addressing the main issues that cause hunger, economic insecurity, climate change, and ultimately a fractured food system that makes waste food easier and is designed to optimize profit.

At its core, the FRN operates by forming partnerships between college campuses and local food recovery agencies. The organization empowers student volunteers to collect surplus food from campus dining halls, sporting events, and other venues that would otherwise be discarded, allowing them to make a meaningful difference in their local communities. Through volunteerism, leadership development, and educational programs, the FRN empowers students to become advocates for sustainable food practices and social justice. This rescued food is safely transported and donated to local non-profits, shelters, and community organizations. By diverting food from the waste stream and redistributing it to those in need, the FRN simultaneously tackles food waste and food insecurity.

The impact of the FRN's work is substantial and far-reaching. Across its network of college campuses, the organization has recovered millions of pounds of food that would have otherwise gone to waste. This equates to millions of meals provided to individuals and families in need. According to their most recent annual report (FRN, 2022), 4.6 million meals were donated to the communities in 45 states. Across its 213 chapters, an average of 2.236 pounds of food were recovered per student chapter.

One of the fundamental values of the FRN is its commitment to sustainability. Approximately 40% of the food produced in the United States goes to waste. This not only squanders valuable resources like water, energy, and labor but also contributes to greenhouse gas emissions and environmen-

tal degradation. In 2022, 2791 metric tons of CO_2 emissions were prevented because of their FRN action. By rescuing and redistributing surplus food, the FRN helps reduce these negative environmental impacts and promotes a more sustainable food system, but the FRN's efforts in alleviating hunger but also contribute to the overall well-being and health of communities and environment: 2791 metric tons of CO_2 emissions were prevented because of their action.

Furthermore, the FRN recognizes the pressing issue of food insecurity that affects millions of people nationwide. By recovering and redistributing food to local organizations, the FRN plays a vital role in ensuring that vulnerable populations have access to nutritious meals. This addresses the immediate needs of those experiencing food insecurity while also fostering a sense of community and solidarity.

Moreover, the FRN serves as a catalyst for social change and community engagement. The organization actively involves students in food recovery initiatives, providing them with an opportunity to make a meaningful difference in their local communities. Through volunteerism, leadership development, and educational programs, the FRN empowers students to become advocates for sustainable food practices and social justice.

In addition to its direct impact on hunger and sustainability, the FRN has broader ripple effects. By raising awareness about food waste and food insecurity, the organization sparks conversations and inspires individuals to act. The FRN's model has been replicated on campuses nationwide, leading to the establishment of numerous student-led food recovery initiatives. This collective effort amplifies the impact of the FRN's mission and further promotes sustainable and equitable food systems.

In conclusion, the Food Recovery Network stands as a powerful force in the fight against food waste and food insecurity. Through its collaborative approach, the organization has harnessed the energy and passion of students to create a more sustainable and just food system. By rescuing surplus food and redistributing it to those in need, the FRN addresses food waste's environmental and social aspects. Its impact extends beyond immediate hunger relief, fostering community engagement, inspiring behavior change, and paving the way for a more sustainable future. The Food Recovery Network models how collective action and grassroots initiatives can bring about positive change in the world.

4.6. *Urban Farm Minneapolis*

Urban farming has gained significant attention recently as a sustainable solution to address food security, promote local agriculture, and foster com-

munity engagement in urban areas. One notable example is the urban farm project promoted by Urban Ventures in Minneapolis. This case study explores this initiative's key features and impacts, highlighting its contribution to urban sustainability and community development. Urban Ventures is a non-profit organization in Minneapolis focusing on community development and empowerment.

Their urban farm project seeks to transform vacant lots and underutilized spaces into productive agricultural areas, providing fresh food access to residents and empowering the community through education and engagement. Key Features of the Urban Farm Project are: 1) Transforming Urban Spaces as they identify vacant lots and unused spaces throughout Minneapolis and convert them into productive urban farms. These sites are carefully chosen to maximize their potential for cultivation and accessibility to the community; 2) Sustainable Farming Practices and farming techniques are emphasized, such as organic farming, permaculture principles, and water conservation. By prioritizing environmentally friendly practices, the urban farm minimizes synthetic inputs and promotes biodiversity within the urban landscape; 3) Community Engagement and Education is another aspect as the Urban Ventures staff actively involves the local community in all aspects of the project. They offer educational programs, workshops, and volunteer opportunities for residents of all ages, fostering a sense of ownership, empowerment, and skill development; 4) Fresh Food Access is one of the primary goals of the urban farm project as it is meant to address food insecurity in Minneapolis. The farm produces a variety of fruits, vegetables, and herbs, which are distributed through farmers' markets, community-supported agriculture (CSA) programs, and partnerships with local businesses and food pantries in the so-called "food deserts".

So, the impacts and benefits of the project are countless: economic opportunities, as per the employment and training opportunities within the local community. Residents are engaged in various farm-related activities, such as planting, harvesting, and marketing, fostering economic resilience and self-sufficiency. Environmental Sustainability, as the urban farm promotes sustainable land use practices, reduces long-distance food transportation's carbon footprint. Additionally, utilizing vacant lots helps combat urban blight and enhances the aesthetic appeal of neighborhoods. It fosters community cohesion through its educational programs, community events, and a sense of belonging among residents. It serves as a gathering space for individuals from diverse backgrounds to come together, learn, and collaborate.

The urban farm project promoted by Urban Ventures in Minneapolis is a clear example of the transformative potential of urban agriculture and hope-

fully will serve as a model for other cities to address the challenges of urban living while nurturing a vibrant and resilient community.

5. Conclusions

In conclusion, while the smart city concept remains ambiguous and lacks a universally agreed-upon definition, there is a growing recognition of the need for a comprehensive approach that prioritizes the well-being of citizens and promotes sustainability. As the prevailing top-down, market-driven model of smart city development has been criticized for neglecting social and environmental concerns, exacerbating inequalities and gentrification, it is essential to shift towards a more human-centered, bottom-up approach that involves the active participation and input of city users and stakeholders.

The urban food system plays a crucial role in shaping the sustainability and resilience of cities. With most of the global population residing in urban areas, cities consume a significant portion of the world›s food resources. Addressing food waste through innovative technologies and efficient waste management strategies is crucial for transforming smart cities into sustainable, zero-waste urban environments.

The presented case studies highlight various innovative approaches to waste management and sustainability in different contexts, with the engagement of multiple stakeholders, including consumers, producers, and local governments. By considering citizens as experts in their daily food practices and involving them in developing interventions and experiments, cities are on the right path to play a significant role and contribute to multiple Sustainable Development Goals, ranging from poverty alleviation to environmental protection and social equity.

Human-centered theoretical lines' approach to exploring smart cities discourse is paramount to demystifying the idea that smart cities are exclusive to wealthy developed countries. In parallel, we suggest good practices for alternative ways of co-creating an inclusive and sustainable smart city, specifically using urban food management strategies. Public policies for smart cities often include initiatives and strategies for efficient organic waste management. The management of organic waste is a critical aspect of urban sustainability, as it can reduce environmental impact, promote recycling, and improve overall quality of life in cities. With the case studies of this article some public policies were identified as good practices to be spread around. The software used by Lemobs and Karlovac Eco-gate stress what kind of technologies smart cities must provide to valorize the collection services for organic waste. This includes the regular collection of food scraps, yard waste,

and other organic materials integrated with the use of technology and data analytics to track and analyze organic waste generation patterns. This data helps in optimizing waste collection schedules, identifying areas with high waste generation, and making informed policy decisions. Other examples can include sensors in waste bins to optimize collection routes, smart waste bins that compact waste to reduce volume, and digital platforms for reporting and monitoring waste collection. An important point is to guarantee that the population can deal with those innovations, and the adaptation of services for diverse communities as the indigenous one showed by Lemobs.

In any case, the Minhoca na Cabeça e Revolução dos Baldinhos programs make significant contributions to the organic waste management without any advanced technology, but with civil society work force and educational programs. Besides of this, public policies for smart cities must consider urban food systems to ensure sustainable, equitable, and efficient access to food resources for their growing populations, as Food Recovery Network and Minneapolis Urban Farm cases. Encouraging urban agriculture initiatives, such as community gardens, rooftop farms, and vertical farming, through policies and incentives can help cities reduce their reliance on distant food sources and increase local food production. Policies that address food deserts and food insecurity in urban areas are also recommended. This may include incentives for grocery stores to locate in underserved neighborhoods, subsidies for healthy food options, or support for food banks and meal programs.

To the coalition between people's interests, their power of agency and sustainable smart cities is necessary public awareness and education. Smart cities invest in public awareness campaigns to educate residents about the importance of organic waste management. These campaigns can include workshops, informational materials, and online resources. Also, public-private partnerships and collaboration with non-profit organizations can play a significant role in successful organic waste management and sustainable food systems. These partnerships can bring expertise, resources, and innovation to the table, and incentives to encourage businesses and individuals to adopt sustainable practices.

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