Smart and Sustainable Cities Through Short Supply Chains of Food

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Abstract: The world in general and cities in particular are facing tremendous challenges at the environmental, social, economic and institutional levels. Currently, cities need to be sustainable and smart. An economic important and innovative sector at urban areas is food security. As our better knowledge, the majority of the literature, explores the concept of smart cities from the point of view of information and communications technology, and the connection with the social and sustainability aspects remains unsolved. This paper tries to overcome this gap in the literature. The main aim is to analyze the contribution of short supply chains of foods in terms of sustainability of smart cities. The need to address complex social problems and sustainable change in face of complex and wicked societal ills, such as the ones resulting from the ongoing coronavirus pandemic, known as COVID-19, emphasize the importance of this study. The article reports the conclusions of a scoping revision of the literature and the preliminary results of four research projects in this area, including the *SGDsCONSUM* project. These results confirm positive impacts of short supply chains of food in urban areas in the four dimensions of sustainable development and smart and sustainable cities. The conclusions of this article will be helpful for producers, consumers, traders, importers, exporters, tourists, financial institutions, and government sectors related to agricultural economic activities, projects, and programs in order to implement their policies accordingly.

Keywords: short supply chains of food; sustainability, smart cities, COVID-19.

1. Introduction

Nowadays, the world in general and the cities in particular are facing tremendous challenges at environmental, social, economic and institutional levels (Dos-Santos, IST 2020, Dos-Santos and Ahmad, 2020). These challenges are exacerbated currently by one hand, due to the increasing trend of urbanization of the cities (referencia), and, by the other, due the news challenge of living through a convergence of crises (Broo et al., 2020). That was exacerbated by the ongoing coronavirus disease 19 (COVID-19) caused by the SARSCoV-2 virus, that was first identified in December 2019 in the Chinese city of Wuhan, and was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020 (Lai et al., 2020). Since then, the pandemic has rapidly spread beyond China to almost every country on the globe. COVID-19 has affected millions of people, with several thousands of deaths in all states and territories around the world (WHO, 2020). Governments worldwide have increasingly undertaken an inhibition strategy to contend the outbreak, relying on widening social and intergovernmental measures at national and world level.

Currently, in 2021, when the ongoing Covid-19 global pandemic spread across the world contemporary cities have and acquire new pivotal role in strategic sustainable development (Bibri, & Krogstie, 2019; Maaroof, 2015). Therefore, they have gained a central position in the operationalization of the referred Sustainable Development Goals (SDGs). In particular, the Sustainable Development Goal 11 (SGD 11) of the United Nations' 2030 Agenda, which seek to make cities more sustainable, resilient, inclusive, and safe (Bibri, & Krogstie, 2019; Maaroof, 2015). However, according to UN (2020), over 90% of the Covid-19 cases are in urban areas. That create *per si* a biggest challenge that exacerbate the previous urban challenges due the fact that more than half of the population of the world living in urban areas with a trend of increasement (Dos-Santos, 2016).

The path of smart cities has a huge development of the literature. The new challenges that they are face due to the SDGs of UN also created a great opportunity and development from scholars. On the other hand, urban agriculture and short supply chains of food acquired on the last decades an increasing importance. But except the preliminary work of Dos Santos (2016) the connection and the promotion of sustainable and smart cities by short supply chains of foods remains unexplored. This paper tries to overcome this gap in the literature. The

main aim is to analyze the contribution of short supply chains of foods in terms of sustainability on smart cities, in order to promote smart and sustainable cities.

1.1. The path of smart cities and sustainable cities

The UN adopt the New Urban Agenda at the United Nations Conference on Housing and Sustainable Urban Development in Quito, Ecuador, on 20 October 2016. This was structured by means of an extensive list of institutional recommendations on how to make urban environments become completely sustainable entities, from a cultural, socio-economic, and environmental point of view (Kummitha, 2020).
Among these recommendations, the UN suggested that expediting sustainable transitions in urban contexts require adopting a smart-city approach (triggering the input that digital technologies can offer into solving urban challenges and improving the sustainability of urban service provision (Mora and Deakin 2019; Schiavone et al., 2020).
Although social influence is claimed to be a deterministic factor in technology adoption (Fulk et al., 1987; Kummitha, 2020), hardly any urban studies research has explored how social influence allows cities to adopt particular technologies. The literature largely focuses on the general adoption of smart technologies, and largely neglects the social components namely, the influence from urban communities and their adoption process of innovation.

1.2. The sustainable development applied to smart and sustainable cities

The literature traditionally classifies sustainable development based on the social, economic and environmental components. Furthermore, Dos-Santos and Ahmad (2020) includes a new component in sustainable development, namely, the institutional framework. Hence, sustainability acquires not just the social, environmental and economic dimensions, but also, the institutional dimension, that means the grade of support and infrastructures from public policies, namely, the Multiannual Financial Framework at European Union among others multilateral agreements in other continents associated to the infrastructure and public policies of development of each country that have different levels across the world.
At environmental level climate change has exacerbate serious negative impacts at our societies in all the levels. Therefore, in 2018, the Intergovernmental Panel on Climate Change (IPCC) report highlighted the need for rapid and drastic action on climate change by 2030 to prevent the disastrous effects of a world warmed by more than 1.5 °C above pre-industrial levels, raising the urgency of achieving the United Nations (UN) Sustainable Development Goals (SDGs) adopted by Member States in 2015. Even rapid decarbonization, the report warned, would likely not be sufficient to address the intertwined problems of poverty, mass migration, politics and ecological collapse that the SDGs seek to address. Indeed, the Mediterranean Experts on Climate and environmental Change (MedECC, 2020) reinforce these concerns referring that annual mean temperatures on land and sea across the Mediterranean Basin are 1.5°C higher than during pre-industrial times and they are projected to rise until 2100 by an additional 3.8 to 6.5°C for a high greenhouse gas concentration scenario and 0.5 to 2.0°C for a scenario compatible with the long-term goal of the UNFCCC Paris Agreement to keep the global temperature well below +2°C above the pre-industrial level (RCP2.6). On the other hand, the MEDECC Report (2020) also refer that Mediterranean cities are growing due to increasing population and socio-economic change, notably on the coasts of southern countries. Due to increasing heat stress, the planning and management of cities around to Mediterranean and the world will need to focus more on human health and resilience to environmental change. Impacts of climate change on urban areas are expected to be disproportionally high due to a concentration of population and assets – especially in high-risk prone areas - in combination with hazard-amplifying conditions (e.g. increased run-off resulting from soil sealing, or urban heat island effects).

1.2.1. At the social level

Understanding the local social and cultural context is a precondition for attaining technological affordance (Kummitha, 2020). As DeSanctis and Poole (1994) and Kummitha, (2020) highlight, social problems represent social reality and offer necessary cognitive frames for technologies to be invented. However, affordance can be difficult to achieve when technologies are forced into smart cities. As social context sets the platform for technological affordance, the effectiveness of smart city technologies is difficult to ascertain (Kummitha, 2020). Although social influence is claimed to be a deterministic factor in technology adoption (Fulk et al.,

1987; Kummitha, 2020), hardly any urban studies research has explored how social influence allows cities to adopt particular technologies. The literature largely focuses on the general adoption of smart technologies, and largely neglects the social components, namely, the influence from urban communities and their adoption process of innovation.

1.2.2. At the economic level

At the economic level cities around the world and in Europe present different grades of development and levels of urbanization. Usually the standard human welfare indicator used is GDP per person among developing and developed countries. This indicator has long been criticized for being overly simplistic and misleading (Lomborg, 2020). According to the OECD (2017) GDP was not designed to provide a proxy for both economic and general welfare and present limitations (Stiglitz et al., 2018; Lomborg, 2020). The problem is that most suggestions for the replacement of GDP as a measure include a dizzying array of indicators, from the UN's 169 SDG targets (UN 2015) to the 50 well-being indicators in OECD's own How is life (OECD 2017; Lomborg, 2020).

1.2.3. At the institutional level

According to UN (2020) the world in general and cities in particular presents different levels of development. These different levels of development across the countries, implicate, in general, different levels of policies to support development, and, as well as, different levels to support and invest and promote the sustainability across the countries in general and cities in particular.

1.3. The role of smart cities on sustainable development

Contemporary cities have a pivotal role in strategic sustainable development; therefore, they have gained a central position in operationalizing this notion and applying this discourse. This is clearly reflected in the Sustainable Development Goal 11 (SGD 11) of the United Nations' 2030 Agenda, which seeks to make cities more sustainable, resilient, inclusive, and safe (Bibri, & Krogstie, 2019; Maaroof, 2015).
We are living through a convergence of crises (Broo et al., 2020). From the application of sustainability theory and technological change to the smart cities, the concept has been in use since the early 1990s (Gibson, Kozmetsky, & Smilor, 1992). However, it has gained wide international increasing importance in the last decade due the increasing urbanization that the world is facing and that target 'smartness' as a social, economic, environmental and urban governance goal (Masik et al., 2021) that will improve the quality of life in urban areas.
Moreover, the world is currently facing a COVID-19 pandemic, and this create new challenges for all the society in general and for the cities and short supply chains in particular. This paper tries to overcome this gap in the literature.

2. Literature Review

2.1. The Covid 19 outbreak

The ongoing Coronavirus disease (COVID-19), caused by the SARSCoV- 2 virus, was first identified in December 2019 in the Chinese city of Wuhan, and was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020 (Lai et al., 2020). Since then, the pandemic has rapidly spread beyond China to almost every country on the globe. COVID-19 has affected millions of people, with several thousands of deaths in all states and territories around the world (WHO, 2020). Governments worldwide have increasingly undertaken an inhibition strategy to contend the outbreak, relying on widening social measures and policies. The Covid 19 outbreak had hard impacts in economic, social, environmental and institutional terms in our lives.

2.2. Main sustainable indicators of agricultural activity in European Member States that affect short supply chains of foods and urban agriculture

The EU's rural development Regulation 1305/2013 (EU, 2020) defined for the first time short supply chain of food (SSCF) as a supply chain involving a limited number of economic operators, committed to cooperation, local economic development, and close geographical and social relations between food producers, processors and consumers. Indeed, the concept assumes context-dependent economic, socio-cultural, policy, organizational characteristics, having different impacts on local economies. There are many different forms of SSCFs in Europe, however, they share a common characteristic of reduced numbers of intermediaries between the farmer or food producer, and the consumer (Jarzębowski et al., 2020).
Figure 1 presents the food production index that covers food crops that are considered edible and that contain nutrients based on World Bank database from 2000 to 2018 covering the 28 Member States (MS) of the European Union. The coffee and tea are excluded because, although edible, they have no nutritive value. The results confirm an increasing trend among the majority of the MS during that period in face to the needs of an increasing population and global demand.

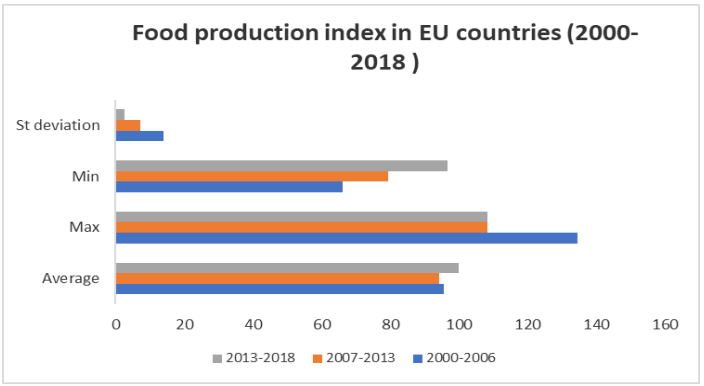

Figure 1: Food Production Index in European Countries (author calculations based on World Bank database, 2020).

Figure 2 presents the agricultural land based on World Bank database from 2000 to 2018 covering the 28 Member States (MS) of the European Union. Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow (World Bank, 2020). The results of Figure 2 confirm a decreasing trend in agricultural land use in European Member States. That means the urban areas and urban production need to gain more relevance.

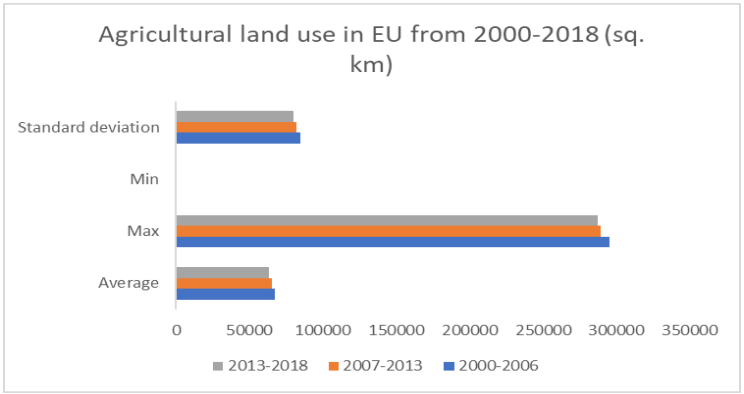

Figure 2: Agricultural land use in European Countries (author calculations based on World Bank database, 2020).

Figure 3 presents the agricultural employment in European Member States from 2000-2018. That indicator could be a social indicator of agricultural activity. The results confirm a trend of decreasing in agricultural employment over the last two decades. That was possible by the technological change in agriculture. Technological change and innovation will be more practicable in urban areas due the high concentration of high qualified human resources and R&D. Hence, urban agriculture and SSCFs could achieve here a social importance increasing the employment in part time or full time from disables or unemployment people in the cities, increasing the output of fresh foods and promoting the smart and sustainable cities by short supply foods.

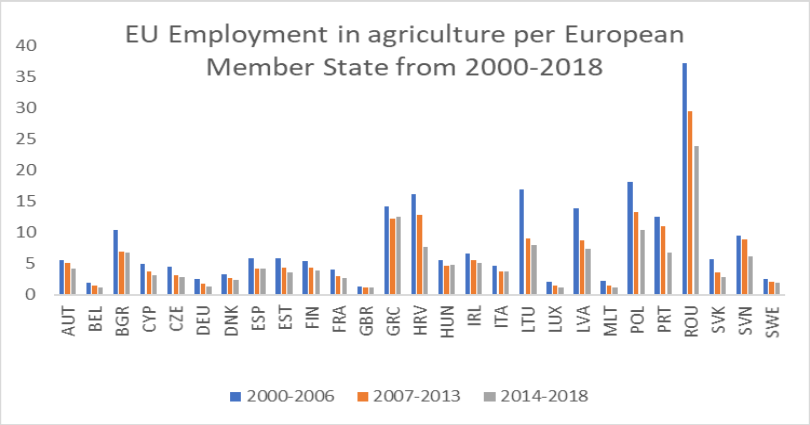

Figure 3: Agricultural employment per country in European Union from 2000-2018 (author calculations based on World Bank database, 2020).

Figure 4 represents the fertilizer consumption in EU member States (kilograms per hectare of arable land). The results indicate a trend of increase in the last decades. That could compromise the targets of the respective SDGs and implies the need to decrease without compromising the level of production. So, it will be necessary more technologies of production in lands currently abandoned or in urban and peri-urban areas and an increase in the use of organics fertilizers resulting from the treated urban trash.

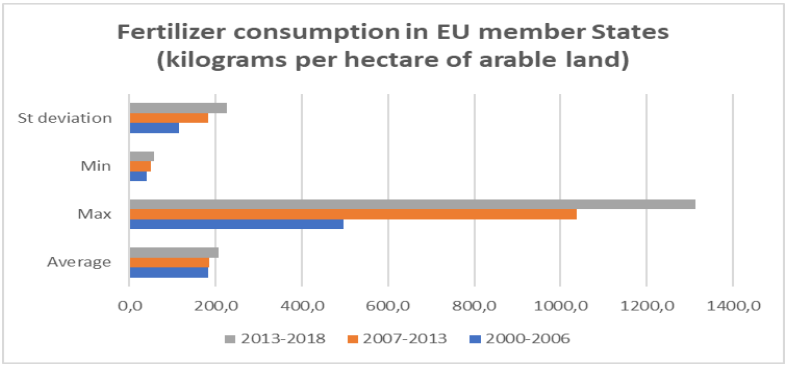

Figure 4: Fertilizer consumption in EU member States (authorship based on World Bank, 2020)

2. Methodology

To attain the main goals of the present paper, a systematic literature review was conducted to identify theoretical and empirical literature and the main previous scientific projects focused on smart and sustainable cities and/or short supply chains of food to conduct to the sustainability process. Indeed, the new insights from the project *The Ethical-Sustainable Consumer Behavior Before and After the COVID Pandemic and the respective Living Lab in development in Portugal (SDGsConsum)* from Portugal from Instituto Politécnico de Lisboa/other international projects across Europe, were used as case studies and exploratory methodology (quantitative and qualitative), based on initial data and feedback from stakeholders from the project *SDGsConsum*.

Indeed, the other data came from the ISI Web of Science (WoS), Web of Knowledge (WoK) and Scopus databases as well as, from main scientific research projects developed in Europe on the last years financed by Horizon 2020 from European Commission from European Union.
The databases (WoS and WoK) used include searched full-text scientific papers from May to June 2021 and included initially about 2300 papers from social sciences to technology, economics and econometrics, business and management and agricultural sciences. After the exclusion of the papers not directly related to the topic remains about 350 papers. Non-English articles, book chapters, dissertations, interviews, and conference abstracts were excluded.

3.1. Projects aiming achieving urban agriculture and short supply chains of foods

Table 1 presents the main European projects aiming to promote sustainable consumption and short supply foods in urban cities where we used qualitative and quantitative information and data from these projects.

Table 1: Main projects to promote sustainable consumption and short supply foods in urban cities

Project	**Countries**	**Main goals**
COST FA 1503	European Member States	To promote aquaponics and short supply foods in urban areas (Horizon 2020, 2020)
SDGsConsum	Portugal and European countries	To promote short supply chains of foods and sustainable consumption in urban areas (ESCS- IPL among various Universities at national and international level, 2020)
SMARTCHAIN	European Member States	To further support the development of collaborative short food Short supply chains and promote a more favorable framework for sustainable, local, healthier and ethically produced food in Europe.
FAO, UN	Developing countries	Short supply chains of food for promoting local foods and local markets

Authors, 2021.

3. Results and discussion

The literature review reveals and increasing trend of publication among the topics “smart-cities”; “sustainability” and the SDGs related to the environmental consequences in cities. Nerveless, with the exception of the seminal work from Dos-Santos (2017), the topic smart cities refer the main ICT technologies in order the big cities became smart. On the other hand, the interest from scholars and public decision makers about sustainability neglect until now, on most of the times, the food supply chain system or the topic is referred from the point the view of IT and mathematical programing. Although a great number of papers from agricultural sciences and environmental sciences about the benefits from society of urban agriculture the linkage among the topics and subjects remain unreferred or with a limited approach.
However, based on the preliminary results from the new projects above referred, and mainly from the project SDGsConsum (2020) is possible to anticipate the main contributions of short supply chains of foods in terms of sustainability (economic, social, environmental and institutional), which are presented in Table 2.

Table 2: Sustainable impacts of SSCF in smart cities

Economic Impacts	**Social impacts**	**Environmental impacts**	**Institutional impacts**
Reduction of farmers' economic uncertainties.	Promotion of more direct relations between producers and consumers.	Reduction of resource use (such as fossil fuel or packaging).	Promoting a direct increasing on approval rate of R&D projects and programs and the consequent competences in sectoral competitiveness
Support the profitability of small and medium urban farms.	Enhance trust within the value chain.	Reduction of food waste and saving food.	Promoting a development, and their multiplier effect on R&D.
Increase the re-circulation of urban community income.	Foster social inclusion.	Promotion of less polluting production methods (e.g., organic farming).	Promoting skills development of staff and researchers.
Creation of new jobs in urban and peri-urban areas (generating urban employment).	Revitalization of local communities.	Reduction of GHG emissions and carbon footprint.	Increasing the percentage of R&D/GDP with multiplier effect.
Decrease of production costs and market price.	Contribution to urban and peri-urban development (particularly in marginal areas).	Reduction of energy use. Reduction of food miles.	Increase and promotes the improvement of ICT technologies and smart cities infrastructures.
Improving synergies with other sectors.	Awaken the sense of community.	Improving the education and environment values of students since the yearly years.	Promote the SDGs achievement and respective targets related to SDG 11 and SDG7 among others.
Increase of food production quality and contribution to European food safety.	Consumer empowerment and better recognition of producers and food quality.	Promotion of healthy diet and social and health improvements	Promotion of IST network infrastructure and the use of big data to promote SSCFs

Source: Own work based on the results of the Conference conducted within the SDGsCONSUM project and adjusted from Jarzębowski et al., (2020).

4.1. Contribution of short supply chains of food to sustainable and smart cities

Table 3 presents the impacts of Sustainable Development Goals and targets (DGDs) on SSCF in smart cities. The results confirm that SDGs have several impacts on many targets and goals in various SDGs in smart cities. Moreover, the institutional dimension of SDGs/sustainability could increase the attention to implement and manage that with public decisions makers.

Table 3: The impacts of Sustainable Development Goals and targets on SSCF in smart cities

Sustainable Development Goals	**Target**	**The role of SGDs and targets on SSCF in smart cities**
	1.5	SSCFs, provide a financial resource for entrepreneurs, small producers, disability people that living in peri-urban areas, reduce the costs of food transportation, provide ecosystems, improve the living environment and increase property values, ultimately boosting local green economies
	2.1 and 2.2	SSCFs provide direct sources of food and direct markets (ex: fruits and vegetables, mushrooms, etc.)
	2.3	Increase the income and the agricultural productivity of small-scale food producers and family farms, in particular women, indigenous peoples, family farmers, refugees and disabled and disadvantaged people living in peri-urban areas
	2.4	Urban agriculture and peri-urban agriculture associated to SSCFs ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
	11.5	Reduce the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product, with a focus on protecting the poor and people in vulnerable situations caused by disasters, including water-related disasters, by improving the green and urban areas around the cities and promoting the short supply chains of local food
	11.6	Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

	11.7	Provide universal access to safe, inclusive and accessible, green and spaces, in particular for women and children, older persons and persons with disabilities
	11.a	Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning

Future research should focus on understanding the impact of different technologies on cities and how the social and cultural contexts in different cities influence the same technology and its level of affordance (Kummitha, 2020).

4. Conclusion

Besides a huge amount of information, data, and results from projects and literature about smart cities, sustainability and the importance of new forms of agriculture in urban areas, the critical issue about the importance and respective methods and policies to promote SSFCs in smart cities in order to achieve smart and sustainable cities became quite unconnected. This paper presents the main results that can be used by scholars and by public decisions makers in order to achieve the SDG17, strengthen the means of implementation and revitalize the global partnership for sustainable development applied to the smart and sustainable cities.

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