‘Smart food city’: conceptual relations between smart city planning, urban food systems and innovation theory

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Abstract

This paper develops a conceptual link between smart city planning and urban food systems research in terms of governance and innovation. The ‘smart city’ concept is linked to an urban research agenda which seeks to embed advances in technology and data collection into the infrastructures of urban environments. Through this neoliberal framework, market-led and technological solutions to city governance and development are prioritised. The urban food movement has a different trajectory compared to the smart city agenda, comprising a diverse mix of urban food production practices, including community and grassroots-based social innovations, and associated more recently with food security discourses. Recognising these ideological and epistemological differences (between the smart city and the urban food movement) is important for conceptualisations of ‘smart food city’ governance. Based on theoretical reflections, review material and findings from a European project on city-region food systems, the paper argues that smart technology can be an important part of the solution to city food challenges but in combination with social innovations to enable flexible modes of governance that are inclusive, technologically and socially-orientated and linked to specific city-region contexts. Key elements include city regionalism, new organisational structures and connectivities, a circular model of metabolism and social practices.

Keywords: Smart city planning; Urban food systems; Smart food city; Technopolitics; Social innovation; City regionalism

Introduction

This paper examines links between smart city planning and urban food systems research[1], particularly conceptual relations between innovation and governance. The impetus for this paper emerged from an invitation to speak at a symposium on the *Governance of the Smart Cities Food Agenda* in Milan in September 2015. Connected to the Milan World Expo Challenge, the aim of the symposium was to examine relations between governance, smart cities and food. This was a novel proposition but it is not a straightforward task given ideological differences between the two fields of research and innovation. The smart city agenda is neoliberal and business led, using ICT and techno-science innovation as solutions for urban growth but also as realist epistemologies that visualise cities in very specific ways. The urban food agenda emerges from a heterogeneous community and grassroots-based movement that is civic and socially-orientated and increasingly framed through food security discourses. Urban food research – and specifically conceptualisations of what I term 'smart food city' modes of governance – recognizes the important role of technology-orientated innovations but *in combination* with social innovations, the latter of which represent changes in social practice and/or institutional change in the way society is governed (Kirwan et al., 2013; Neumeier, 2012). In fact, smart technologies are already being used by urban food projects (ICT is very important to the food movement for communication, apps now link producers and consumers and build knowledge and share ideas about quality conventions, vertical farms, etc.) but the two concepts are not connected and relations between them adequately critiqued.

The smart city concept is much debated in urban research (Greenfield, 2006; 2013). Marr (2015) suggests it is something we will be hearing a lot more about in the future.

[1] There is inevitably some slippage between the terms smart 'city' and 'urban' food. This reflects the nature of the two literatures reviewed and their preferred term of reference.

In essence, the concept seeks to embed advances in technology and data collection into the infrastructures of the environments where we live (Coletta et al., 2017; Kitchin, 2014). There is much excitement about the potential these technologies have to provide cities and city planners with strategies and pathways that are more resource efficient and sustainable, including data-driven systems for transport, waste management and energy use. Models such as the 'triple helix of smart cities' (Leydesdorff and Deakin, 2014) conceptualise cities as regional innovation systems with knowledge (from universities, industry, democratic government, etc.) central to growth and linked by technology and informatics. Nevertheless, the concept warrants closer analysis and critique, particularly when connected with urban *food* systems. Take the 'urban food question' (Morgan, 2015), for example, which is about how to feed cities in a just, sustainable and culturally appropriate manner when faced with looming climate change, widening inequality and worsening world hunger problems. This presents socio-cultural and politico-economic challenges that cannot be resolved by smart technology alone.

Until recently urban food questions have been neglected in urban studies. The burgeoning of food-related activities in cities is making food issues difficult to ignore. Cities around the world are now engaged, for example, in food and agriculture practice, as municipal authorities, city councils and urban social movements all play increasingly important roles in food policy (Deakin et al., 2016; Derkzen and Morgan, 2012). This includes: urban agriculture becoming more involved in strategies to mitigate against climate change and urban heat island effects (Wiskerke, 2016); diet-related issues (notably obesity) prompting cities to develop strategies to create more sustainable urban foodscapes (Sonnino, 2016); the emergence of urban food strategies and policy councils as new spaces of deliberation (Moragues-Faus and Morgan, 2015; Moragues Faus and Marsden, 2017); and food justice-orientated and civic urban agriculture initiatives providing alternative food networks for consumers, including the urban poor, that concomitantly challenge the organisation of urban political economies (McClintock, 2014; Reed and Keech, In press; Tornaghi, 2016).

From a food policy and urban studies perspective, the city is gradually being recognised as an important part of the food system, which was not always the case (Sonnino, 2009), and, crucially, as a dynamic space for creativity, experimentation and green activism (Hardman et al., In press; Sonnino, 2016), including new forms of social innovation, governance and sustainability transition (Maye and Duncan, 2017; Wittmayer et al., 2014). The key question this paper seeks to examine is the conceptual relationship between the governance of smart cities, urban food and social innovation. Connecting smart city frameworks to food governance is important, given predictions that they will significantly determine the governance and functioning of cities in the future. However, general consensus about the merits of doing this does not mean that connecting these debates is a straightforward task given the aforementioned differences not to mention the political implications of smart city representation (Vanolo, 2014). Developing inclusive 'food smart systems' will require polycentric governance arrangements and a broader view of 'innovation' than is usually expressed in smart city discourses to understand how smart technological developments work through and in combination with 'softer' social innovation practices and systems of governance.

To develop this argument, the paper starts by reviewing the smart city and urban food concepts respectively. This shows how the smart city concept is framed essentially as a neo-liberal urban agenda, with an emphasis on techno-science to develop urban and regional economies. Urban food, by contrast, is framed from a food security perspective, which has assumed a strong urban dimension in recent years and is much more socially-orientated. These differences have implications for 'smart food city' conceptualisations. Critiques from sustainability science are used in this paper to develop an approach to urban food governance that recognises the dangers of 'technopolitics', acknowledges multiple stakeholder perspectives and recognises urban food system sustainability as comprising multiple issues and modes of response. Crucial in this regard is acknowledgment of the role of social innovation in urban food systems. These ideas are further developed in the next section, drawing on key findings from analysis of urban food projects in seven European city-regions[2] conducted as part of a European Framework-funded project called SUPURBFOOD, to develop a more inclusive conceptualisation of the 'smart food city', with smart technology part of but not the only solution.

The 'smart city' concept

The term 'smart city' is divided into two distinct but related understandings (Kitchin, 2014). First, it refers to the increasing extent to which cities are composed of so-called 'everyware' (Greenfield, 2006), meaning the increasingly pervasive use of computing and digitally instrumented environments that are now embedded into the urban environment (e.g. fixed and wireless telecom networks, sensor and camera networks). These technologies are used to monitor, manage and regulate city flows and processes. Mobile forms of computing are also increasingly used by citizens who live and navigate the city and which themselves also produce data (Marr, 2015). By connecting and analysing this 'everyware' data it is possible to provide 'a more cohesive and smart understanding of the city…[and] rich seams of data that can be used to better depict, model and predict urban processes and simulate the likely outcomes of future urban developments' (Kitchin, 2014: 2). In short, everyware makes the city more knowable via more fine-grained, interconnected and often real-time flows of data.

[2] The seven regions were Rotterdam, The Netherlands, Metropolitan Area Rome, Italy, Metropolitan Area Vigo, Spain, the Bristol city-region, UK, city-region Zurich, Switzerland, and Greater Riga Region, Latvia. Three elements of urban food provisioning were examined: closing the cycles of organic waste, water and nutrients; shortening of food chains; and the multifunctional use of land in urban and peri-urban areas (for details see: www.supurbfood.eu; accessed: 09/10.2017).

Everyware can also provide the supporting infrastructure for business activity and growth, as well as stimulating new forms of entrepreneurship.

The second conception of smart city is about the development of a knowledge economy within a city-region (Kourtit et al., 2012; Leydesdorff and Deakin, 2014). In this context, a smart city is 'one whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people' (Kitchin, 2014: 2). ICT is important here too: it provides the platform to mobilise and realise innovative ideas. However, simply embedding smart technology into a city fabric is not what makes it 'smart'. It is about how ICT is used in combination with human and social capital[3] to enable and manage growth that makes it 'smart'.

In the first interpretation 'smart' is largely technocratic and technological, defined by ICT and its use to manage and regulate city flows. In the second interpretation it is about how ICT can enhance policies and governance that relate to economic development and education; in other words, ICT are enablers and provide the platform for innovation and creativity, which in turn facilitate socio-economic and environmental development. The feature that unites these two smart city interpretations is 'an underlying neoliberal ethos that prioritises market-led and technological solutions to city governance and development' (Kitchin, 2014: 2). For instance, many who support smart city development are big business (e.g. IBM, Microsoft), keen to promote their new technologies and advocate deregulation and more open economies. For city officials and governments 'smart cities offer the enticing potential of socio-economic progress' (ibid., p. 4), promising, for example, more liveable and sustainable cities and hubs for innovation.

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[3] I.e., the knowledge, skills, mechanisms and social practices used by people and organisations (both public and private) to adopt these forms of technological innovation at individual, household, local community and city-wide scales.

Smart cities can be characterised then as (Hollands, 2008):

- embedding ICT into the urban landscape;
- a neoliberal approach to governance and a business-led urban development mantra;
- a focus on human and social dimensions of the city from a creative perspective;
- adoption of a smarter communities agenda; and
- a focus on social and environmental sustainability.

Hollands (2008) identifies a tension in the smart city agenda between serving global/mobile capital and stationary ordinary citizens, attracting/retaining an elite class and serving other classes, and top-down, corporatized development and bottom-up, diffuse approaches. Another key feature of the 'smart city' concept is the prioritisation of data capture and analysis to underpin policy development and enable new forms of technocratic governance (Kitchin et al., 2015). Such data are viewed as neutral, objective measures. However, analysis of the new forms of data being produced in cities, including how they are mobilised by governments and business, is starting to emerge. Kitchin et al (2015), for example, have examined the new phenomena of 'big data'. Their analysis shows there is much belief and hype that 'big data' will lead to a transformation in the knowledge and governance of cities, providing fine-grained, real-time understanding of urban processes. Big data is about 'massive, dynamic, varied, detailed, inter-related, low cost datasets that can be connected and utilised in diverse ways (Kitchin, 2014: 3), including: directed (generated via traditional forms of surveillance, such as CCTV), automated (where data are produced automatically by a device or system, such as a check-out till, for example) and volunteered (where data are gifted by users, such as interactions across social media).

Automated forms of data have attracted most attention from those concerned with managing cities, which includes surveillance and also sensors (Marr, 2015). The emergence of real-time analytics by city governments is also notable, including, for example, the movement of vehicles around a transport network and attempts to collate different forms of surveillance and real-time analysis into a single hub (e.g. the Office of Policy and Strategic Planning for New York city) and the creation of 'city dashboards' (Coletta et al., 2017), which provide citizens with real-time data about various aspects of the city and complemented by visualisation sites that create real-time maps, etc. Such 'big data' mechanisms provide 'a powerful means of making sense of, managing and living in the city in the here-and-now' (Kitchin, 2014: p7). The smart city concept is therefore a key part of the urban agenda, with great potential to be transformative and 'disruptive' in terms of reordering, through technology, how we live our lives in cities and how we understand and manage them. However, there is currently no explicit reference to food in definitions of what is a 'smart city'. This is a major shortcoming given food's socio-economic significance to city life, and highlights the urgency to merge the two research fields.

Urban food systems and the new geography of food security

To conceptualise relations between the smart city, governance and food it is important to also summarise what we know about urban food systems research, particularly issues that are demanding governance responses (Sonnino, 2009; 2016; Wiskerke, 2016). Urban food systems refer to the different ways food that is eaten in cities is produced, processed, distributed and retailed (i.e. different modes of provisioning) (ibid). This includes foods that may be produced using industrial processes and packaged many miles away from the city, to food (e.g. cereal crops) grown in the countryside surrounding the city, to food grown on an urban agriculture project within the city boundary. The majority of resources used by a city come from and are produced in places outside cities' borders (Steel, 2008). Food is no different. The food provisioning system in a city then is a hybrid food system; it is not just shaped by the immediate conditions in the surrounding city-region - it is also shaped by dynamics at a national and international level.

Analysis of urban food strategies shows how urban food system research is increasingly being shaped by food security as an underlying theme, even though it never features in their titles (Sonnino, 2016). Responses to the 'new geography of food security' are manifesting locally, with a strong urban dimension that involves municipalities taking a key role as 'food system innovators'. The concept of food security 'evokes a series of interrelated public health, socioeconomic and ecological crises that threaten human survival and, for this reason, require strong public intervention' (ibid., 191). This new geography of food security is shaped by different pressures, including the 'nutrition transition', which is connected to the expansion of the Western diet; politics, which is linked to food riots and problems of financial access to nutritious food; extreme variation across different socioeconomic groups, which has been particularly problematic in urban areas; and a series of interrelated ecological pressures. These issues are particularly evident and concentrated in cities and they are acting as drivers of change. Take nutrition, for example, or what Wiskerke (2016) calls 'the public health challenge'. Of the 7 billion people in the world 2 billion suffer from diet-related ill-health (obesity, malnutrition and hunger). In a number of cities diet-related ill-health is now a key driver of change in urban systems. In Toronto, for instance, the formation of the Toronto Food Policy Council is linked to the city's Department of Health (Blay-Palmer, 2009).

However, urban food research is about much more than food security. The local food literature shows, for example, how it is connected to community cohesion, social well-being and mental health, food growing practices through allotments, community gardens, guerrilla gardens, etc. (Kirwan et al., 2013; Kirwan et al., 2014). Urban food innovations are also responding to ecological pressures, particularly climate change.

Climate change will impact on urban food systems in terms of impacting the productive capacity of agriculture around the world and, within cities, in terms of urban heats islands (Wiskerke, 2016). Urban agriculture is increasingly valued for its role in climate change adaptation and mitigation through the creation and maintenance of green open spaces and increasing vegetation cover in the city, thus helping to reduce urban heat islands by providing shade and additional evapotranspiration (Dubbeling, 2014). These production spaces can also help to store excess rainfall and thereby reduce flood risks in cities.

Urban agriculture also plays a key role in the productive reuse of urban organic waste and wastewater that can help to reduce energy use in fertilizer production and organic waste collection and disposal, as well as lowering emissions from wastewater treatment. Changes in the use of resources to secure urban food provisioning is also essential, including fossil fuels, water (water footprint of food products), and land (de Zeeuw and Drechsel, 2016). New York's City Council has identified energy, water and land constraints as potential threats to their food supply and have developed a strategy (FoodWorks) to address these issues, including the further development of urban agriculture (Wiskerke, 2016).

The focus for this paper is the link with the smart city concept, which does not feature much in urban food research accounts; the two concepts emerge from different contexts and literatures. Nevertheless, the rise of food insecurity in cities, which frames urban food research, raises important questions about the availability of infrastructures and adequate technologies to respond to the challenge. Moreover, this section shows that urban food research is about *more than food security*, including health, well-being, community cohesion and local civic action. In urban food research there is much excitement about the transformative potential of urban food strategies to develop 'more synergistic relationships between urban food consumers and producers and between urban areas and their surrounding hinterland' (Sonnino, 2016:

193). The interlocking nature of the challenge certainly requires a systemic perspective to account for the interrelatedness of the whole food chain. However, what type and level of change is happening as a result of urban food innovations? Are they niche innovations that are transformative in terms of 'intrinsic benefits' (positive changes at the community level but that do not alter the wider regime) yet remain limited in terms of 'diffusion benefits' (ideological and seek to affect the regime) (Seyfang and Smith, 2007)? This analysis should also include smart city transformations and links with urban agriculture to enable change to the dominant food system in cities. There is not space here to address these issues in detail, but the next section develops a critical perspective, before outlining a strategy for the 'smart food city' that involves a combination of governance nodes, including giving greater emphasis to social innovations as enablers for transformative capacity.

Connecting the 'smart city' and urban food: technopolitics and social innovation

Smart technologies have much to offer city planners and food chain actors, including how we grow food in cities to the efficient management of supply chains that deliver food to cities. The literatures have so far not been connected, but there are examples that connect the two. In urban agriculture, the most talked about example of 'smart agriculture'[4] is vertical farming. This concept was popularised by Dickson Despommier (2010) in his book, *The Vertical Farm: Feeding the World in the 21st Century*. Plants grown in long, narrow beds that are staked in layers and are under LED grow lights, with roots covered in nutrient-rich mist. These systems use smart technologies, with the light, temperature and nutrients the plants receive closely monitored by sensors. Such technologies use less energy to transport food to markets (with them often grown on sites close to urban consumers), requiring also less water and

[4] This refers to a set of agriculture technologies now coming on stream, many of them linked to precision agriculture.

pesticides than traditional agricultural practices would require. In response to criticism about the reliance on LED lights, new vertical farms are also emerging that use natural sunlight (Rose, 2015). There are now vertical farms in Asia, Europe and North America. Tower blocks have also been built or re-purposed for intensive horticulture production, including where the skin of the building is used as an algae breeding resource (Curry et al., 2014; de Zeeuw and Drechsel, 2016).

Like the smart city concept, this is a technological fix, in this case combining architecture and the built environment with emerging technologies to urbanise food production. There are other applications of smart technology to food chains e.g. using sensors and integrating data systems to improve food chain performance in terms of energy use during distribution, improving logistics systems, and improving food waste management. These new forms of technology and precision agriculture, including unmanned aerial systems (UAS) and agricultural 'big data' metrics, are valued for their potential to ensure the sustainable production of enough food as well as addressing the problems of land degradation, water shortage and climate change (Bee, 2015). In the UK, for example, a strategy for agricultural technologies was developed in 2013 to improve the productivity, competiveness and resilience of the food industry (Department for Business Innovation and Skills, 2013). Similar initiatives are taking place in other countries e.g. Germany, The Netherlands, the US.

'Smart agriculture' is positioned at the global scale, supporting businesses and researchers to develop smarter food production systems through technological innovation to address food security. This includes city farming projects adopting vertical farming and other technological and design solutions (Viljoen et al., 2016). Smart agriculture technologies resonate with smart city technologies in terms of the applications developed. For example, the use of 'big data' within the supply chain and farming system involves collating very large and varied datasets which can then be analysed to reveal patterns in real world interactions (Bee, 2015; cf. Kitchin, 2014).

Agricultural robotics and 'smart machines' use 'intelligently targeted inputs' to do a range of tasks e.g. driving tractors, milking cows, picking and grading strawberries (Bee, 2015). Unmanned aerial systems (drones) and 'internet of things' (IoT) technologies (e.g. sensor-controlled rooms to grow lettuce) can cut costs, improve production efficiencies and reduce the use of resources (Kobie, 2015).

Smart agri-tech solutions are therefore being developed to respond to a range of food system pressures, with vertical farming technologies the most prominent in urban agriculture contexts. They offer a techno-science response to sustainability problems within agriculture and sit alongside other 'eco-efficiency' approaches that include genetic modification, nanotechnology, genomics and computerisation (Beddington et al., 2012; Foresight, 2011; Royal Society, 2009). Some scholars are critical of this techno-scientific approach to food security. Critiques of sustainability science also question the way that methodologies, such as Life Cycle Analysis (LCA), have been turned into techno-political instruments that the food industry can use to demonstrate certain environmental performance credentials (Freidberg, 2014).

Critiques of smart city technologies and big data analytics raise similar concerns about the politics of urban data and an overly technocratic approach to governance and city development. For example, big data instruments provide the basis for developing a more efficient, competitive and sustainable and transparent city. However, they also raise concerns about the politics of big urban data, technocratic governance and city development, the corporatisation of governance, technological lock-in and the creation of panoptic cities (Kitchin, 2014). Urban projects that measure and monitor cities using indicators, benchmarks and real-time dashboards are narrowly conceived and represent powerful realist epistemologies (framing the city as visualised facts) that are significantly reshaping how citizens and managers view and manage the city (Kitchin et al., 2015). Vanolo (2014) argues that 'smartmentalism', which is actioned through the use of specific technical instruments, has created new urban imaginaries that distinguish between the ‘good’ and the ‘bad’ city. Despite the best intentions of such initiatives, which aspire to make the city more transparent and governable, they are open to manipulation by vested interests and are underpinned by ‘naïve instrumental rationality’. This process of political legitimisation is not dissimilar to food security, where dominant food discourses and actors frame and legitimise the appropriate response.

The technopolitics critique calls, therefore, for methodologies and governance mechanisms that democratise knowledge and reflect values and perceptions in addition to scientific approaches and knowledge claims. Inspired by the values of post-normal science (Funtowicz and Ravetz, 1994), this recognises complexity, uncertainty, incomplete data and multiple stakeholder perspectives. For urban food systems research this demands a broader definition of innovation, combining material, science and technology-orientated innovations with social innovations (Bock, 2012; Maye, 2017). As Neumeier (2012) explains, social innovations are “[c]hanges of attitudes, behaviour or perceptions of a group of people joined in a network of aligned interests that in relation to the group’s horizon of experiences lead to new and improved ways of collaborative action within the group and beyond” (p. 55). Social innovation occurs when a network of actors *changes its way of doing things* and the consequence is some form of tangible improvement for those actors involved and possibly beyond. The crucial aspect in this respect is the change in attitudes, behaviour or perceptions resulting in a new form of collaborative action. This type of innovation thus represents changes in social practice (e.g. innovations in consumption practices) and/or an institutional change in the way society is governed (e.g. enabling more civic involvement). Social innovations are therefore non-material, with material outcomes (e.g. fresh food, a new community building) being complementary to this; the focus is asset building, not needs (realisation).

Analysis of the Local Food (LF) programme in England (Kirwan et al., 2013; Kirwan et al., 2014) justifies this perspective. Findings showed that the majority of LF projects were urban. Crucially, most LF projects were not really about food, and are best described as community projects with food as the pretext and a vector for social agency and the development of community capacity. These examples of grassroots social innovation identify important material *and* non-material contributions and form a crucial part of a city's urban food fabric (Sonnino, 2016). 'Unlocking' old styles of thinking and developing resources and pathways to greater sustainability thus requires 'radical innovations' (technological *and* social) that challenge the rules about how urban food systems operate, including consumer behaviour (Maye, 2017; Smith, 2006; Wiskerke, 2003). This is inevitably highly contingent and therefore has important implications for 'smart food city' modes of governance, because it implies capturing and critiquing the adoption of technological and social innovation practices at a range of scales, from the household and the firm up to the city-region.

Reimagining the 'smart food city'

Urban food systems research identifies a range of inter-related factors currently shaping urban food systems, notably food security. The confluence of 'intensifying circumstances' (Hinrichs, 2014) has encouraged closer examination of the sustainability of urban food systems and the best ways to respond to urban food questions (cf. Morgan, 2015). In this paper it has prompted the question: what might the 'smart food city' look like? Given the above concerns around linking the 'smart city' concept to urban food governance, particularly the tendency towards technocratic city development, corporatized forms of governance and technological lock-ins, which may not match well or reflect the diversity of urban food practices and innovations, preference is to talk more in terms of enabling systems of innovation and governance which *include but not exclusively* smart city innovations and technologies. This is necessary to reflect and value important non-tangible, non-material social innovations that take place through households, food organisations and governance structures to enable resilient urban systems. In other words, smart forms of urban food governance cannot rely only on techno-scientific solutions, accounting also for cultural and social innovations and practices.

Using findings from SUPURBFOOD (Wiskerke, 2016) and building on Sonnino (2016), in relation to urban food security, the following elements of the 'smart food city' are important. The first is *city regionalism*. A key finding from the SUPURBFOOD project was the need to examine and manage urban food systems at the city-region scale (Wiskerke, 2016). The city region was the most appropriate scale to develop and implement an integrated and holistic approach to plan urban food systems. Each city-region has specific features and constraints so this needs to be done to reflect contextual specificities, with a variety of channels identified to enable a city to procure food. Whether the city-region scale is adopted explicitly or not, evidence suggested cities were starting to think strategically beyond the confines of their city boundary. Sonnino's (2016) work on urban food strategies showed too how cities have been drivers for municipal and regional authorities in Europe and North America to consider food now part of the urban agenda (see also Blay-Palmer, 2009). These regionalisation strategies are using flexible interpretations of relocalisation and the 'foodshed' to connect the city, the countryside and concerned stakeholders.

A second related element of the smart food city is a focus on *'connectivities'* (Sonnino, 2016). This refers to the role of governance co-ordination in the design and implementation of more inclusive urban food strategies and plans. Urban food strategies are a tangible mechanism to enable smart food city governance, accepting that developing comprehensive food strategies is not easy, dependent on local factors, including the political and democratic system (Blay-Palmer, 2009). The recommendation from SUPRUBFOOD was to develop governance systems at a city-region level. As urban food strategies span policy domains, a key challenge in this regard is to organise administrative and political responsibility for the strategy, for example, by forming a municipal department of food, giving the planning department responsibility for food or setting up a food policy council (Wiskerke, 2016). Connectivity is enabled by urban food planning as social and technological innovation enacted through institutional change.

Another important aspect of urban food planning is spatial synergies that achieve multiple benefits from the same place, with synergies created by using food as the vector to link different urban policy objectives together (Morgan, 2015; Wiskerke, 2016). The 'Continuous Productive Urban Landscape' concept (Morgan, 2015), for example, is a physical and environmental design strategy that provides planners with a strategic framework to link productive landscapes within cities. In this vein, SUPURBFOOD recommended developing multifunctional urban and peri-urban agroforestry and agriculture spaces in city-regions to serve different purposes simultaneously. Rooftop farming also creates food and concomitantly combats urban heat islands, generates biodiversity in a city and can be used for storm water containment (Dubbeling, 2014). Clever redesign of systems of urban food provisioning, which includes smart-technology solutions, can meet several policy domains at the same time e.g. reduce food and nutrition security, enhance environmental quality, create employment and improve community cohesion.

The third element of the 'food smart city' is *circular metabolism*, which is about cities shifting from a linear model to a circular model of metabolism (Wiskerke, 2016), whereby different outputs are recycled back into the system so that they become inputs. As above, this again includes 'smart city' methodologies and high-tech systems, such as metropolitan food clusters and agro-parks, but it also includes low-tech systems, such as agro-ecological production that produce compost from household waste. In SUPURBFOOD the recommendation was that decisions on the most appropriate system can be flexible, which could include a combination of systems and technologies dependent on specific city-region characteristics.

The final element of the 'smart food city' values *social practices* as a form of innovation and learning. A key finding from SUPRUBFOOD was the need to better understand social practices as they take place at a local level. One of the implications of this is the idea that sustainability transitions can gather momentum around relatively 'soft changes' that become normalised i.e. a 'systems of practice' perspective (Watson, 2012). This involves looking at opportunities to change the practices of associated systems e.g. legislation governing a city's food regime. This can mean developing new practices, redeveloping existing practices and/or dropping problematic practices. Langendahl et al. (2014), for example, examined a medium-sized processing firm in the UK in terms of the bundle of practices that have developed and redeveloped over time in relation to sustainability. In urban food contexts this involves practices within institutions and the environment in which something takes places, including, for example, alignments of interest between food entrepreneurs and policymakers. This type of innovation is about changes to governance than technological innovations, particularly building capacity along vertical and horizontal axes, as demonstrated in analysis of urban food strategies through the emergence of food policy actors as new scalar policy actors (Sonnino, 2016). However, it also involves understanding how food movement and grassroots and community urban food groups are using and are helped by ICT and other smart technologies to develop their organisational structure. For example, how do physical infrastructures, including smart technologies, facilitate the creation of more distributive urban food systems (Moragues Faus and Marsden, 2017).

Conclusions

The aim of this paper is not to discredit or disregard smart technologies. Instead, it seeks to provide a broader view of innovation and governance that incorporates smart technology in a way that reflects urban agriculture practices and challenges on the ground. This has involved providing a critical perspective on what we mean by the term 'smart city' and how that form of policy thinking, with its associated politics, strategies and technologies, might be aligned with urban food agriculture and systems of provisioning (i.e., what do we mean by 'smart food city'?). To answer this question, two key arguments have been developed. First, the dangers of 'technopolitics' have been highlighted (Freidberg, 2014; Vanolo, 2014) and the paper has argued for an approach to urban food chain sustainability that, informed by post-normal science (Funtowicz and Ravetz, 1993) and innovation theory (Maye, 2017; Maye and Duncan, 2017; Stirling, 2006), allows multiple realities and stakeholder perceptions to be acknowledged and accounted for. This more inclusive ontology helps to overcome 'hypocognition' (Lakoff, 2004), whereby urban food system sustainability is linked to one single issue (e.g. food security) or mode of response (techno-science solutions) that in the process ignores other equally important issues and forms of innovation (social innovations/capacities).

In building this case the 'smart food city' is an emerging techno-innovation concept that, when combined with urban food research, needs to recognise social and civic forms of innovation, in keeping with urban food system traditions (epitomised by social practices, governance systems and alignments of interest). An appreciation of social and socio-technical practices that can influence change at local ways and in soft ways, although less obvious in some cases, is important because they may collectively amount to significant change within the associated system. A practice approach is advocated in innovation theory (Evans, in press; Watson, 2012) because it allows a more horizontal appreciation of transformation, including the gradual influence of soft changes. This was evidenced in early food chain transition papers (e.g. Wiskerke's (2003) analysis of the Dutch wheat regime) but is only now gaining the full attention and consideration it deserves. The second key argument then is a preference to talk about forms of governance innovation for city food systems in open and polycentric ways (Sonnino, 2016; Wiskerke, 2016). This involves a city-region perspective as a planning principle, which helps to overcome the silo nature of city planning to achieve multi-level forms of smart food city governance.

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