Smart cities food governance: critical perspectives from innovation theory and urban food system planning[1]

Damian Maye

Countryside and Community Research Institute,
University of Gloucestershire, UK (email: dmaye@glos.ac.uk)

Introduction

The 'smart' concept has become significant in recent years in urban, rural and regional development contexts, epitomised by smart growth, smart specialisation and smart city and regional planning (Naldi *et al.* 2015). The smart growth concept is not new, with a fairly well established literature in regional planning, particularly in the United States. Within Europe, smart growth has become an important policy-orientated concept. In the Europe 2020 growth strategy, for example, smart, sustainable, and inclusive growth are key objectives that are central and also viewed as mutually reinforcing if Europe is to reach its stated growth targets (European Commission 2011). One of the underlying features of this smart growth agenda is the idea that you build policy models that favour local competencies and regional advantages. As Naldi et al. (2015: 91) note, the discussion of how smart growth concepts 'should be applied and understood in a regional context is far from settled'.

I suggest here that a similar case can be made regarding smart city planning, particularly as it relates to food production and provisioning. In a recent article about 'big data and the internet of things', Bernard Marr (2015) suggests 'smart city' is a term we will be hearing a lot more about in the coming years. The basic idea is to embed advances in technology and data collection into the infrastructures of the environments where we live. They potentially provide strategies and pathways that are more

[1] Full reference: Maye, D. (2016) Smart cities food governance: critical perspectives from innovation theory and urban food system planning. In M. Deakin, D. Diamantini and N Borrelli. (eds) The Governance of City Food Systems. Fondazione Giangiacomo Feltrinelli, Rome, et al, pp.: 49-67.

resource efficient and sustainable. Marr's article provides several examples of data-driven systems for transport, waste management and energy use, including a future where refuse collection lorries are directed to locations where rubbish needs collecting and lighting in streets is controlled by intelligent street lighting.

Smart cities are linked then to the wider smart growth agenda but their discussion also warrants specific analysis and critique. In this short paper I argue for the need to have a broad view of what we mean by 'smart', particularly in relation to emergent discussions about 'smart cities' and 'smart city food governance'. The paper argues that we must account for more than smart technological developments and techno-scientific solutions, recognising also the important role and value of social innovation practices, as well as smart forms of food governance. Ideas from innovation theory, transition theory and critiques of sustainability science are used to develop this more critical perspective. Reflections will be informed also by recent empirical work examining agri-food dynamics and innovation in city-region contexts. At the end of the paper I will conclude that it may be best to talk about 'resilient urban food system governance', with smart technology as part of but not the only solution.

What makes a city smart? The smart city concept and emerging critiques

In a recent review, Rob Kitchin (2014)suggests the term 'smart city' is divided into two distinct but related understandings. First, the smart city concept refers to the increasing extent to which cities are composed of so-called 'everyware' (Kitchin, 2014), 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. 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). Everyware makes the city more knowable via more fine-grained, interconnected and often real-time flows of data. It can 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. 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 critically important here too: it provides the platform to mobilise and realise innovative ideas. However, as Kitchin explains, simply embedding smart technology into a city fabric is not what makes it 'smart'. Here it is about how ICT is used in combination with human and social capital to enable and manage growth that makes it 'smart'. In the first interpretation then '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 thing 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 example, many who support smart city development are big business (e.g., IBM, Mircosoft), 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. Hollands (2008), cited in Kitchin (2014), conducted a review of industry and government literature on smart cities and identified five characteristics: 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; a focus on social and environmental sustainability. Hollands (2008) suggests there is 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 that joins different interpretations of 'smart city' 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. To date there has not been much analysis of the new forms of data being produced in cities, including how they are mobilised by governments and business, although Kitchin et al (2015) have recently published papers on the new phenomena of 'big data'. As they note in their review of this area, there is much belief and hype that 'big data' will lead to a transformation in the knowledge and governance of cities, providing, for example, fine-grained, real-time understanding of urban processes. We are talking here about 'massive, dynamic, varied, detailed, inter-related, low cost datasets that can be connected and utilised in diverse ways (Kitchin, 2014: 3). Big data sources are divided into three categories: 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 particular attention from those concerned with managing cities, which includes things like surveillance and also sensors, for example. Linked to this we have seen the emergence of real-time analytics by city governments, including, for example, the movement of vehicles around a transport network and, more recently, attempts to collate different forms of surveillance and real-time analysis into a single hub (Office of Policy and Strategic Planning for New York city, for example). In cities such as London we see too the creation of 'city dashboards' (see Figure 1), which provide citizens with real-time data about various aspects of the city, such as weather, air pollution, and complemented by visualisation sites that create real-time maps, etc. (London Dashboard).

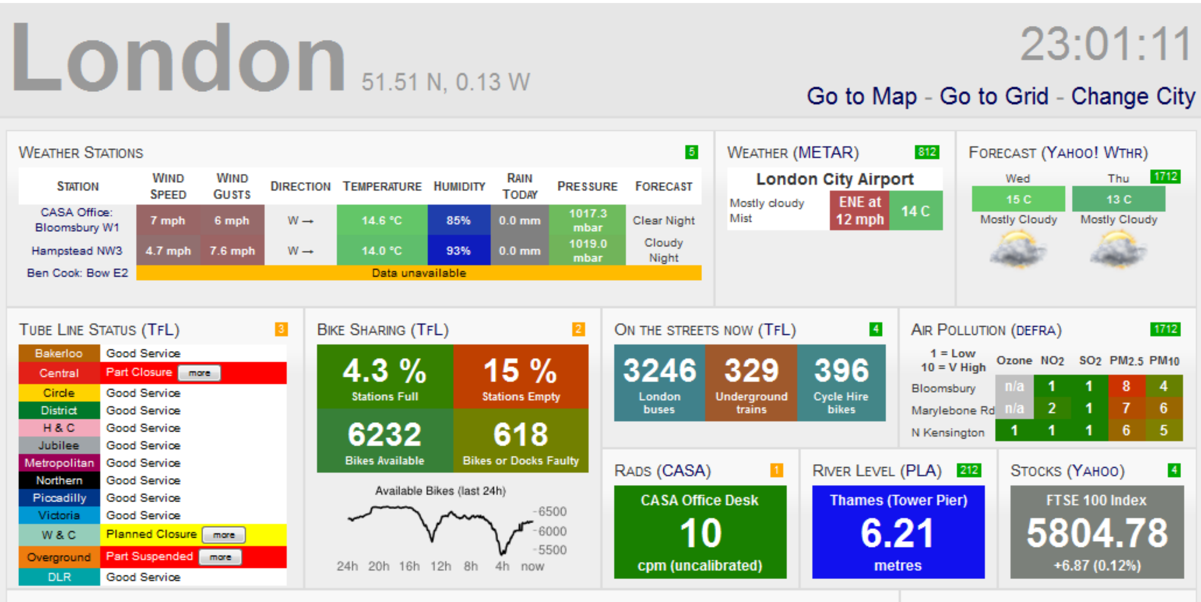

Figure 1: The London City Dashboard (Source: http://citydashboard.org/london/)

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). These big data instruments provide the basis for developing a more efficient, competitive and arguably sustainable and transparent city, but they also raise concerns about, for example, the politics of big urban data, technocratic governance and city development (assuming that all aspects of a city can be measured and monitored which is clearly narrow in scope and reductionist/functionalist), the corporatisation of governance and a technological lock-in, buggy, brittle and hackable cities, and the creation of panoptic cities.

In their study of recent urban projects that measure and monitor cities using indicators, benchmarks and real-time dashboards, Kitchin et al (2015) suggest they are narrowly conceived but represent powerful realist epistemologies (framing the city as visualised facts) that are significantly reshaping how citizens and managers view and manage the 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 what they call 'naïve instrumental rationality'. They prefer to view such data projects as data assemblages that are complex and politically-infused socio-technical systems.

Smart agriculture: the precision agriculture revolution

The critique of smart city projects is important to bear in mind, especially when we consider how urban food provisioning and urban food systems can be described and developed under a 'smart city food governance' framework. As well as 'smart city', the smart concept is also present in agri-food sustainability discourses, particularly the emergence of 'smart agriculture' or so-called 'climate smart agriculture' as a framing concept for a set of agriculture technologies now coming on stream, many of them linked to precision agriculture. This discourse is evident in the UK, for example, where a strategy for agricultural technologies has been developed to improve the productivity, competiveness and resilience of the food industry (Department for Business Innovation and Skills 2013). The 'Agri-Tech strategy' and Agri-Tech Strategy blog have a number of interesting examples and features that explain how the government and food industry partnership can work together to develop smarter food production systems through technology and science innovation. There was an interesting post on the blog recently, for example, by Stephen Bee (2015), describing the precision agriculture revolution. He started the blog post by referring to the 2050 forecast that 60% more food will need to be produced for the world's population. The basic argument was that new forms of technology, including unmanned aerial systems (UAS) and agricultural 'big data' metrics have the potential to ensure the production of enough food, as well as addressing the problems of land degradation, water shortage and climate change.

There is a number of Agri-tech Catalyst projects, funded under the Agri-tech Catalyst funding scheme, that are supporting businesses and researchers to develop new innovative solutions to address the global food security challenge (notice the emphasis on the global scale of the problem). Some examples include (Bee, 2015):

- **Big Data** – in general terms this is about, as Kitchin (2014) explained, collating very large and very varied datasets which can then be analysed to reveal patterns in real world interactions. For instance, the Produce World Group (a very large fresh produce business in the UK) are leading the *Soli-for-life Beta* project which will collate and analyse 'big data' within the supply chain and farm systems, including, for example, soil analyses, crop rotations and fertiliser records, with the datasets integrated into an aggregated data holding. These aggregated data could eventually be used by producers to better understand the drivers behind farm system performance.
- **Robotic Farming** – agricultural robotics are now been developed to do a range of tasks, including driving tractors, milking cows, killing weeds with chemicals (to avoid using chemicals), picking and grading strawberries, mowing grass, and searching for weeds, pests and diseases (from both the air and the ground). These 'smart machines', using something called 'intelligently targeted inputs', have the potential to revolutionise the way crops are grown. The Agri-Tech scheme is funding a Robotic Broccoli Harvesting project, for example, which is testing 3D camera technology that will better identify when broccoli are ready for harvest and has the potential to significantly reduce production costs.
- **Drones (Unmanned Aerial Systems)** – drones are now being used and developed to improve crop management, including pest and herbicide control, application of fertilisers, etc. There is a drone to tractor process – fly the drone over a field for in-field analysis, the field is scanned and field data downloaded to a map on iPad, a prescription is then generated and values generated (in the office – a field application map is generated), and data are then taken and inputted into the tractor (e.g., fertiliser, spraying or planting prescriptions) (for more on this sort of technology see a video called 'Sensefly' – www.sensefly.com). PepsiCo, who make Quaker Oats amongst other things, are also leading a project in the UK to turn data from drones into data measurements so that growers can optimise yield and quality across fields. The measurements will be fed into an Oat Crop Model that will then guide farmers to decide when they can achieve best results for their crops. The predicted output is that the tools could increase average yields by over 1 tonne per hectare, whilst contributing to sustainable intensification, and reducing imports.

Agriculture is also applying and trialling 'internet of things' (IoT) technologies, including sensor-controlled rooms to grow lettuce and automated heaters for bees. From a food production perspective, IoT makes a lot of sense, as it can potentially cut costs and boost food production, but sensors can also improve animal welfare and reduce the use of resources such as water (Kobie, 2015, The Guardian, 5th August, 2015). For Kobie, agriculture is an area where IoTs have 'little downside, and a host of benefits'. Some of the sensor technologies are potentially very smart. For example, Fujitsu and Microsoft have worked together to grow high-tech lettuce, aimed for consumers with kidney problems (lettuce is high in potassium). The sensors can help agricultural plants to grow faster and can create higher yields, as well as specialisations. Using building sensors, they have fine-tuned conditions to grow low-potassium lettuce (by controlling CO2, temperature, humidity, light intensity and other factors that affect growth). You also have web-connected cows. In this case, sensors are tracking dairy cows so that farmers can detect illnesses earlier (lameness and mastitis costs the UK dairy industry £100 million annually), which reduce suffering for the cow and increases milk yields. The blight of the bee population is well documented, with numbers in sharp decline and linked to a range of possible factors, including colony collapse disorder. Researchers at the University of Minnesota have developed sensor technology to attack the mites that cause colony collapse disorder (Kobie 2015). The sensors enable heat to be targeted at specific parts of the hive at specific times to target the mites which can be interrupted by temperature changes. The electronics monitors the temperature and produces heat to kill the mites without harming the bees.

In urban agriculture contexts, the most talked about example of high-tech agriculture is vertical farming. This concept was first popularised by Dickson Despommier (2010) in his book, *The Vertical Farm: Feeding the World in the 21st Century*. There are vertical farms in Asia, Europe and North America. 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 closed monitored by sensors. Such technologies are advocated by some because they use less energy to transport food to markets (with them often grown on sites close to urban consumers), requiring also less water and pesticides than traditional agricultural practices would require. Some, however, are critical of the reliance on LED lights, with new farms emerging that use natural sunlight (a free source of energy) (Rose 2015). We can think of other applications of smart technology to the food chain: using sensors and integrating data systems to improve food chain performance in terms of energy use during distribution, improving logistics systems, improving food waste management, etc.

There is clearly some smart and potentially very useful agri-tech solutions being develop to respond to food system pressures, including vertical farming technologies that are prominent in urban agriculture contexts. Most examples cited above are selected from the UK but similar initiatives are taking place in other European countries too (e.g., Germany and The Netherlands). This type of 'smart agriculture' talk is framed around 'sustainable intensification', a term which was first applied in a developing world context to describe processes of sustainable agricultural intensification that produce more output from the same area whilst reducing the negative environmental impacts and increasing the flow of environmental services (Pretty *et al.* 2011). The term has become a powerful instrument in discussions about global food security (Garnett *et al.* 2013; Maye and Kirwan 2013). One might say it has been appropriated from its original developing world contexts to articulate a techno-science response to sustainability problems within agriculture. The general definition is the same in terms of needing to produce more food from less land, resources, energy, water, etc. Most of the sustainable intensification literature in relation to global food security then advocates using a mix of 'eco-efficiency' approaches that include things like genetic modification, nanotechnology, genomics and computerisation(Foresight 2011). A further indication of the prominence of this term in food security policy is reflected in the final report from the Commission on Sustainable Agriculture and Climate Change (Beddington *et al.* 2012), with Recommendation 3 of that report entitled: 'Sustainably intensify agricultural production while reducing greenhouse gas emissions and other negative environmental impacts of agriculture'.

Such documents symbolise a techno-scientific approach to sustainable food security and the global food crisis. Similar to the critiques of smart city technologies and big data analytics which raise concerns about the politics of urban data and an overly technocractic approach to governance and city development, critiques of sustainability science within agri-food studies are emerging. Freidberg's (2014) work on Life Cycle Analysis (LCA) methodologies, which have been designed to measure environmental performance, shows, for instance, how they have been turned into techno-political instruments that the food industry can use to demonstrate certain environmental performance credentials. Defining what counts as 'sustainable food' in terms of a footprint can become highly political, technical and self-serving. This argument extends too to 'smart cities', 'sustainable intensification' and 'smart city food governance'. 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, reflecting, in other words, the values of post-normal science(Funtowicz and Ravetz 1994), wherein complexity, uncertainty, incomplete data and multiple stakeholder perspectives are explicitly acknowledged.

Urban food systems: general trends and conditions

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 purpose of this paper is not to discredit or disregard such technologies. It aims instead to provide a broader view of innovation and smart city governance that incorporates technology, but is not seen as the only solution, thus building on the critiques of techno-politics summarised above and designed to reflect urban agriculture practices on the ground.

To build this more democratised view of smart urban food governance it is useful to first summarise what we know about urban food systems, as summarised in a recent review by Wiskerke (2015). In mid-2009 the world's population became more urban than rural. By 2050, projections suggest 66% of the world's population will be living in urban areas. There are significant differences in patterns of urbanisation between regions. Asia and Africa is predominantly rural while Europe and America are more urbanised. Urbanization through mega cities is widely talked about, but the majority of population growth will occur in smaller cities and towns: both face several development, governance and sustainability challenges. A major challenge in all cities is resource use. The majority of resources used by a city come from and are produced in places outside cities' borders (Steel 2008), which is typically referred to as the 'urban ecological footprint' (Rees and Wackernagel 1996). The urban ecological footprint, expressed in terms of the annual demand for land and water per capita, has increased as a consequence of urbanization. Cities also face other challenges, including growing inequalities in wealth, health, access to resources, availability and affordability of services, and environmental pollution (Wiskerke, 2015).

An urban challenge which has been ignored for some time in urban studies but is now gaining attention in urban policies and planning is food provisioning. The reason for this dichotomy is linked to urban and rural policy orientations, with food often seen as linked to agriculture and thus belonging to rural policy, which has meant that food provisioning has been linked to rural and regional policy, food security defined as a production failure and food policy promoted as a non-urban strategy (Sonnino 2009). Food's significance in urban development and in improving quality of life has also been ignored. As discussions around urban agriculture and urban food systems grow there is now more and more urgency to what these terms mean in practice. As Wiskerke (2015) explains, an urban food system refers to the different modes of urban food provisioning, which refers to the different ways food that is eaten in cities is produced, processed, distributed and retailed. We are referring then to 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 food provisioning system in a city is a hybrid food system. An urban food system is not just shaped by the immediate conditions in the surrounding city-region; it is also shaped by dynamics at a global distance (Steel, 2008).

There are in fact a number of external conditions currently shaping urban food systems that have attracted much attention and are shaping food policy debate, including the above mentioned discussions linked to food security and sustainable intensification. Wiskerke (2015) usefully identified the following conditions, the key elements of which are summarised below:

- *Population growth, urbanisation and changing diets*: alongside population growth and urbanisation a changing diet, also described as the 'nutrition transition', is occurring. This process relates to an increase in energy intake and a change in the composition of diets. The growth and pressured applied by an urbanising world population is particularly pressing here, although food scholars rightly note the need to be cautious of the discourse describing a need to double food production (Tomlinson 2013). We know too that 40% of the food produced is not consumed due to harvest losses on the farm and post-harvest losses further up the chain. Thus reducing harvest and post-harvest losses could be just as important as increasing production yields. 33% of food purchased in the UK is thrown away (Lang 2010).
- *Scarcity and depletion of resources*: food provisioning activities (from production to eating) need natural and human resources, including energy, nutrients, water, land and labour. Key resources for food provisioning are depleting. Changes in the use of resources to secure urban food provisioning is therefore essential, including fossil fuels, water (water footprint of food products), and land. For example, energy, water and land constraints have been identified by New York's City Council as potential threats to their food supply and they have developed a strategy (FoodWorks) to address these issues, including encouraging the development of urban agriculture.
- *Climate change*: this condition 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. Urban agriculture is increasingly valued for its role in climate change adaptation and mitigation (Dubbeling 2014) 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 increasing evapotranspiration. These spaces can also help to store excess rainfall and thereby reduce flood risks in cities. Urban agriculture can also play 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.

- *Public health*: Of the 7 billion people in the world 2 billion suffer from diet-related ill-health (obesity, malnutrition and hunger). Obesity rates in Europe range from 10% to 38% of the population. Particularly alarming is the rapidly rising prevalence of overweight children. Child malnutrition is a significant problem in developing countries. In a number of cities diet-related ill-health is 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). The London Food Strategy was also linked to a public health agenda.

Urban food systems, innovation theory and transformative capacity

The confluence of 'intensifying circumstances' (Hinrichs 2014) or conditions described above has created a sense of urgency to re-examine the sustainability of urban food systems. Wiskerke (2015) suggests that they create a significant challenge to create, what he terms, 'resilient urban food systems'. This raises the wider question about what might 'smart' or 'resilient' urban food systems look like. A key response here is that smart forms of food governance for more resilient urban food systems cannot rely only on techno-scientific solutions, accounting also for cultural and social practices. To answer this question more fully it is useful to explain how we define and what we mean by 'innovation'. This section of the paper addresses this question. Using these ideas it will then introduce some principles for designing and developing 'smart', or as preferred here, more resilient urban food systems, as described by Wiskerke (2015).

The innovation literature draws two useful distinctions. The first is a distinction between technological and social innovations (Bock 2012):

- *Technological innovations* include consumer goods like the iPhone or Dyson hoover. Examples within farming could be a tractor or more controversial bio-economic technologies such as Genetically Modified Organisms or some of the other smart technology applications described above. In simple terms, these examples are material, economic, technical, science and technology-orientated innovations.
- *Social innovations* might be changes in consumer behaviour e.g. carrier bags use, recycling behaviours, or innovations in consumption practices. We are talking here then about changes in

social practice in terms of attitude, behaviour, and/or perceptions. It might also be a change in the way society is governed – e.g. enabling more civic involvement. We are referring then to innovations that lead to, as Neumeier (2012) puts it, "[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" (*ibid.*: 55).

Innovation is central to transition processes: it provides the means to 'unlock' old styles of thinking and to develop resources and pathways to greater sustainability. The second important distinction then is between incremental and radical innovations:

- *Incremental innovations* – These are also referred to as *'first order' innovations* in the literature. They are basically innovations (technological or social) that maintain the status quo. In other words, they don't challenge the rules about how a system (e.g. the agri-food system) operates or how we behave as consumers/citizens.
- *Radical innovations* – These are also referred to as *'second order' innovations* in the literature. They refer to innovations that change the regime or system. Things like organic agriculture in its early days were radical. Debates about GMOs now are also radical.

Radical innovations (whether technological or social) are most likely to influence a regime when it is under pressure. Sustainability transitions take place when the old techno-economic principles are replaced by new ones. There are a number of studies on urban sustainability transitions, concerning food, energy, transport, etc. We know from this literature that transition to a new regime is highly contingent on a range of different processes and multiple levels (Smith 2006; Wiskerke 2003). This has important implications for smart city food governance agenda, because it implies a need to consider technological and social innovations as 'smart approaches' to urban food growing and provisioning, including too analysis of practices at multiple scales.

Recent work with urban agriculture projects in city regions as part of an EU project called SUPURBFOOD, for example, has examined innovation practices at the project / firm level. The study involved working in 7 city regions and firm-level cases included short food chain cases, energy, waste and nutrient recycling cases, and multifunctional land use cases. One of the key findings to emerge from this work was the need to better understand social practices as they take place at a local level. Within the social practice theory literature a 'systems of practice' perspective is developing (Watson

2012). One of the insights from Watson's work on cycling, for example, is the idea that transitions can gather momentum around relatively 'soft changes' (e.g. increasing recruitment of cyclists) that become normalised and change how roads are designed, for example. This work is starting to look at opportunities to change the practices of associated systems (e.g. legislation governing the food regime). Through this sort of social practice theory approach, context is also inserted back into the centre of analysis. A recent study by Langendahl *et al.* (2014) examined a medium-sized processing firm in the UK – this work examined the sustainable innovation journey in a firm as a bundle of practices that are developed and redeveloped over time, which can mean developing new practices, redeveloping existing practices and dropping problematic practices. In the Supurbfood work, we have extended this approach, arguing that to understand 'transition processes' one needs also identify 'alignments of interest' and to examine transformative capacity.

Transformation then is another important concept to add into the discussion of 'smart city food governance', especially when those discussions are aligned, as they need to be, with wider understandings of sustainability transition and an appreciation of social and socio-technical practices that can influence change at local ways and in soft ways that, although less obvious in some cases, may collectively amount to significant change within the associated system. We need, in other words, to determine what type and level of change is happening; this could be a change in practices within a business, but it can extend to a change in government legislation, for example.

Transformative capacity is defined in the grassroots innovations literature as 'intrinsic benefits' (positive changes at the community level but doesn't alter the wider regime) and 'diffusion benefits' (ideological and seek to affect the regime) (Seyfang and Smith 2007). A practice approach is now advocated in innovation theory because it allows a more horizontal appreciation of transformation, including the gradual influence of soft changes. In SUPURBFOOD, what we have started to focus on then is examining practices, institutions and the environment in which something takes places. This includes, for example, analysis of alignments of interest between food entrepreneurs in a firm and policymakers in a city. Such alignments enable things to happen. This was evidenced in some of the 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. We can look then at how firms / projects have developed interactions and influenced change across domains.

One might ask why this social practice approach is important in relation to smart city food governance debates. The argument presented here is that it helps to better reflect some of the important nontangible, non-material social innovations that take place through food and related food organisations and governance structures (which are equally 'smart' I would argue). Smart city food governance needs to be framed in a way that captures technological, social and socio-technological innovation at a range of levels, including firm and household scales. A recent evaluation of the Local Food (LF) programme in England involved the author and colleagues (Kirwan *et al.* 2013; Kirwan *et al.* 2014) helps to further justify this perspective. Launched in 2007 as part of the Big Lottery's 'Changing Spaces' programme, the £60 million LF programme distributed lottery grants to more than 500 food related projects, with the aim of helping to make locally grown food accessible and affordable to local communities. It opened for applications in March 2008 and ran until March 2014. The overarching aim was to make locally grown food accessible and affordable to local communities. The evaluation findings showed that the majority of LF projects (including those with a short chain element) were urban. 88 projects were funded in London, for example. In our evaluation of the LF programme we assessed programme success in terms of material outputs (volume of fresh food produced, for example). If such projects and schemes are evaluated only in those standard ways they fail to do well. What the evaluation showed very clearly was that in fact, most LF projects were not really about food, and are probably best described as *community projects* with food as the pretext and a vector for social agency and the development of community capacity. Community projects like the ones described here form a crucial part of a city's urban food fabric. These examples of social grassroots social innovation could easily be marginalised in 'smart food city governance' frameworks but they make important, non-material contributions.

Resilient urban food systems

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, the preference here is to talk more in terms of enabling 'resilient urban food systems', which can include but not exclusively smart city innovations. In a recent contribution, Wiskerke (2015) outlines a series of principles for designing more resilient urban food systems.

- *Adopt a city-region perspective*: A city region perspective to urban food systems argues that the city region is 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. New York's food vision, FoodWorks, for example, is based on a detailed analysis of the city's food system. With the wider decentralisation of policy responsibilities to local government this approach has value. Whether the city-region scale is adopted explicitly or not, there is certainly evidence to suggest cities around the world are starting to think strategically beyond the confines of their city boundary. In Europe and North America, for example, public health concerns and concerns about the ecological footprint of urban food systems have been drivers for municipal and regional authorities to consider food now part of the urban agenda. Prompted by the food price spikes in 2007/2008 urban and peri-urban agriculture have been adopted in municipal and a few national policies, particularly in developing countries where the focus is on enhancing food security.

- *Connect flows*: The idea here is to connect urban flows so that resources in waste are recovered for flows that create value. The sanitary-environmental approach to urban waste management has meant that flows have become disconnected (pigs in cities feeding on organic waste, for e.g.). For food waste, The Netherlands have an approach, called Moerman's Ladder, that is useful and starts with preventing food waste (e.g., use for human food – food banks), followed by a range of options for optimising residual food waste streams (use as animal feed, transforming into fertiliser through composting). Circular metabolism is a concept now featuring in debates about creating more sustainable cities, which is all about cities shifting from a linear model to a circular model of metabolism, whereby different outputs are recycled back into the system so that they become inputs. There are different ways that this can be done, including centralised high-tech systems, such as metropolitan food clusters and agro-parks using ideas from industrial ecology, but also low-tech systems, such as agro-ecological production that produce compost from household waste, for example. Which system is used, or the combination of systems and technologies, will depend on specific city-region characteristics.

- *Create synergies*: this principle is all about spatial synergies (the flows principle is about connecting resources in circular ways. The basic idea is to achieve multiple benefits from the same place, with synergies created by using food as the vector to link different urban policy objectives together. For instance, developing multifunctional urban and peri-urban agroforestry and agriculture spaces in city-regions can serve different purposes simultaneously. Rooftop farming, for example, creates food but it also combats urban heat islands, generates biodiversity in a city and can used for storm water containment. Renting *et al.* (2013) have examples in their study, including synergies between food provisioning, green urban infrastructure and biodiversity conservation in Cape Town, South Africa. Clever redesign of systems of urban food provisioning can therefore meet several policy domains at the same time (e.g., reduce food and nutrition security, enhance environmental quality, create employment, and improve community cohesion and health education).

- *Plan for resilient urban food systems*: a number of cities are now developing food strategies and policies – in Europe and North America, for example, but also in developing countries and emerging market economies, with well-known examples in Peru (Lima) and Bogota (Columbia), for example. Urban food strategies differ enormously but the key is that cities develop and plan for food system resilience. Developing comprehensive food strategies is not easy, dependent on local factors, including the political and democratic system, but it is possible, as seen in Toronto (Blay-Palmer, 2009). The key is to develop these systems at a city region level, which does seem to be gaining traction with local authorities, as evidence by the 2013 Bonn Declaration of Mayors at the 4th Global Forum on Urban Resilience and Adaptation. As urban food strategies span policy domains a key challenge is to organise administrative and political responsibility for the strategy, which might be done by forming a municipal department of food, giving the planning department responsibility for food or setting up a food policy council (the latter, if funded properly, may be preferable as it combines stakeholders from the public, private and civic sphere).

Conclusion

This paper has provided 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. In other words, what do we mean by the term 'smart city food governance'? To answer this question I have made two general arguments. First, I have highlighted the dangers of 'technopolitics' and argued for an approach to urban food chain sustainability that, informed by post-normal science (Funtowicz and Ravetz 1993) and reflexive governance (Stirling 2006), allows multiple realities and stakeholder perceptions to be acknowledged and accounted for. This helps to overcome so-called 'hypocognition' (Lakoff 2004), whereby urban food system sustainability and resilience is linked to one single issue (e.g. climate change, food security) or mode response (techno-science solutions) that ignore other equally important issues and forms of innovation (social innovations/capacities). In building this case I have argued that 'smart cities' is an emerging concept but techno-innovation driven and that we need to recognise social and civic forms of innovation, in keeping with urban food system traditions (epitomised by social practices, soft changes and associated systems, transformation and alignments of interest). Building on from this argument my second key argument is a preference to talk about the governance of resilient urban food systems. This involves a city-region perspective as a useful planning principle to adopt. This can help to overcome the silo nature of planning and achieve more multi-level forms of urban food governance.

References

Beddington, J., Asaduzzaman, M., Clark, M., Fernández, A., Guillou, M., Jahn, M., Erda, L., Mamo, T., Van Bo, N., Nobre, C., Scholes, R., Sharma, R. and Wakhungu, J. (2012). *Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change.* CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. .

Bee, S. (2015) Agri-tech strategy at the forefront of Precision Agriculutre Revolution, Agri-Tech Strategy Blog.

Blay-Palmer, A. (2009). "The Canadian pioneer: the genesis of urban food policy in Toronto". *International Planning Studies* **14** (4), pp. 401-416.

Bock, B. (2012). "Social innovation and sustainability; how to disentangle the buzzword and its application in the field of agriculture and rural development". *Studies in Agricultural Economics* **114** pp. 57-63.

Department for Business Innovation and Skills (2013). *A UK Strategy for Agricultural Technologies.* . DBIS, London.

Despommier, D. (2010). *The Vertical Farm: Feeding the World in the 21st Century*. New York: St Martin's Press.

Dubbeling, M. (2014) Urban agriculture as a climate change and disaster risk reduction strategy, pp. 3-7: *Urban Agriculture Magazine*.

European Commission (2011). *Regional Policy for Smart Growth in Europe 2020.* . A report prepared for European Commission, Directorate-General for Regional Policy. Brussels.

Foresight (2011). *The Future of Food and Farming: Challenges and Choices for Global Sustainability*. London: The Government Office for Science.

Freidberg, S. (2014). "Footprint technopolitics". *Geoforum* **55** (0), pp. 178-189.

Funtowicz, S. and Ravetz, J. R. (1993). "Science for the post-normal age". *Futures* **September** (25/7), pp. 739-755.

Funtowicz, S. and Ravetz, J. R. (1994). "The worth of a songbird: ecological economics as a post-normal science". *Ecological Economics* **10** pp. 197-207.

Garnett, T., Appleby, M. C., Balmford, A., Bateman, I. J., Benton, T. G., Bloomer, P., Burlingame, B., Dawkins, M., Dolan, L., Fraser, D., Herrero, M., Hoffmann, I., Smith, P., Thornton, P. K., Toulmin, C., Vermeulen, S. J. and Godfray, H. C. J. (2013). "Sustainable Intensification in Agriculture: Premises and Policies". *Science* **341** (6141), pp. 33-34.

Hinrichs, C. (2014). "Transitions to sustainability: a change in thinking about food systems change?". *Agriculture & Human Values* **31** (1), pp. 143-155.

Hollands, R. G. (2008). "Will the real smart city please stand up?". *City* **12** (3), pp. 303–320.

Kirwan, J., Ilbery, B., Maye, D. and Carey, J. (2013). "Grassroots social innovations and food localisation: An investigation of the Local Food programme in England". *Global Environmental Change* **23** pp. 830-837.

Kirwan, J., Ilbery, B., Maye, D. and Carey, J. (2014). *Local Food programme: Final Evaluation Report*. Royal Society of Wildlife Trusts. [online] [cited 29 September 2015] URL: Available from: http://www.localfoodgrants.org/public/evaluation_full_report.pdf

Kitchin, R. (2014). "The real-time city? Big data and smart urbanism". *GeoJournal* **79** pp. 1-14.

Kitchin, R., Lauriaulta, T. P. and McArdleb, G. (2015). "Knowing and governing cities through urban indicators, city benchmarking and real-time dashboards". *Regional Studies, Regional Science* **2** (1), pp. 6–28.

Kobie, N. (2015). "The internet of food: why your steam might have come from a connected cow". *The Guardian,* Wednesday 5 August 2015.

Lakoff, G. (2004). *Don't think of an elephant!: know your values and frame the debate. The essential guide for progressives*. White River Junction VT 05001, Canada: Chelsea Green Publishing Company.

Lang, T. (2010). "From 'value-for-money' to 'values-for-money'? Ethical food and policy in Europe". *Environment and Planning A* **42** (8), pp. 1814 – 1832.

Langendahl, P.-A., Cook, M. and Potter, S. (2014). "Sustainable innovation journeys: exploring the dynamics of firm practices as part of transitions to more

sustainable food and farming". *Local Environment: The International Journal of Justice and Sustainability* **DOI: 10.1080/13549839.2014.926869**.

Marr, B. (2015) How big data and the internet of things create smarter cities., Forbes / Tech, May 19, 2015.

Maye, D. and Kirwan, J. (2013). "Food security: A fractured consensus". *Journal of Rural Studies* **29** (0), pp. 1-6.

Naldi, L., Nilsson, P., Westlund, H. and Wixe, S. (2015). "What is smart rural development?". *Journal of Rural Studies* **40** pp. 90-101.

Neumeier, S. (2012). "Why do Social Innovations in Rural Development Matter and Should They be Considered More Seriously in Rural Development Research? – Proposal for a Stronger Focus on Social Innovations in Rural Development Research.". *Sociologia Ruralis* **52** (1), pp. 48-69.

Pretty, J., Toulmin, C. and Williams, S. (2011). "Sustainable intensification in African agriculture ". *International Journal of Agricultural Sustainability* **9** (1), pp. 1-241.

Rees, W. and Wackernagel, M. (1996). "Urban ecological footprints: why cities cannot be sustainable - and why they are a key to sustainability". *Environmental Impact Assessment Review* **16** (4), pp. 223-248.

Renting, H., Naneix, C., Dubbeling, M. and Cai, J. (2013). *Innovative experiences with multifunctional (peri-) urban agriculture in city regions in the Global South. SUPURBFOOD deliverable 3.5*. A report prepared for RUAF Foundation Leusden, The Netherlands.

Rose, J. (2015) Green pie in the sky? Vertical farming is on the rise in Newark: *The Salt*, August 05 2015.

Seyfang, G. and Smith, A. (2007). "Grassroots Innovations for Sustainable Development: Towards a New Research and Policy Agenda". *Environmental Politics* **16** (4), pp. 584 – 603.

Smith, A. (2006). "Green niches in sustainable development: the case of organic food in the United Kingdom". *Environment and Planning C: Government and Policy* **24** pp. 439-458.

Sonnino, R. (2009). "Feeding the City: Towards a New Research and Planning Agenda". *International Planning Studies* **14** (4), pp. 425–435.

Steel, C. (2008). *Hungry city: how food shapes our lives*. London: Vintage Books.

Stirling, A. (2006). Precaution, foresight and sustainability: reflection and reflexivity in the governance of science and technology. In J. P. Voss, and D. Bauknecht (eds): *Reflexive governance for sustainable development*: Edward Elgar Publishing.

Tomlinson, I. (2013). "Doubling food production to feed the 9 billion: A critical perspective on a key discourse of food security in the UK". *Journal of Rural Studies* **29** (0), pp. 81-90.

Watson, M. (2012). "How theories of practice can inform transition to a decarbonised transport system". *Journal of Transport Geography* **24** pp. 488–496.

Wiskerke, H. (2015). Urban food systems.

Wiskerke, J. (2003). "On promising niches and constraining sociotechnical regimes: the case of Dutch wheat and bread". *Environment and Planning A* **35** pp. 429-448.