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The Governance of City Food Systems

**Edited by Mark Deakin,
Davide Diamantini
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ABOUT THIS BOOK

This book explores the governance of city food systems. It serves to highlight, not only the smart, sustainable and inclusive nature of the urban and regional governance, which underpins the growth of infrastructure development, but that also support the solution corridor opening up for city food systems to bridge territorial divisions in the access to and distribution of goods and services produced by the agricultural sector. Highlighting the governance of city food systems in this way, it also offers a series of critical insights into the territorial divisions of urban and regional governance, which underlie the growth of infrastructure developments and that surface as matters relating to the resilience of city food systems.

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The Governance of City Food Systems

Introduction

This book explores the governance of city food systems. It serves to highlight, not only the smart, sustainable and inclusive nature of the urban and regional governance, which underpins the growth of infrastructure development, but that also support the solution corridor opening up for city food systems to bridge territorial divisions in the access to and distribution of goods and services produced by the agricultural sector. Highlighting the governance of city food systems in this way, it also offers a series of critical insights into the territorial divisions of urban and regional governance, which underlie the growth of infrastructure developments and that surface as matters relating to the resilience of city food systems.

This serves to:

- bottom-out the urban and regional governance of these infrastructure developments as key resource-based challenges, that not only underpin the municipal strategies emerging to meet them, but which also support the capacity-building exercises surfacing to promote city food systems as climate smart, sustainable and inclusive;
- draw attention to the infrastructure developments that are resourceful in securing the strategies needed for municipalities to build the capacities, which are required for city food systems to be climate smart in sustaining the production of goods and services that are not only affordable, but which are also nutritious;
- highlight the potential that climate smart and sustainable city food systems have to not only produce affordable and nutritious goods, but also be inclusive in delivering services able to meet the health needs and well-being requirements of place-based communities. Place-based communities, which otherwise remain divided, not only because the right to access such goods would be unequal, but for the reason the distribution of services should also be inequitable.

Composed of four papers, the book captures the state-of-the-art on the urban and regional governance of infrastructures developments that underpin the resilience of city food systems and which support municipal strategies as capacity-building exercises, that are not only climate smart, but which are also sustainable and inclusive in bridging territorial divisions.

Exploring food, governance and cities as key themes of the Milan World Expo, the first paper examines where the governance of city food systems fits into the debate surrounding the climate smart, sustainable and inclusive growth of infrastructure developments in Milan. This serves to outline the methodological challenges such infrastructure-driven service developments lay down for the City of Milan and set out the contested strategies of experimentation in

capacity-building the World Expo stands on. In overcoming these methodological challenges, it uncovers the interdisciplinary landscape, which opens up over the contested experimentation of such strategic exercises in climate smart, sustainable and inclusive growth and reveals the material needed to test the underlying premise of the infrastructure-driven service developments that surface from the Expo. In particular, that assertion, which suggests: the infrastructure-driven service developments underpinning Milan's World Expo, are exemplary, because the participatory nature of the food governance system it supports provides the municipal strategy needed for other cities around the world to build the capacity also required for them to be smart.

The second paper broadens this exploration of food, governance and cities by focusing attention on growing concerns surrounding not so much the "smartness", but sustainability of the agri-food sector. Concerns the authors suggest amount to nothing less than a new geography of "food security", redrawn and mapped out in four fundamental ways. Firstly, in terms of a food insecurity, which today is simultaneously a problem of under-, over- and mal-consumption that affects over one quarter of the world's population in both developed and developing countries. Secondly, in relation to the strong political dimension food security displays in terms of the riots that followed the spike in food prices in 2008 and which demonstrated to governments across the world the real significance of food. Thirdly, the social division of food and insecurities emerging across urban territories. Fourthly, with respect to the interrelated ecological pressures (over and above looming climate change) these territorial divisions in turn bring to bear on the governance of city food systems.

Set with the insecurities of this new geography and concerns about the sustainability of the food sector, the third paper argues for the need to have just such a broad view of what is also meant by "smart cities" and "smart city food governance". This paper argues that smart city food governance cannot be accounted for in the meta-cognitive realm of scientific and technical terminologies, but only in combination with the social innovation, which smart city food governance systems also relate to as infrastructure-driven service developments. In developing a "more" critical perspective on smart city food governance, this paper suggests: the value of smart and sustainable growth needs to be assessed in terms of the extent to which, the infrastructure developments currently taking place are able to secure food and stabilize provision. In particular, are able to secure food and stabilize provision, by way of the ecosystems that municipal strategies cultivate to meet these requirements and through the capacity-building exercises, which cities in turn embark on, to not only be resilient, but environmentally sustainable in bridging territorial divisions.

The fourth paper is set within this resilience debate, perceived need to reduce ecological footprints and promote self-sufficiency, via local food production and shorter supply chains. It explores the multitude of social, environmental and economic benefits that emerge from such a securitization of city food systems. As this paper stresses, as with other fields of policy-making, food policies also demand a sufficient information and knowledge base for municipal strategies to be effective in bridging territorial divisions and as a result, call for tools able to build such

capacities. In meeting this call, the paper offers an account of FOODMETRES (Food Planning and Innovation for Sustainable Metropolitan Regions) developed from a series of technical references and decision support tools. Technical references and decision support tools that allow stakeholders from the agro-food business, civic and governance sectors to enter into knowledge-driven debates on how to optimize the supply function of metropolitan areas, by means of innovative food chain planning, which is smart in having the capacity to promote sustainable development.

These papers were originally presented at a Symposium on the Milan World Expo entitled: *The Governance of the Smart City Food Agenda*. Organized by Milan-Bicocca and Edinburgh Napier Universities, this Symposium formed part of the Milan Expo Urban Laboratory's contribution to the Scientific Agreement on the UN Food Charter and Urban Policy Food Pact, launched by Milan City as part of the World Food Day.

The editors would like to thank the Feltrinelli Foundation for hosting the Symposium and agreeing to publish the proceedings.

The Editors, November 2015

Food, Governance and Cities

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Introduction

Food, governance and cities have all emerged as key themes of the Milan World Expo. This paper explores these themes by examining food in the governance of the World Expo as a smart city. In embarking on this examination, it reviews where food governance fits into the debate over the Expo as a smart city and outlines the methodological challenges, which the contested and experimental nature of the interdisciplinary landscape that surrounds this global event pose for policy makers. In going on to overcome these methodological challenges and map out both the contested and experimental nature of this interdisciplinary landscape, the paper lays out the material needed to test the underlying premise of the Expo's smart city debate. In particular, that assertion, which surfaces in the media and suggests that Milan's World Expo is exemplary, because the exposition of food governance, which it lays down as a model for the rest of the world to follow, provides the means for other cities to do the same and be equally smart in "feeding the planet and energizing life".

The Milan World Expo

Within the Milan World Expo, debates about food, governance and cities relate to policy actions promoted by the City to champion food. What is particularly smart about Milan's championing of food is set out in terms of the:

- site Milan assembles for the World Expo;
- infrastructures the City develops to service the Expo;
- management system the municipality assembles to advise people about the event;
- information this in turn provides to learn about food from the exhibits on display and knowledge of how to move around the pavilions;
- interactive experience this gives visitors and invitation it extends them to participate in the event;
- governance legacy this leaves behind for others to learn from and go on to champion in

other cities around the world.

The ability of the master plan to coordinate the 110-hectare development and lay down the infrastructures needed for this to be sustainable is also noted. This draws particular attention to the ability of the development to meet the event's mobility requirements, the site's water, waste and energy needs, along with the pavilion's logistical demands. Here the smart grid, renewable energies this draws on to fuel the LED lighting, power and heat the installations, along with the remote sensing systems controlling their use and ecological footprint of the pavilions' low carbon buildings, are all singled out. As too is the application of the internet of things (IoT), adopted to manage the environment, via cloud computing software systems, able to monitor the respective microclimates all of this produces.

The exhibits installed in the pavilions are also attributed the same status by virtue of them:

- demonstrating the potential that high-rise farming techniques have to produce food, while using natural daylight, solar power and water recycling techniques to intensify the rotation of crop cycles;
- showing the prospects which the genetic modification of staple foods, such as rice, have to weather global warming and the water shortage this produces;
- presenting a vision of a future landscape able to feed the planet and energize life.

Meeting the demands of over 100,000 visitors each day, these infrastructures, services and exhibits, offer a leading example of a smart city built from the ground up. That is, built from a former derelict brownfield site, up into an installation, which not only champions food, but also exhibits how the world can generate the productive capacity needed for the governments of nation-states around the world to feed the planet and energize life.

The governance legacy, which this smart city development lays down, draws heavily on the World Bank's (2010) Smart Climate and UN's (2011) Smart Food Programmes', along with the EC's (2010) articulation of the Smart, Sustainable and Inclusive Growth Strategy. In particular, the EC's promotion of the digital infrastructures, data management techniques and renewable energies for building a climate smart food system. This legacy system is embodied in the Urban Food Policy Pact, the C40 Climate Leadership Group and Covenant of Mayors have developed for World Food Day (October 16th 2015) and that Milan, along with over 120 other cities across the world, are co-signees to.

Development of the Expo as a smart city

While the claims for the Expo to be a smart city may appear grand, if we examine them against the state-of-the-art on such developments, they do reflect much of what is currently known and understood about such matters.

Deakin (2010, 2012a, 2012b, 2013, 2014, 2015a, 2015b) captures this state-of-the-art. This review of the literature identifies three emerging accounts of smart city development. Listed chronologically, these accounts are of “smart city rankings,” “future Internet” developments and “triple helix” models (Giffinger, 2008; Schaffers et al. 2011; Leydesdorff and Deakin, 2011; Deakin and Leydesdorff, 2013). This state-of-the-art captures what is one of the most defining features of the ranking, future Internet and triple helix models of smart cities. Which is, that while the need for some form of ranking is acknowledged by all three accounts, the future Internet is content to merely participate in such developments, whereas the triple helix model sees the governance of smart cities as something integral to their constitution as urban and regional innovation systems (Deakin, 2014, 2015a, 2015b; Komninos, 2015).

This triple helix model of participatory governance puts store in the statement by Caragliu et al. (2011: 70) on what it means for cities to be smart and which suggests that a city may not claim this title unless it is part of an urban and regional innovation system, whereby:

“investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government.”

While still performance-based, the holistic nature of this definition nicely balances the different social, cultural and economic components of smart city developments without prejudging either the weight or significance of any specific element. Perhaps more significantly, it also serves to emphasize the role ICT-related developments play in sustaining economic growth, underpinning social welfare and supporting cultural health and well-being, by highlighting the internet as an enabler of participatory government. The metrics of this future Internet-based governance are set out in the triple helix model of smart cities advanced by Lombardi et al. (2012) and Kourtit et al. (2013). This serves to get beyond the empiricism of the smart city ranking and the collaborative logic of future Internet-based developments. It achieves this by allowing those cities pioneering the development of future Internet-based technologies to be smart by participating in the governance of the infrastructures underlying the social, cultural and environmental attributes of this urban and regional innovation system.

Hirst et al. (2012) also highlight the growing significance of the internet-based technologies underpinning this urban and regional innovation system and supporting the “smart, sustainable and inclusive growth” strategy’s translation of this statement into the EC’s Smart Cities and Communities Programme. Statements that also serve to underpin the Smart Specialization Platform, which in turn support territorial competition and cohesion. Hirst et al. (2012) offer a principal component-based analysis of smart city developments. This captures the findings of the study undertaken on smart city developments as instances of where cities have been smart in underpinning this deep restructuring of the ICT, energy and building sectors and supporting the contribution such an urban and regional innovation system makes to the governance of Europe’s Smart, Sustainable and Inclusive Growth Strategy.

Those cities pioneering the participatory governance of Europe's Smart, Sustainable and Inclusive Growth Strategy, are Manchester, Amsterdam, Malmo and Barcelona. Studies of these urban and regional innovation systems reveal how smart cities have begun to construct their sustainable and inclusive growth strategies around the ICT, energy and building sectors. In particular, the digital infrastructure, data management, renewable energy, smart buildings and smart transport components of this innovation system. These studies also go some way toward tracing the principle legacy systems of smart city development - namely the ICT and energy sectors and the modulation of their growth as a "broadband" of digital infrastructure, data management, renewable energy, smart buildings and smart transport applications.

With the ICT sector, the smart growth of the first two modulations dominate (digital infrastructures and data management). With the energy sector, attention settles elsewhere, vis-a-vis on to the sustainable and inclusive growth of the renewable energy and smart buildings modules. With the ICT sector, the drivers of smart growth are areas such as high-speed broadband, data collection and storage. Issues that extend into the energy sector and which include the renewables of combined heat and power, efficient heating and cooling systems, smart grids and metering of smart buildings. This configuration also serves to highlight where the integration of these legacy systems constructs a platform for the governance of smart and sustainable growth. It also outlines the system boundaries underpinning the digital infrastructures of the data management technologies and supporting the renewable energies of smart buildings. Perhaps more significantly, it also illuminates the aim of this "underpinning" as being to support the sustainable growth of city-districts.

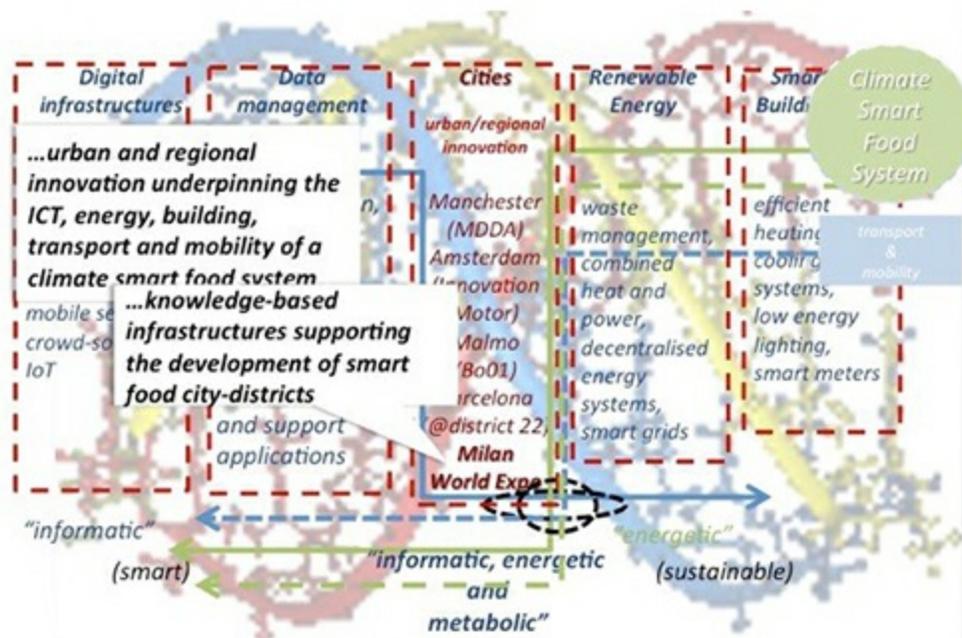


Figure 1: Milan World Expo as a Climate Smart Food System

Adapted from Hirst et al. (2012) as an urban and regional innovation underpinning the ICTs, energy, buildings, transport and mobility of the climate smart food system found in the Milan Expo. The same types of knowledge-based infrastructures supporting the development of smart food city-districts appear in Manchester, Amsterdam, Malmö and Barcelona

Figure 1 illustrates how the Expo maps onto these smart city developments. As can be seen, it is composed of the same developments Hirst et al. (2012) highlight and Deakin (2013, 2014) draw attention to in terms of the exhibition's status as an urban and regional innovation. In particular, as an innovation underpinning the ICT, energy, building, transport and mobility of a climate smart food system supporting the knowledge-based infrastructures of smart food city districts.

The New Scientist recently reported on such a climate smart food system. Under the title of "Vertical Farms", it draws attention to the potential of such an urban and regional innovation as a digitally enabled, data gathering and renewable generating set of buildings, smart in terms of water recycling, energy consumption, carbon emission and ecological footprint of their transport and mobility networks. They suggest such farming systems are particularly useful innovations for cities with high population densities, land use shortages and congested transportation networks, cutting costs by as much as 70% and increasing productivity 4-fold, via multiple cycles of crop rotation. The value of farming rooftops, derelict buildings, vacant land and waterways, has also been explored by Horwich and Mulloth (2010) and Specht et al. (2014). Orsini et al. (2014) estimate the innovations underpinning such climate smart food systems; have the potential to increase productivity by as much as 10%.

While such representations of “participatory governance” are valuable in verifying the status of the Expo as a smart city and opening up the opportunity there is to leverage the truly transformative capacities of cities declaring themselves smart, it appears despite this, very little is known about how to regulate such a process of urban and regional innovation. The reason for this is simple and rests with the assumption that smart city ranking and future Internet accounts make about urban and regional innovation growth being organic in nature, vis-a-vis something, which governance systems appropriate, by way of digital infrastructures and through data management techniques found in the renewable energies and smart buildings of the food sector. These assumptions are far reaching and have the effect of:

- undermining the idea of “needing to know about” such urban and regional innovations, let alone the governance systems by which to regulate these developments, because it is natural and in that sense follows a given course of action, stable and secure in terms of any resulting adaptations;
- undercutting the public’s interest in smart cities, because the suggestion of such development being little more than “business-as-usual”, means any governance issues that arise over either what intelligence such digital infrastructures are based on, or wealth of data management techniques they create to support the renewable energies of smart buildings, can be dealt with both way of and through the normal channels;
- allowing the governance of smart cities to become associated with and dependent on the corporate strategies of an enterprise culture. In particular, of an enterprise culture, which suggests that as an exercise in business-as-usual, the governance system which they promote need pay little attention to how the sustainable and inclusive growth they search for can, not only tackle the digital divide, or combat fuel poverty, but social exclusion of the area-based deprivation this in turn cultivates;
- managing the expectation of smart cities in such a manner that any resilience they have to the deprivation, exclusion and poverty of such divisions, firmly rests on urban and regional innovations in the digital infrastructures, data management and renewable energies of smart buildings serving the food sector. In that sense, on climate smart food systems, which cultivate the enterprise architecture of business models, able to support sustainable and inclusive growth.

Unfortunately, what this kind an organic, bottom-up growth does is leverage so much enterprise as to effectively dis-embed itself from the social needs and cultural requirements it has traditionally been the academic community’s responsibility to not only uncover, but also leverage the transformational capacities of. This occurs because of the business community’s tendency to cut the intellectual capital of this governance system so far back into the cybernetics of wealth creation, that it leaves those cities claiming to be smart, standing alone on an enterprise culture, which does little more than sustain the competitive instincts and cohesive virtues of their digital infrastructures and data management. The downside of relying on such a governance system as the standard-bearer of “wise management” lies with the tendency, which developments in renewable energies and smart buildings, have to rest on a governance system

grounded in a notion of resilience that bears no relation to the environment.

The difficulties that emerge from these broken links and dis-connections i.e. to renewable energies, smart buildings and the environment, are numerous and indicate the pressing need for any such reference to the enterprise culture of a bottom-up, organic growth, to account for the:

- transformational capacities of climate smart food systems, not in strictly technical, but wider social, cultural and environmental terms;
- ICT, energy and building sectors' contribution to the transformational capacities of such food systems;
- standards of city governance, which meet the social need for food and cultivate the environments that are required of them, as a material condition of their sustainable and inclusive growth.

Where climate smart food systems fit into city governance

This perhaps goes some way to explain why many commentators question where such climate smart food systems fit in the governance of cities. For dependent on the qualities of ICTs as general-purpose technologies to drive productivity and energy to fuel sustainable growth, the need for smart buildings to be included in such an urban and regional innovation system has up till now been overlooked. While Milan may be a “really existing” smart city, whose buildings prove to be an exception to this rule, drawing attention to sustainable growth, still falls short of the mark, because any claim for them to be climate smart food systems needs to bottom out this urban and regional innovation and baseline what it means for city governance.

As Morgan and Sonnino (2010) note, this first means addressing the emerging trend in urban and regional food systems. They represent these as being the:

- food price surge in 2007–8, when global wheat prices nearly doubled and rice prices almost tripled, with the long-term trend is for food prices to remain at a higher plateau than in the past, which means that hitherto unaffected social classes are now threatened with hunger and malnutrition;
- sharp increase in food insecurity: of the world's 6.6 billion people, some 2 billion are food insecure, meaning they cannot afford a healthy diet and suffer from vitamin and micronutrient deficiencies that limit their physical and cognitive capacities. By 2050, the world's population is predicted to stabilize at roughly 9 billion. Given currently available technologies, consumption patterns and climate change, food security for all will become more difficult to achieve unless food security policies are better calibrated with sustainable development policies;
- effect of climate change on agri-food systems around the world. Most serious predictions

suggest that the worst effects (water and heat stress, damaged ecosystems and rising sea levels) will be in poor countries that have done least to cause the problem in the first place, exacerbating the problem of food insecurity and creating an enormous ethical obligation on the global north to help the global south with both mitigation and adaptation strategies;

- growing incidence of land conflicts. With one of the most remarkable features of the 20th Century being the growth of overseas investment in agriculture as rich, but food stressed, countries (like Saudi Arabia and South Korea) seek to buy or lease fertile land in poor countries.

Morgan and Sonnino (2010) propose, these trends mark a transition in the urban and regional food regime, which, citing Friedmann, (2009: 355), they suggest can perhaps best be described as “a period of unresolved experimentation and contestation”. For Morgan and Sonnino (2010: 2) these trends have the effect of raising the question of city governance to a new level. In particular, to a level where the insecurities surrounding the provision of food exerts much greater pressure on municipalities to develop strategies capable of stabilizing the situation and allowing communities to participate in the governance of the very capacity building exercises they enter into.

For them investment in the human and social capital of these strategies and capacity-building exercises, is what gives them the status of being smart, because they serve to bottom-out the material realities of city governance. Not so much in terms of digital infrastructures, data management techniques, or set of renewable energies for smart buildings, but urban and regional food systems. To be exact, as the technological components of those food systems, which use water, consume energy and emit carbon from buildings, as part of the agri-business’ search for products that are not only affordable, but which are also sufficiently nutritious in promoting health and well-being.

What this new food regime in turn asks is nothing less than:

- a redirection of the intellectual capital and wealth creation underlying the governance of urban and regional innovation, away from the ICTs, energy and building of smart cities and towards the human and social capital of food;
- a focus on how the human and social capital of food can co-exist with urban and regional innovations in the ICT, energy and building sectors;
- an examination of how such urban and regional innovation can generate the intellectual capital needed for cities to be smart in assembling the means by which to meet the sustainable growth requirement;
- exploration of how municipalities can draw upon this type of innovation to develop food strategies that are not only capable of stabilizing provision, but which build the capacities communities also need to participate in the wealth creation opportunities, both the

informatics, energetic and metabolic of this transformation offers to sustain an inclusive growth.

That is to say, nothing less than study of how the wise management of a sustainable and inclusive growth strategy can be sufficiently resilient to deliver on the affordability, nutrition and health, which cities expect from the governance of such climate smart food systems. For what such a climate smart food system calls for is anything but organic growth and instead lays down the principle of the need for cities to know about the governance of that urban and regional innovation, which underpins it. That urban and regional innovation, which underpins it and in turn supports the human and social capital of those technological developments, found the ICT, energy, building and food sectors. Developments in the ICT, energy, building and food sectors, that are anything other than “business as usual”, but disruptive in the sense, which the “experiments” they in turn contest the human and social value of, raise public interest in the subject and channel this in new directions. In particular, towards the development of municipal strategies and capacity-building exercises, which pick-up the creative slack that currently exists in the urban and regional innovation system and capacity this has to sustain an inclusive growth. That creative slack, which because of these values is no longer dependent on corporate strategies, but the “civics” of that social enterprise culture, which rests in the third sector and unlike its counterparts in either the state, or independent, does offer municipalities the prospect of wise management. Wise management that in turn sustains this venture, by building the capacity, which communities need to be inclusive in tackling area-based deprivation, combating fuel poverty and bridging the digital divide as a material condition of the resilience also required for the municipal strategies cities adopt to be smart in sustaining such an inclusive growth.

Studied from this vantage point, any urban and regional innovations in the governance of smart cities do not stand alone, but alongside one another and as the ICTs, energy, building and food systems of a wider social, cultural and environmental agenda targeting the transformational, vis-a-vis sustainable and inclusive capacities of their stakeholder communities. Stakeholder communities that in this instance take on a form which is as much corporate, civic, business and citizen-based, in the sense the sustainable and inclusive interests of this creative commons are now seen to co-exist with the growth of ICTs in the energy, building and food sector overseeing the drive towards public consultations and deliberations. Consultations and deliberations in which, the innovations of this participatory governance system act as wise management techniques that are content to be piloted as forms of direct democracy. As forms of direct democracy, which are capable of adapting to external pressure for change in ways that are ecologically resilient. In ways, that are ecologically resilient in, not only sustaining the inclusiveness of urban and regional innovation systems, but also underpinning the trans-national process of competition, which such economies in turn support.

Methodological challenges

Approaching the governance of smart cities as a question of innovation within the ICTs, energy, buildings and food of urban and regional systems that sustain their inclusive qualities and which lean in the direction of a predominately civic, as opposed to an exclusively corporate exercise, does begin to generate the intellectual capital to overcome the pre-existing methodological challenges. Methodological challenges, which until now have not only frustrated the governance of smart cities, leaving it divided along the corporate and civic, cultivating the virtues of the ICTs, energy, building and food sectors, either as a technocratic, or democratic system of regulation. In that sense, divided along the lines of the corporate and civic, vis-à-vis technocratic and democratic representations of governance, whose communities stand apart from one another, isolated as rival constituencies and which compete for recognition. In particular, compete for recognition as the intellectual capital of a wealth creation process that: while divided along such lines vis-à-vis, corporate, civic, technocratic and democratic, offers a governance agenda (on the urbanisation of ICTs, energy, buildings and food as regional systems), which is sufficiently innovative for cities to claim the status of being smart.

The inter-disciplinary landscape

Drawing upon the co-ordinates, which the participatory governance system of this inter-disciplinary landscape maps out, it is possible to set these divisions aside and in that sense:

- challenge the assumption which states the governance of urban and regional innovation, vis-à-vis of ICTs, energy, buildings and food in smart cities is organic in nature, bottom-up and institutionally grounded. That is, something which does not need to be known about, let alone understood, because it is natural and in that sense allows smart cities to follow a given course of action, stable and secure in terms of any transformational capacities which it leverages;
- tackle the reasoning behind this assumption by drawing attention to the tendency enterprise culture has to make this governance agenda dependent on the corporate strategies of business communities, unstable and insecure in terms of the transformational capacities of the of ICTs, energy, buildings and food sectors smart cities leverage. In particular, in terms of the transformational capacities which they leverage from a predominately corporate governance system and in that sense, technology driven strategy for cultivating an enterprise architecture, designed to do little more than construct the business models which such developments currently rest on;
- resolve this instability of any such urban and regional innovation by leveraging the sustainable and inclusive qualities of smart cities founded upon the direct democracy of a participatory governance system. The innovation of a participatory governance system that is equally civic and exercise in the consultative and deliberative agenda of a direct democracy. In that sense, of a direct democracy, in which cities stand alongside one another as smart in underpinning the the social, cultural and environmental values they

share with the ICT, energy, building and food sectors as technical developments supporting the cohesive virtues of a creative commons;

- appropriate the intellectual capital needed to account for the urban and regional innovations of such smart city developments. In particular, account for the provision of digital infrastructures, data management techniques, renewable energy, smart buildings and food, as innovations in the direct democracy of a participatory governance and in terms of the capacity which their ecosystems have to index resilience as part of a triple bottom-line, vis-à-vis social, cultural and environmental assessment;
- reveal how innovations in the direct democracy of this participatory governance system are key in the development of smart cities as centres of digital infrastructure, data management techniques, renewable energy and smart buildings in the food sector. Key in the sense, which they offer the only opportunity to break the stranglehold that corporate enterprise culture holds over such developments. That is to say, break with the growth of a predominately-corporate governance system, by replacing the technology driven strategy this cultivates with the architecture of a participatory democracy. In particular, with the architecture of a participatory democracy, whose consultations and deliberations are on a human and social scale, which take on the status of ecosystems, able in that sense to appropriate the resilience needed for cities to be smart in meeting the triple bottom-line requirement to sustain them (the ICT, energy, building and food sectors) as inclusive developments.

From this it follows that any talk of resilience in smart cities is something which is currently left at the level of corporate rhetoric and called upon to cover up methodological failings in the governance of the urban and regional innovation systems forming the technologies of any such transformation.

Given the lack of public trust in the technologies of such transformations (in digital infrastructures, data management, renewable energy generation and food security) and growing fragmentation of their governance i.e. divided into their respective informatics, energetic and metabolic qualities, this leaves the participatory governance of this interdisciplinary landscape messy. For this suggests any consultations and deliberations over the matter of resilience is currently still too closely aligned, not so much with the humanitarianism of a socially inclusive, culturally diverse and environmental sustainable development of some triple bottom-line, as the biophysical elements of ecosystems. In particular, in terms of what physics, chemistry and engineering contribute to climate change adaptation and where a new generation of digital services; such as IoT, promotes the data management technologies of urban and regional governance that not only fuel the process, but also feed the transformation, which smart cities call for.

What is noticeable about these innovations is that many of them are constructed on digital platforms designed to manage data, save energy from buildings, secure food, reduce carbon emissions and mitigate global warming, as part of an adaptation, whose processing of resource

endowments makes ecosystems resilient to the natural hazards of climate change. As regards the biophysical elements of these ecosystems, it might be fair to say the jury is still out on what physics, chemistry and engineering are contributing to the resilience of any such sustainable and inclusive development. Many see this as another exercise in the wise management of resource endowments and confuse what is meant by resilience and environmental sustainability, by either studying the former, or ignoring the concept under the assumption the inclusiveness of such development is captured, albeit in a rather coarse way, by the latter. Unfortunately, this ambiguity does have real consequences; to the extent many of the studies that go under the name of resilience, would be stronger if they were less “elementary” and more systematic in terms of their ecological-integrity and contribution this makes to the environmental sustainability of socially inclusive development. Such studies would be able to capture the biophysics of this tradition as part of the search for ecosystem integrity, but perhaps more importantly, as a way to link what this cultivates back to the equity of environmentally sustainable and socially inclusive development. By contrast, those working on resilience stick very closely to the biophysics of ecosystems, as distinct and opposed to any sense of their stakeholder community and consequently, get locked into the type of environmental determinism common to find associated with matters relating to socially inclusive development.

Much of the research carried out in this anthropological tradition is more open and has been at pains to clarify the current shortcomings in government policy on social inclusion and cultivation of an environmentally sustainable community development. In particular, the tendency for policy to mainstream bottom-up approaches that at best serve to reproduce the status quo and which, at worst leave the social basis of the low-income communities they subject to such actions even more impoverished. Even more impoverished, due to having their prosperity sacrificed, not so much on the biophysics of ecosystems, or cult of ecological integrity, as wealth created from the governance system’s mis-management of what the renewable energies and smart building of the food sectors, otherwise contribute to environmental sustainability as a process of climate change adaptation.

That process of adaptation, which it is important to note, currently impact worse on low-income communities than any other. Not because they are any less resilient to external shocks of this kind, but for precisely the opposite reason. That is for the reason the humanity of their tightly knit social capital is the very thing, which puts the demographic of such communities in a culturally unique position. In that culturally unique position, which allows them to appropriate an environment, which in ecological terms has the resilience needed for any such adaptation to meet the triple bottom-line requirement everyone else falls short of. Which everyone else falls short of, because it is only the human and social demography of such (low-income) communities that possesses the means to cultivate the capacity, which is needed for the ecosystem to be resilient in meeting the environmental sustainability requirement that climate change adaptation lays down. But, which in spite of possessing the capacities that make them resilient, communities of this kind still find themselves standing somewhere between “a rock and a hard place”. That is to say, in the most unfortunate position of being sufficiently resilient to meet this environmentally sustainable requirement, while still firmly locked into the poverty,

social exclusion and culture of area-based deprivation, which attends this adaptation process.

This is perhaps the reason why we should be particularly wary of the current resilience debate in the governance of the smart cities food agenda. For it not only asks the impoverished, excluded and deprived communities, situated in the slow-growth lane, to pick up the cost of securing the ecological integrity necessary, but meet the almost super-human task of also realizing the type of environmental sustainability, which others in the fast lane can only dream of. Which others in the fast lane can merely dream of, because they are excluded from such growth and yet in spite of this, the governance system that is currently in place, still expects those who stand elsewhere, vis-à-vis in the slow lane, to secure on their behalf. Secure on their behalf and for no other reason than being the most resilient, they unlike others mainstreamed into the fast lane, do possess the human and social capital by which to carry the inequalities of the enterprise culture that such a process of wealth creation imposes upon them. Inequalities, which the enterprise culture of this wealth creation imposes upon them and the environmentally sustainable development it in turn constructs, also goes on to augment as a logical outcome of the poor's systematic exclusion from this process. In particular, systematically excludes them from, as either the human, social or the cultural components of a community rightfully constituted as members of a democracy possessing the legal right to directly participate in the governance of the ICTs, energy and building making up the smart cities food agenda.

The point to bear in mind, with what can perhaps best be referred to as the “triple bottom-bind” of the poverty, exclusion and area-based deprivation such communities find themselves culturally locked into; is that as a rapidly emerging “top-level” issue, the search for environmentally sustainable development doesn't cut deep enough. In that sense does not cut deep enough into either, the inhumanities of the underlying social structure, or cultural practices of those impoverished, excluded and deprived communities supporting the environmental sustainability of such development, to offer anything other than an index of resilience. This is because such an agenda merely serves to “scratch the surface” and falls along way short of humans generating either the social structure or cultural practices needed for their communities to be resilient in absorbing the cost of any external shocks into the governance system equally and as an urban and regional innovation capable of adapting to climate change. In particular, by adapting to climate change by demonstrating the capacity, which is needed to meet this triple bottom-line requirement. More specifically, meet this triple bottom-line by transcending the inequalities that are inherent in such notions of resilience and undercutting the “incapacities”, which the urban governance of such a regional innovation system otherwise constructs for the smart cities food agenda.

For the capacity building of municipal strategies to mainstream as something, more significant than a symbol of resilience and excuse for “treating the symptoms” of poverty and exclusion, vis-a-vis be something other than cultural therapy for managing area-based deprivation, the governance of the smart cities food agenda has to cut deeper into the socio-demographic structure of such inequalities. Given the array of social challenges, cultural

discourses and environmental crisis', let alone economic stagnation and retrenchment communities currently encounter in embarking on any such venture, generating the intellectual capital urban governance needs to build the capacity regional innovation systems require to overcome the human and social inequalities of these territorial divisions is a tall order.

What is particularly striking about the inter-disciplinary landscape, which this in turn maps out, is the intensity of the research agenda that it sets those studying the urban governance of regional innovation systems (Deakin 2013b, 2013b). That is, the high level of subject-specific and generic, vis-a-vis pedagogical rigour, which is needed to act upon the critical insights they offer to be innovative. More specifically, the need for the pedagogy that is not only innovative in building such capacities, but also able to engage with the stakeholder communities participating in, what is for all-intents-and-purposes, the systematic construction, vis-à-vis assembly, articulation and translation of the smart city food governance agenda into a set of transformational experiences (Deakin, 2014a).

Being transformational in this respect, means it is also a field of research few in the academic community seem willing to engage with, because as a point of intersection between fundamental, strategic (applied) and routine (third mission) research, the material cuts across divisions in the purely scientific, technical and more routine, every-day knowledge domains. This is because for capacity building to work as a municipal strategy such structures need to be scaffold as a joint venture and in that sense as a collaboration, the design and construction of which in turn requires to be just as strong, stable and secure as any other material brought to the exercise (Deakin, 2014b; 2015). Consequently, any effective integration of these components is challenging to say the least and their potential synthesis even more demanding. As a counterpoint to either, the administrative logic of a totalising state, or disorganising tendencies of an increasingly privatised and singularly technologically driven reasoning, such community-based actions do have great symbolic value. However, in taking on this status they do little more than merely support the notion of a creative commons and tend instead to act as supplements to representative governance systems labouring under the voluntarism and charity of not-for-profits. While these are particular forms of capacity building, finding their application as municipal strategies all too often falls short of the mark. Short of the mark in the sense, they fail to confront the poverty, social exclusion and culture of area-based deprivation, as something to be "rooted out".

To overcome the impoverishment of exclusion and area-based deprivation, which such a resilient, safe and secure representation of governance remains locked into, means urban and regional innovation cultivating a sense of community that is smart because the ecosystems, which develop possess the capacity that municipal strategies need for cities to sustain the environment as part of a bottom up construction. It isn't any coincidence that many of the most successful capacity building exercises, which have developed over the past twenty years, be they municipal strategies in either ICT deployment, energy generation, building design, or food procurement, sustain the environment on the back of socially inclusive community-based actions. Community-based actions cultivating governance systems able to tackle poverty and

combat the social exclusion of area-based deprivation these sectors in turn tackle from the bottom up.

The problem with trying to govern any such urban and regional innovation, lies with the tendency for this to be of such a fundamental nature they prove insurmountable for those seeking to capture the human expectations social needs, cultural requirements and material conditions, vis-à-vis concrete material realities of the people whose civic status come to symbolize these communities. All too often: as with cultural identity thinking and the environmental determinism of the green movement; the subjectivities of the cause i.e. cultural heritage conservation, energy consumption, carbon emission and waste management, are put before the social needs, cultural requirements and material realities encountered. Put before the social needs and cultural requirements of people as the human capital of civil society and in front of an enterprise culture that not only lies behind such capacity building exercises, but dynamic of the municipal strategies, which for “all-intents-and-purposes”, serve to do little more than add insult to injury. That add insult to injury because such anthropocentric, socially constructive and culturally relevant research exercises remain very top-heavy, downloaded onto the communities, which they are intended to serve, so what is done to them and by others, albeit in their name, is insufficiently organic for any such governance of the smart cities food agenda to be fully resilient.

This aside, however, it does need to be recognized that leveraging any such bottom-up transformation of cities into something smart is a matter, which can perhaps best described as a long-term venture. In particular, a long-term venture that does need to tap into such a “ground swell” of opinion, but with the foresight required for the digital technologies, data management, renewable energies and smart buildings of their transport and mobility to be “wise before the event”. In particular wise before the event by having the ability to ground any such system in the intellectual capital of a scientific and technological movement, which is equally capable of integrating the urban and regional innovation of any such bottom-up construction into the ecosystem of a sustainable community development. That is to say, a sustainable community development, which is rooted in and based on the direct democracy of participatory governance. In that sense, on the direct democracy of a participatory governance, which is able to cut deep into the triple bottom-line and possibility, such an urban and regional innovation in turn offers for any socially inclusive and culturally diverse structure of communication to act as the ecosystem of a post-carbon economy. The ecosystem of a post-carbon economy, whose climate smart food system does have the capacities needed for cities to be resilient in not only tackling the inequalities of the digital divide, or combatting fuel poverty, but insecurities this builds into and transports back in to system. Those insecurities this builds into and transports back into the system, as that very thing, which the participatory governance of smart cities requires to overcome in order for the food agenda to deliver on the affordability, nutrition, health and well-being that sustainable communities expected from the inclusiveness of their growth.

Conclusions

While the claims for the Expo to be a smart city may appear grand, if we examine them against the state-of-the-art on such developments, they do reflect much of what is currently known and understood about such matters. However, while such representations of their governance are valuable in verifying the status of the Expo as a smart city and opening up the opportunity there is to leverage the truly transformative capacities of cities declaring themselves smart, it appears very little is known about either the experimentation, or contestation surrounding the governance of the emergent food regime.

The reason for this is simple and lies in the:

- need for the transformational capacities of smart city governance, not to be represented in strictly technical, but wider social, cultural and environmental terms;
- requirement for the digital infrastructures, data management, renewable energies and smart buildings laid out in the Expo for the food sector, to be something more than a matter of sustainable growth;
- pressure to re-direct attention towards a set of standards, which meet the human expectations and social need for food and that cultivate the environments required of them, as a material condition of such developments.

To meet these expectations, needs and requirements in turn means mapping out the interdisciplinary landscape of the governance system which they set the parameters of as urban and regional innovations underlying the development of smart cities and deep restructuring of the ICT, energy, building, transport and food sectors this in turn supports. Instruments that include the models; networks, analytical frameworks and metrics, which make it possible to capture the governance of smart cities as the communicative structures of an ecosystem regulating the urban and regional innovation of what might be best termed: a fully resilient triple bottom-line.

Having presented the governance of smart cities in the form of such a critical synthesis, vis-a-vis as the urban and regional innovation of a climate smart food system, this examination of food, governance and cities has drawn particular attention to lingering concerns associated with the symbolism of such a master-signifier. In particular, the tendency there is for much of the research carried out to highlight the current shortcomings in government policy on the informatics, energetics and metabolic of sustainable development. More specifically, for policy to mainstream bottom-up approaches that at best serve to reproduce the status quo and which, at worst leave the human and social basis of the low-income communities they subject to such actions even more impoverished. Even more impoverished for having their prosperity sacrificed on a less than wise management of what the digital infrastructures, data management, renewable energies, smart buildings, transport and mobility of food systems, fail to secure in terms of the affordability, nutrition, health and well-being communities expect from cities.

That process of mis-management, which it is important to note, currently impact worse on the low-income communities of cities than any other. Not because they are any less resilient, but for precisely the opposite reason. For the reason their tightly knit human and social capital is the very thing, which puts the demographics of such communities in the culturally unique position of being able to secure an environment that in ecological terms has the resilience needed to meet the triple bottom-line sustainable development requirement everyone else falls short of. Which everyone else falls short of, because it is only the social demography of low-income communities that possess the means to cultivate the capacity needed for the ecosystem of cities to be resilient in meeting the environmental sustainability requirement of a climate smart food system. But, which in spite of possessing the capacities that makes strategies of this type resilient, still leaves the citizens of these communities standing somewhere between “a rock and a hard place”. That is in the most unfortunate position of being sufficiently resilient to meet this environmentally sustainable requirement, but firmly locked into the digital divide of a fuel poverty, which undermines the buildings, transport and mobility of climate smart food systems.

This aside, the symbolism of such a master-signifier does recognize that leveraging any such bottom-up transformation is something, which is at best a long-term venture. In particular, a long-term venture that does need to tap into such a “ground swell” of opinion, but with the foresight, which is also required by cities for the digital technologies, data management, renewable energies, buildings, transport and mobility of climate smart food systems to be “wise before the event”. Wise before the event by grounding any such system in the intellectual capital of a scientific and technological movement, which is equally capable of integrating the urban and regional innovation of any such bottom-up construction into the ecosystem of a sustainable community development, grounded in and based on the direct democracy of participatory governance.

In this instance, on the direct democracy of a participatory governance able to cut deep into the triple bottom-line and possibility, which the climate smart food system of such urban and regional innovation offers for the socially inclusive and culturally diverse structure of this ecosystem to act as a post-carbon economy. Act as a post-carbon economy, whose climate smart food system or such an urban and regional innovation to be resilient. needed for such an urban and regional innovation to be resilient Be resilient in not only tackling the digital divide, combatting fuel poverty, or unlocking the immobility, which insecurities of this type build into such systems, but in also meeting the requirement for their participatory governance to be equitable. To be equitable in delivering the affordability, nutrition, health and well-being communities expect of them.

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Rethinking Food Governance: Urban Innovations

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In recent years, burgeoning prices for basic foodstuffs (especially wheat and rice), growing concerns about the sustainability of the agri-food system under the effects of climate change, and the growing incidence of land grabbing activities in poor countries have been redefining the meaning and the geography of “food security” in four fundamental ways (Sonnino, 2014). First, food insecurity today is simultaneously a problem of under-, over- and mal-consumption that affects over one quarter of the world’s population in both developed and developing countries. Second, the problem has acquired a strong political dimension. The riots that followed the spike in fuel, food and energy prices of 2008 demonstrated that ensuring that all citizens have physical and financial access to nutritious food is a matter of national security, as G8 countries acknowledged at their first meeting on agri-food issues held in Italy in 2009 (Morgan and Sonnino, 2010). Third, the variation of food insecurity levels across different socio-economic groups has become extreme, especially in urban contexts. As Holt-Gimenez (2008) observed, the food riots that followed the price surge of 2008 exploded not in areas where food was unavailable, ‘but where available food was too expensive for the poor’ – that is, in cities. Fourth, there is a range of interrelated ecological pressures (over and above looming climate change) on all stages of the food system. In synthesis, an emerging literature shows that global food consumption patterns are decreasing the availability of water, which is widely utilised for processing foods (such as meat and dairy products) that form the basis of the Western diet (Collette et al. 2011). At the same time, urbanisation is exacerbating the problem of soil degradation (UNEP 2012), especially in developing countries, where the amount of land devoted to food production continues to decrease (Chappell and LaValle 2011). Global food security is further threatened by very high levels of food losses and waste that occur at different stages of the supply chain and that affect as much as one-third of the total amount of food that is produced globally (Sonnino et al., 2014).

Mainstream approaches to food security are unable to capture the systemic and evolutionary nature of this global food security crisis, locked as they are into oppositional narratives (e.g., sufficiency vs. efficiency) and obsolete dichotomies (production vs. consumption). As several researchers have argued, there is a need for a new policy agenda that accounts for the context-dependent manifestations of the new geography of food security and, more broadly, for the ‘deeply inter-locking nature of economic, social and environmental systems’ (Misselhorn et al. 2012: 10). Quoting Lang (2010: 94), ‘the new era’s policies must assume the connections between

environment, social justice and health'. In practice, this entails a shift from the conventional policy tendency to address single issues to the adoption of a systemic perspective that takes into account the interrelatedness of the whole food chain and of the whole food cycle (Lang and Barling, 2012: 318).

Urban governments are at the forefront of this new policy agenda. At a time when most of the world's population is urbanized, "cities have acquired a new role: namely, to drive the ecological survival of the human species by showing that large concentrations of people can find more sustainable ways of co-evolving with nature" (Morgan and Sonnino, 2010: 210). The driving force behind these newly envisaged roles, we will argue, is predicated upon two factors. Firstly, a desire to harness the power of established civil society groups and 'bottom up' local movements that align with the wider interpretations of 'sustainable food security' (see, for example Dwiartama and Piatti, 2015 and Allen, 2008). Secondly, the desire at the local level to fill the policy vacuum that has been left by national policies, entrenched as they are within a larger scale productivist paradigm (Lawrence et al., 2013; Sage, 2012; and Godfray et al., 2010). These policies, which follow the mainstream approaches to food security, have at best little, and at worst negative, impacts upon individual abilities to provide household food security (see Frankenberger and McCaston, 1998) within their local foodscape (Dowler and O'Connor, 2012; MacMillan and Dowler, 2012).

The recent proliferation of urban food strategies, charters and plans, and the establishment of multi-actor partnerships such as food policy councils, show that in many countries (particularly in the global North) city governments are indeed rising to this grand challenge, and solidifying their roles as food system actors. Although it is still too early to assess the tangible impacts of these initiatives, the literature has highlighted their transformative potential, especially in relation to the new variable spatial, socio-economic and ecological 'fixes' that they are attempting to create (Marsden and Sonnino 2012).

Much less attention has been paid to the governance innovations associated with the emergence of urban governments as new scalar food policy actors. This chapter aims to contribute to fill this gap through an analysis of the narratives of urban food strategies from the UK and North America. Why do cities perceive the need to break away from the wider national and global food governance context? How do they relate themselves with other levels of governance? More broadly: what type of relations do urban food strategies envision between different food system actors and activities?

Urban Food Strategies: the Multi-Level Governance Context

Reacting to the atrophy of the global and national policy approaches, urban food strategies often emphasize the unique role that cities can play in pioneering a systemic transformation of the food system. The primary step in establishing support within the multi-level governance context is to embed the urban and local food strategies into the local institutional fabric and

create reciprocal connections between the groups who have helped produce the documents (such as civil society groups) and the governance institutions endorsing and championing them. In many cities, the process of developing food charters and strategies originated with civil society groups and food activist movements. This is the case, for example, in Cardiff, where the original Food Charter was developed by a large group of interested parties led by a prominent local food social enterprise. The process itself led to the formation of a food council facilitating links between civil society groups and the local administration. In Bristol, the first food charter was developed by the Bristol Food Network (BFN), a community interest company that “supports, informs and connects individuals, community projects, organisations and businesses who share a vision to transform Bristol into a sustainable food city” (Bristol Food Network, 2014). The local authority also developed their own internal food charter before the members of both intersected into what became the Bristol Food Policy Council producing the Bristol Good Food Plan. Plans such as this one are a symbolic statement of how civil society groups such as the BFN are assimilating and making connections into their most immediate governance scale: the local.

The emphasis on the transformative potential associated with the lower governance scale (the urban) never translates into a defensive, autarkic or self-referential approach to food system change. Quite the contrary, urban food strategies aim to build capacity along the vertical governance axis – or, in simple terms, to create or strengthen connections between the urban, regional, national and global scales. Such connections have a bidirectional flow. On the one hand, cities explicitly re-cast themselves as sites of experimentation - or, as stated in New York City’s strategy (New York City Council 2010: 3), as models “of how targeted local action can support large scale improvements”. Similarly, the English city of Sandwell, in its ‘Growing Healthy Communities Strategy’, recognises its unique position in producing a strategy that was “the first of its kind in the UK.” Significantly, Sandwell is casting itself as a site of experimental learning not just internally, but for other urban and local areas following their lead: “we recognise that implementation of an ambitious strategy for expansion and coordination of an extended community agriculture initiative will take time, commitment and resources, and will be a continuing process of listening, learning and improving... We will be leaders in the field of community agriculture at a Boroughwide level, and will have a good deal to learn, but the learning that will take place will be valuable to other urban authorities that will follow” (Sandwell PCT and Sandwell MBC, 2008: 31).

At the same time, however, urban food strategies raise the need for support at higher levels of governance. Faced with specific constraints created by a wider economic context that makes cities ‘net importers of food’ (Manchester City Council 2007), subject to market forces and vulnerable to changing consumer preferences (London Development Agency 2006: 17), urban governments request targeted forms of intervention from their national policy-makers. New York City, for example, invokes a re-orientation of farm subsidies at the federal level to support the production of healthy food (e.g., fresh fruit and vegetables). The city of Philadelphia, on its part, turns to its regional government to request the introduction of new tax policies that incentivize fresh food production for local markets (Sonnino, 2014). In the UK, the narratives

emerging through these novel food strategies takes a more critical tone in calling for higher level support. The Bristol Good Food Plan, for instance, comments: “to reform the food system in this integrated way has not yet been built into any UK local government policy and strategy, in fact on a national level food exists in 19 different government ministries. Nor could a local government achieve such changes alone. It requires the commitment and proactive participation from a wide range of city and city region stakeholders”(Bristol Food Policy Council, 2013:9). In County Durham’s Sustainable Local Food Strategy, there is an acknowledgement that “Any food strategy sits within wider global, regional and local contexts, which can both limit and enable what can effectively be achieved. Much of the food we eat in the UK is part of a highly complex globalised food system where food chains can become long and not always transparent...” The strategy goes on to note that the national governments approach food security has fallen short of the required task of “re-connecting people with food” before stating; “This Strategy attempts to address some of these issues by encouraging actions that enable more people to become directly involved...” whilst pertinently remarking that “A local Food Strategy cannot hope to address broader structural issues causing poverty and ill health” (Charles and Durham Community Action, 2014). The implications of such statements suggest a need for stronger support from national governments.

In short, the first important governance novelty that cities are introducing is a relational approach to localization. Urban food strategies are not designed to create bounded foodscapes with a local territorial identity. The effort here, as the analysis of the horizontal governance axis will also show, is to progress a flexible and inclusive localism that creates positive and synergistic connection between policy actions at different scales. As we will argue in the next section, this “new localism” (Sonnino, 2014) has important implications for the ways in which cities attempt to reconnect with their rural hinterland.

Urban Food Governance: The Horizontal Axis

One of the most significant aspects of the new localism is a broadening up of the notion of “local” beyond the municipal boundaries. Most urban food strategies recognise the potential of the ‘local/urban’ (as defined by New York City) in enhancing food production, and there is widespread support for urban agriculture and community growing schemes in relation to both food security and sustainability objectives. However, the main focus of the urban food narratives is what New York City Council defines as the ‘local/regional food system’, which is seen as crucial to address food security concerns. As stated in Los Angeles’ food strategy: “while the benefits of urban agriculture are significant to individuals and neighbourhoods, poverty and hunger... exist on such a massive scale that supporting urban agriculture should only be viewed as a supplement, not a replacement, strategy to solve food insecurity and improve food access” (Los Angeles Food Policy Task Force 2010, 26).

Regions, and the connections between municipal organisations within them, are also given prominence in many strategies in the UK. The surrounding ‘South West England’ region, for

example, is an important feature of the Bristol Good Food Plan. Indeed, one of the strategy's key objectives is to "increase procurement of regional staples, and establish more markets for local producers." (Bristol Food Policy Council, 2013: 22) This objective recognises the role of the wider region in shaping the local foodscape for the better and suggests support through "an established network of retail markets could provide fresh, seasonal, local & regional foods throughout the city." (*ibid.*: 23).

Significantly, many North American cities utilize the term "foodshed" to broaden the definition of local food, taking into account, as stated in San Francisco's food strategy, not just territoriality, but also a series of quality attributes such as agricultural production methods, fair farm labour practices and animal welfare (Thompson et al. 2008: 4). Likewise, Los Angeles associates the concept of 'foodshed' not just with food production and consumption, but also with a range of regional economic, employment, demographic and environmental indicators (Los Angeles Food Policy Task Force 2010). As Toronto's food strategy states, "the strategic challenge is to build the links within this common foodshed" (Toronto Public Health Department 2010: 7) - a refashioned foodscape in which the city, the countryside and all different actors and stakeholders that occupy their spaces are reconnected, physically, culturally, environmentally, socially and economically. Quoting Manchester's food strategy (Manchester City Council, 2007: 19): "At present... the model is a chain in which food is produced outside the city, brought in, sold, consumed and the waste and packaging disposed of, generally outside the city again... There is considerable scope for... creating a closed loop system [that] would attempt to reconnect the city to the food it consumes and reduce the environmental impact of food consumption".

Further to expanding the productive and consumptive foodscape beyond the local municipal boundaries, strategies are creating governance connections at the regional level to enable horizontal integration. Coming back to Bristol, the Good Food Plan states that their "... approach to food is both daring in scope and ambition; its aim is a Sustainable and resilient Food plan integrated on a regional level." (Bristol Food Policy Council, 2013:7). This statement of commitment to the wider hinterland to which the city belongs is echoed in the Bristol Food Policy Council's efforts to work with their surrounding unitary authorities. One of these is the Bath and North East Somerset authority, which has produced its own local food strategy. Significantly, this document also makes a commitment to "engage with West of England Partners to address gaps in local infrastructure and to co-ordinate opportunities for local food supply" (Bath and North East Somerset Council, 2014:18).

As with the calls for vertical support described above, strategies in the UK note that the absence of institutional frameworks does not and should not interfere with a more enlightened perspective on the local/regional foodscape. Durham, for example, makes explicit the need to create regional links for the good of local food even where regions lack formal relations: "Although the English Regions lost powers and investment with the demise of the Regional Government Offices and the Local Development Agencies in 2011 the North East continues as a constituency for the European Parliament and retains a strong local identity. Local food does

not recognise administrative boundaries and it is important that we maintain close links with other areas in the region.” (Charles and Durham Community Action, 2014:7).

At the other end of the scale, these strategies are both ratifying action on the local/regional foodscape, whilst also recognising their role in the wider system and the impact and potential impact they have on global food security. Strategies and charters such as in Cardiff include a moral and ethical dimension, as illustrated in one of their principles of fair food: “Good working conditions and fair pay: Workers throughout the food chain, both in Wales and abroad, should have good working conditions and be paid fairly for their work and produce.” (Food Cardiff, 2014:2). Comparably, Manchester’s food strategy includes ethically and fairly traded and produced food, emphasising that: “Food production and trading should only use fair pricing and ethical employment for and by producers, in the UK or overseas.” (Manchester City Council, 2007:17). Such statements incorporate the appreciation that these cities hold for the wider implications of food security and not just how it impacts upon the local people and foodscape, but how it in turn can have repercussions in other, often geographically distant, locations. The examples described demonstrate an implicit recognition of cities’ role in global food security. In this sense, a more explicit expression is found in Birmingham’s (UK) food charter, which lists global food security amongst their four priorities -- a significant development in comparison to the examples mentioned above. As proclaimed in their website, “although Birmingham can do next to nowt about global food security in terms of food production, we citizens still have a significant role to play as consumers, and our Council in setting up infrastructures that promote certain kinds of behaviour...” and promotes ways in which its citizens can “...support and encourage research into global food security, and encourage infrastructures that enable all of us to do the best we can to mitigate against famine, hunger and malnutrition.” (Birmingham Food Council, 2015).

Terms such as “connection” and “reconnection” are quite pervasive in the narratives of urban food strategies, and introduce us to two other significant governance novelties that are emerging at the urban level. The first is an effort to connect food to wider sets of public goods. Concepts such as “freshness” and “healthiness”, which are widely deployed in the narratives of urban food strategies, are never discussed in isolation. Rather, there is a widespread attempt to connect them directly with other sustainability goals. Brighton and Hove was one of the earliest cities to stress in its food strategy the relationships that the food system has with ‘social equity, economic prosperity, environmental sustainability, global fair trade and the health and well being of all residents’ (Brighton and Hove Food Partnership 2006: 1). Similarly, Toronto envisions a “health-focused food system” that “nourishes the environment, protects against climate change, promotes social justice, creates local and diverse economic development, builds community” (Toronto Public Health Department 2010: 6). Los Angeles uses the notion of ‘good food’ to frame its vision for a food system that ‘prioritizes the health and wellbeing of our residents [and] makes healthy, high-quality food affordable’, while also contributing to enhance the urban environment, create a thriving economy and protect and strengthen regional biodiversity and natural resources (Los Angeles Food Policy Task Force 2010: 11). Conversely, Bristol has developed the notion of ‘Good Food’, which is described in the Bristol Good Food

Charter as “good for people, good for places and good for the planet” (Bristol Food Policy Council, 2012:3). Using this cross cutting concept of ‘good food’ is important to highlight the inherent links in the food system as well as its wider positive outcomes, showing how food can encompass all three hallmarks. Cardiff’s food charter similarly notes that “good food means fair food: it should be good for people, good for the place we live in, and good for our planet, as well as being affordable and nutritious”; at the same time, it also makes explicit the potential of food to bring a multitude of positive community benefits: “The food we consume has a huge impact on life in Cardiff—not just on our health, but also on our communities, businesses and the environment.” (Food Cardiff, 2014:1). A further example of this holistic interpretation of the benefits provided by a more secure and sustainable food system is provided by the Philadelphia’s plan, which emphasizes the potential of food in terms of “strengthening the agricultural sector, improving public health, protecting soil and water resources’ and, more broadly, ‘encouraging diversity, innovation and collaboration” (DVRPC 2011).

In practice, urban efforts to connect food to other public goods have originated the emergence of what Brighton and Hove (2006) calls “an integrated, cross-sectoral approach to food policy”. There are two main examples of food policy integration that need to be mentioned here. The first is a conscious effort to connect food with other policies and sectors. Los Angeles, for example, raises the need for “integrating local food system planning into our region’s Climate Action Plans, Regional Transportation Plans and other regional planning documents” (Food Policy Task Force 2010); Newquay’s food strategy argues that the development of “reliable markets for local food growers, fishing communities, processors, caterers and retailers” can make a significant contribution to the objectives of its sustainability strategy – namely, limiting the population’s greenhouse gas emissions and ecological footprint and enhancing regional economic development (Duchy of Cornwall and SUSTAIN 2007: 7–8). Cities that have realised this integration include Brighton and Hove. Indeed, the aims stated in its food strategy include supporting “networking opportunities to encourage links between sectors” and ensuring “local policy and planning decisions take into account food issues” (Brighton and Hove Food Partnership, 2012:4). This long standing dedication to “ensure that food work is prioritised in strategy at a city level” (*ibid.*) has been fruitful, as food, in its various secure forms, has been included in a number of city wide policies. For example, local food is included in the City’s local planning framework; local and sustainable food is one of the 10 key principles of the ‘One Planet Living Strategy and Action Plan’ (Brighton and Hove City Council, 2013; and, as of 2014, there was a dedicated food section added to the overarching Sustainable Communities Strategy, which makes specific reference to the food strategy as an achievement for the city: “Spade to Spoon Digging Deeper, the refreshed food strategy, was adopted with cross-party political support in 2012” (Brighton and Hove City Council, 2014). Similarly, since launching the Food Charter in Cardiff, the council has formally signed up and adopted it, integrating the key messages strategically across their own strategies. The ‘One Planet Cardiff’ sustainability strategy for the city includes a section on food that lists one of their actions as supporting “the Cardiff Food Charter and the Cardiff Food Council and promote healthy sustainable and ethical food as part of thriving local economy” (Cardiff Sustainable Development Unit, 2013:4)

The second example of policy integration has to do with the establishment of new institutional arrangements that aim to facilitate coordination at the implementation stage. Chicago, for instance, advocates the establishment of a specific non-profit regional food entity that “should be represented by a variety of members (economic, environmental, transport, agricultural, public health, etc.) to analyse and support food policy issues from a comprehensive perspective and coordinate federal grants and loan programs” (Chicago Metropolitan Area for Planning 2010: 156). Los Angeles also suggests the establishment of a “regional food policy council” (Los Angeles Food Policy Task Force 2010: 28).

The Bristol Good Food Plan describes how a similar group was established following recommendations of research that underpinned the development of the plan: “The Bristol Food Policy Council was launched in March 2011, in order to help drive forward the recommendations from the Who Feeds Bristol report. Bristol is the first city in the UK to have a Food Policy Council. The Council members are drawn from different sectors of the food system, and give their time voluntarily. Administrative support is provided by Bristol City Council.” (Bristol Food Policy Council, 2013:32)

The novelty here has to do with an explicit focus on enhancing participation in the design and implementation of food policy. As stated in New York City’s food strategy, food policy councils can play an important role in eliciting “non-governmental input on policy changes” (New York City Council 2010: 75). This quote echoes recent work on food security governance by Candel (2014), who has emphasized importance of involving civil society in food security governance contexts. As he argues, civil society is in a unique position to identify local problems and response gaps, to enhance public support for food policy intervention and to build capacity across institutions, policy sectors and governance scales. Moreover, the strategies show a unique comprehension that as well as requiring civil society and ‘non-governmental’ support to recognise the local needs and gaps, multi-stakeholder involvement is essential in ensuring the long term success of these local initiatives. As outlined in Sandwell’s Community Agriculture Strategy: “Political and organisational leadership and robust partnership working between Sandwell’s local authorities and voluntary and community organisations will be essential in achieving the aims of the Strategy. This will be a shared endeavour but responsibilities for key steps will be clearly identified. Strategic and service level commissioning which values shared outcomes such as improved public health, social inclusion, and community cohesion will be required.” (Sandwell PCT and Sandwell MBC, 2008:27). This represents the view that connections with a wider set of actors beyond the traditional policy setting are also bidirectional and that a reciprocal relationships contribute to the capacity building between and within these various sectors and actors.

A final way in which these urban innovations are creating horizontal connections is geopolitically, linking across the translocal scale to form a network of cities who collectively gain the capacity to span larger geographical and higher political scales. Examples of these include the Milan Urban Food Policy Pact, the Sustainable Food Cities Network in the UK, the FAO’s Food for Cities global network and the Food Policy Networks project currently being

developed by the Centre for a Liveable Future at Johns Hopkins University in North America. The latter project has been described as developing “effective and robust food policy at the state and local levels by working with existing food policy councils, national organizations and other interested groups.” Recently conducting a review of partnerships and strategies across North America, “The Food Policy Networks is poised to enhance and amplify the impact... by building the capacity of local, state, regional, and tribal food policy organizations to forge working partnerships and to become more effective policy players.” (Center for a Liveable Future, 2015).

In a similar vein, The Sustainable Food Cities Network in the UK aims to provide support to cities and urban areas who are developing strategies and charters and associated partnerships to govern them. Membership of the network is open to “Any town, city, borough, district or county can join the Sustainable Food Cities Network as long as it has a cross-sector food partnership working to create a better food system. The key is that you are willing to share your successes (and your failures!) and are interested in learning from others” (SFCN, 2013). Emphasising the peer to peer learning and knowledge exchange is at the heart of the network. Further, the network also provides support and advice for localities seeking to drive the three positive changes of “establishing an effective cross-sector food partnership; embedding healthy and sustainable food in policy, and developing and delivering a food strategy and action plan” (SFCN, 2013), which in effect reinforces the horizontal connections analysed above. In short, knowledge exchange and capacity building are key mechanisms through which these translocal networks are developing to create horizontal connections and a more relational approach to this renewed vision of a ‘local foodscape’.

Urban governments, in short, are reframing food security as a “polycentric” governance arena that is fostering an inclusive and more collaborative political sensitivity within and between cities. At the urban level, we are witnessing the emergence of much needed examples of policy integration that are fostering the multifunctional potential of food in relation to human and environmental health, social and spatial justice and economic equity – the main domains affected by the unfolding of a new geography of food security. Globally, initiatives such as the Sustainable Food Cities Network in the UK, the Milan Urban Food Policy Pact and FAO’s Food for Cities network show that the re-ordering of food rights, governance and assets in one place leads to cross-over of learning and reflexivity in others. For both policy-makers and researchers, there are new important questions that need to be raised about the mechanisms needed to consolidate these emerging “translocal assemblages” (McFarlane, 2009) and enable them to continue to scale up, scale out and scale down their radically new visions for the future of food.

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Smart Cities Food Governance: Critical Perspectives From Innovation Theory And Urban Food System Planning

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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 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, 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. 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).

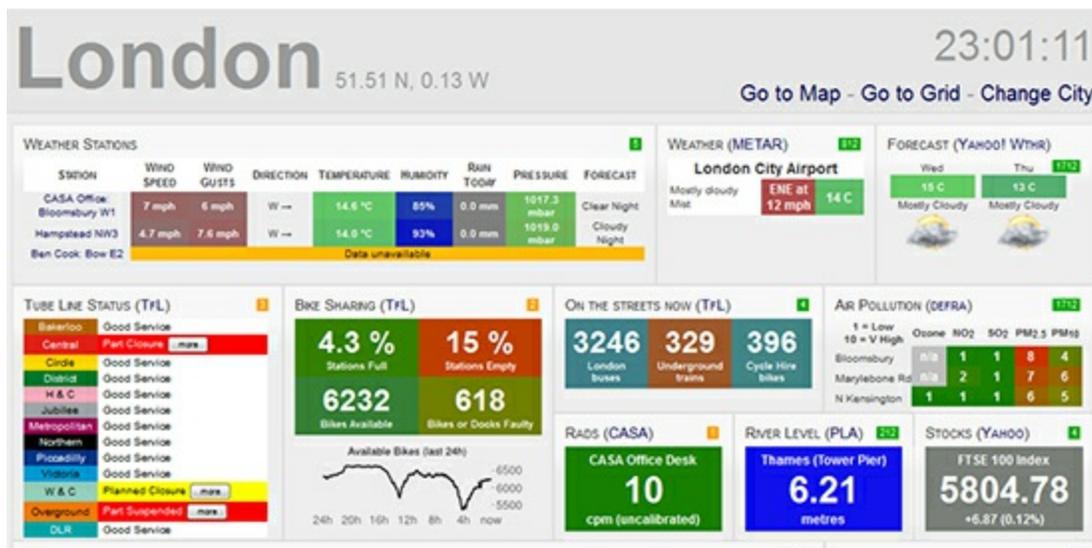


Figure 1: The London City Dashboard

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, competitiveness 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 being 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 stacked 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 developed 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 technocratic 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 heat 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 non-tangible, 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 be 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 insecurity, 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.

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Tools For Metropolitan Food Planning - A New View On The Food Security Of Cities

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1. Introduction

Given the simultaneous presence of several factors affecting the agricultural potential of metropolitan regions, and considering the recent societal debate on food autonomy in the context of food security and sustainability, the 'reconnection' between food demand and supply emerges at policy agendas at both the national and international level. Tackling this phenomenon, FOODMETRES has put forward the concept of Metropolitan Agro-Food Systems as the space where urbanisation processes related to urban (food) consumption, recreational behaviour and preferences, infrastructure and urbanisation meet within a distinct eco-functional and socio-political context. Metropolitan regions must therefore, be considered as extremely dynamic in terms of extension, land use changes and landscape character. In order to frame, communicate and manage the impacts of urban food consumption on metropolitan regions, we develop a string of successive, yet complementary footprint assessment tools:

- (1) the Metropolitan Economic Balance Assessment (MEBA), a measure for framing aspects of food security and supply at the statistical meta level of urban metropolises;
- (2) the regional Metropolitan Area Profiles and Scenario (MAPS) demand tool, for producing scenarios at the level of administrative units;
- (3) the European Metropolitan Foodscape Planner (MFP) supply tool, an interactive, spatially dynamic approach at the land use level based on GIS-technology.

Used apart or in combination, this new generation of tools operates at both the European as well as the national-regional level, offering analytical, comparative and communicative support to food planning. This paper explores the tools' capacity to contribute to informed food policy making at the examples of three metropolitan regions, namely Berlin, London, Milan and Rotterdam.

1.1. Assessment of Metropolitan Agri-food system

Within the debate of urban resilience and metabolism, reduction of ecological footprint and self-sufficiency (Wackernagel et al. 2006; Grewal and Grewal 2012; Barthel and Isendahl 2013), local food production, regionalized food systems and the shortening of supply chains, have gained increasing importance (Goodman and Goodman 2009; Sonnino 2009). Here manifold benefits, such as the reduction of urban food insecurity (Opitz et al. 2015) and disruption to global food supply (Godfray et al. 2010), are coupled with greater resource efficiency (Mundler and Rumpus, 2012) and competitiveness (Sage 2003; Nousiainen et al. 2009; Kneafsey et al. 2013). Benefits that have in turn encouraged many metropolitan jurisdictions, e.g. London (Reynolds, 2009), Toronto (Blay-Palmer 2009) and Belo Horizonte (Rocha and Lessa 2009), to develop food policies, which aim to foster local systems and reconnect cities with their food sheds (Pothukuchi and Kaufman 1999; Jarosz 2008).

Such as with other fields of policymaking, food policies also require a sufficient informational and knowledge base to carry out effective actions (De Smedt 2010). Consequently, questions regarding the local and regional food production and consumption, economic viability and the food chain organisation arise (Illbery et al. 2005; Mok et al. 2014). Essentially an accounting tool and not a forecasting tool, Ecological Footprint assessments rely on ex-post input variables when measuring the spatial impacts of current food consumption (CEC 2008). They do not contain feedback loops that would link today's decisions with resource consumption in the future, or today's resource consumption to impacts occurring in the future. At the same time, in reconnecting territorially food production and consumption, the need for analysis tools has grown. Several studies focus on defined areas and deepen the topic of the relations between demand and supply, in relation to the capacity of the local system in providing required amounts of food, i.e. the assessment of a simplified food balance expressing food self-sufficiency and reliance (Timmons et al. 2008; Mok et al. 2014). A rich literature concerns this kind of assessment in several contexts according to different, though interrelated, models of analysis (Murdoch et al. 2000; Hinrichs 2003; Illbery et al. 2005; Qazi and Selfa 2005; Barham et al. 2005; Porter et al. 2014). They refer to the assessment of potentialities or the quantification of the current capacities of agro-food systems and can be grouped into three main categories:

- (1) Demand-based models: models that evaluate, based on population needs, the theoretic supply in terms of quantities needed or land required (footprint);
- (2) Supply-based models: models that, starting from the production capacity of the territory, estimate how many people can be fed (potentialities);
- (3) Demand-supply models: in this case, based on the real consumption and the real production of a region, rates of self-sufficiency are obtained.

Demand-based models analyses data and information about food consumption and dietary patterns, in terms of either quantities or nutritional value, and quantify the supply needed to potentially meet food demand (see for examples Gerbens-Leenes and Nonhebel 2002; Billen et al.

2009; Desjardin et al. 2010; Zhen et al. 2010; Darrot et al. 2014). Supply-based models indicate the number of people that can be fed with current or future food supply and provision. Realistically, being a city not able to provide resources within its own boundaries, Porter et al. (2013) considered the necessity for a city to depend on productions from remote landscapes. More recently, Cassidy et al. (2013) re-thought the issue of agricultural productivity, shifting the focus from tonnes per hectare to people fed per hectare, and demonstrated that calories produced by an agriculture exclusively directed to human consumption would potentially increase by 70% and feed additional 4 billion people.

Demand-supply models are based on the comparison between actual/current food supply and actual/current demand, expressing this relation either in quantitatively and in relative terms, through an index of self-reliance, defined as the ratio between the amounts. Different studies operate by developing self-sufficiency indexes themselves, as in the case of Ostry and Morrison (2013). Other studies conduct comparisons between offered daily (or annual) servings of food in relation to the total recommended dietary requirements per head of population (Giombolini et al. 2011). As well as those between food requirements and actual production of food grains (Mohanty et al. 2010) or combined food availability data at household level, with country-specific land use data for food items, by determining the required cropland associated with dietary patterns (de Ruiter et al. 2014).

1.2. Contribution by FOODMETRES Approach

Funded by the European Union and running over a period of three years, the FOODMETRES (Food Planning and Innovation for Sustainable Metropolitan Regions) has involved 18 academic and business partners who engaged in a variety of research, tool and capacity-building exercises. The project incorporated an international dimension as well as focussing on concrete cases at the regional level in and around the cities of Rotterdam, Berlin, London, Milano, Ljubljana, Rotterdam and Nairobi. FOODMETRES has developed a series of technical references and decision support tools allowing stakeholders from agro-food business, governance and civil society organisations to enter a knowledge-driven debate on how to optimize the regional supply function of metropolitan areas around cities, by means of sustainable and innovative food chain planning and governance initiatives. The project's novel approach lies in the combination of two distinct yet closely interrelated strands of metropolitan agro-food systems; namely the *spatially explicit dimension* of regionally grown food in terms of 'local footprint hectares' necessary to feed the respective urban populations on the one hand, and the concrete innovation potentials for short food supply chains linking consumers with regional producers on the other (Wascher et al. 2015).

The modelling approach addressed in the FOODMETRES project particularly focusses on the spatiality of metropolitan agri-food systems (AFS). It elaborates the question of area-wise relevance of food demand and food supply (Which relation is there between demand and supply?). The Metropolitan Economic Balance Assessment (MEBA) tool represents the starting

point of a comprehensive cascade of complementary models. The MEBA applies an economic approach to assess the food demand-supply balance within a metropolitan region. Based on the calculation of quantitative elements expressing the relation between food production and consumption at staple food level, such an approach reveals the chances of getting them closer and serves as a tool for the assessment of performances of regional agro-food systems.

The Metropolitan Area Profile and Scenario (MAPS) tool adopts a straightforward data-driven approach of connecting regional food demand (local hectares) with the regional area productivity. The tool's objective is to assess the spatial extent of the agricultural area required for food production ("How much area is needed?"). Its main strengths are (1) the spatial representation (mapping approach), (2) model differentiation of commodity types, (3) the ability to apply different food production regimes (e.g. organic farming, food loss) and consumption patterns (e.g. vegetarian, healthy diets) or population scenarios, and (4) the analysis of theoretical self-sufficiency levels at different administrative levels.

The Metropolitan Foodscape Planner (MFP), in addition, addresses the question of the spatial distribution of the various land use types, which are required for the production of specific crops ("Where to produce?"). This tool offers:

- (1) hands-on assessment allowing stakeholders to re-allocate commodities on a digital mappable;
- (2) quantification and geo-referencing of up to 10 commodity types at the scale of 1 hectare-grids;
- (3) the analysis of self-sufficiency based on a regional concept consisting of four metropolitan food zones;
- (4) landscape-ecological allocation rules to base land use decisions on sustainable principles;
- (5) European data such as EFSA, LANMAP, HSMU and CORINE Land Cover to allow future top-down tool applications for all metropolitan regions throughout the EU.

The described modelling approaches differ not only in terms of methodologies, but also regarding the input data (national/European), modelling rationale (demand-/supply-oriented) and the degree of stakeholder interaction (mappable interaction only in case of MFP). However, the models apply a common spatial understanding of how to minimize the distance between food production and consumption location (urban core), resulting in an idealized circular representation of food zones, comparable to the renowned model by Heinrich von Thünen (1826) about the spatial distribution of agricultural commodities as a function of transportation cost to the central market.

In this paper, we will introduce three modelling approaches (MEBA, MAPS, MFP), which have been developed in the FOODMETRES project and show their applicability in the four case study regions. Our central research question is to what extent food security of urban metropolises can rely on the surrounding metropolitan agricultural food systems (AFS). In other words, we want to find out the degree to which, the metropolitan Agro-Food System is able to

feed the population of its urban core and adjacent agglomeration. In the second part of the paper, we aim at approach the question of regional self-sufficiency in food supply from a more practical side by exploring the opportunities and requirements for a strengthened metropolitan AFS by the implementation of innovative food chains. We shed light on the required setting of political and economic framework conditions to encourage short food supply.

2. Methodology and Modelling Approach

2.1. Footprint basics: demand and supply

Food demand and supply are the two key dimensions of tools for metropolitan food planning. Food demand results from the average feeding habits of the urban population expressed in the dietary energy, protein and fat consumption per person. Typically, such data is only available as the national average and not per city. Given the size and biogeographic range of most European countries – France covering North-Atlantic influences, Alpine and the Mediterranean zone being probably the only exception – average figures can be considered as acceptable. Food habit surveys provide information resulting from the combination between qualitative (What is consumed?) and quantitative (How much is consumed?) aspects of food consumption. It particularly varies according to geographical area and country, economic, social and cultural aspects, population diets, available food items. FAO statistics (FAO, 2015) give a first response to this issue, summarizing and making easily comparable daily consumption for countries all over the world.

Food supply can be referred to land use and available agricultural area in a specific territory or in relation to the amount of obtained raw products (quantities or productivity). This does not mean, however, that these productions still remain confined to only local regions, since large proportions of our food products derive from the global market. This condition restricts the possibility to limit food supply to the local sphere, as it is more precisely affected by all the components of commercial balance, from productions and stocks, to imports and exports.

2.2. Case Study Regions

For the purpose of illustrating the methodologies of the different metropolitan footprint assessment tools, what follows shall focus on a subset of the project's original six case study regions; namely Berlin, London, Milano and Rotterdam. The metropolitan areas of Nairobi have been left out here to reduce complexity when developing the key messages and because both cities deviate in terms of biogeographic location (Africa) and size (Ljubljana) from the others.

Table 1 illustrates the differences between the four selected CSA in terms of population size for the urban core, as well as the wider metropolitan region, the area size in square kilometres, the proportion of agricultural land in both square kilometres and percentage. London is by far

the largest city, followed by Berlin. Rotterdam City Region and Milano are almost of equal population size, but differ substantially in term of the metropolitan region's territory and agricultural land.

Table 1: Population and agricultural area of the four case study regions

<i>Case Study Regions</i>				
<i>Core city</i>	<i>Berlin</i>	<i>London</i>	<i>Milan</i>	<i>Rotterdam</i>
<i>Administrative region</i>	<i>Berlin & Brandenburg</i>	<i>London, South-East & East England</i>	<i>Lombardy</i>	<i>South Holland City Region</i>
Population core city 2015, in 1000 inhabitants	3,502	8,174.	1,242	1,209
Population region 2015, in 1000. inh.	6,037	22,656	7,885	3,695
Total area, in km ²	30,530	38,260	13,111	2,819
Utilisable Agricultural Area (UAA), in km ²	14,576	26,566	4,892	1,685
Share UAA, in %	47.7	69.4	37.3	59.8

2.3. The Metropolitan Economic Balance Assessment (MEBA)

The MEBA model aims at assessing the potentialities for the reconnection of demand and supply in the territory. A multidimensional perspective is used to describe this relation through the simultaneous assessment of different aspects of self-sufficiency expressing the fulfilment of demand in terms of quantities, calories and economic value. Such an approach is aimed at obtaining information that provides the quality of the agro-food system of any region, in relation to: (i) the degree of compliance with food habits and food diet; (ii) the level of food security, defined here as the capability of the system to ensure nutritional and caloric requirements expressed by the population dietary pattern, and (iii) the economic balance of the area and the exposure of the system to global markets. To each of these aspects is associated a respective index, as the ratio between supplied and demanded amounts.

The first dimension concerns the quantitative dimension of food demand (i.e. the consumption) and supply (i.e. the primary production). The amount of per capita consumption depends on specific dietary pattern and finally affects total consumption in combination with the population size of the area. It is therefore clear the latter element is the main driving factor in determining food needs within a territory. On the other hand, the capability of the system to

provide food and meet demand varies according to the available agricultural land use area, to the suitability of the territory itself and to the specialization of the primary sector, especially under particular agro-climatic conditions it has to operate in. As a result, peculiar features of the “production-consumption” patterns in the different regions are identifiable at staple food-level, giving preliminary indications on the potentialities of the system in responding to the compliance with diet.

Dietary habits are also reflected in total caloric intake provided by the diet itself, while supplied quantities affect the availability of one or more specific energy source. It must be specified that in Western or European contexts the “food security” issue scarcely emerges: even if in strongly urbanized contexts the agricultural production is traditionally limited and the city-region is not able to feed itself with its own resources, an efficient system of accessibility and logistics can ensure the distribution of food across the region, certainly augmented by productions from remote landscapes (*Porter et al., 2014*), with problems of food accessibility and affordability limited to a minority of the population.

Concerning the economic aspect, the production value generated by the agricultural system, compared with the corresponding value of staple foods consumed by the population, aims at deepening the potentialities of the system in reconnecting demand and supply, apart from the actual trade balance, import/export flows and value added generated through the food chain. In this case, whenever an incomplete self-reliance and consequently a negative economic balance occurs, an eventual new value generated (by process or product innovations) in the territory could potentially be retained there, balancing the equivalent amount of the economic dimension required through the diet.

2.4. Metropolitan Area Profiles and Scenario (MAPS)

Focussing at the spatial extent of the footprint of food production, the *Metropolitan Area Profile and Scenario (MAPS)* tool represents a spatial model which takes both parameters of regional yields and diets into consideration, broken down to a set of commodity groups. This allows the model’s sensitivity regarding alternative agricultural systems (conventional and organic), reduction of food loss and waste, different diets (given and health recommendations) and temperate domestic and necessary global production. It is the main objective of the MAPS tool to develop an easy-to-adopt approach to spatially assess the necessary agricultural area to supply a pre-defined city, metropolitan area or region. It further should allow for comparative assessments of area demand for food production (based on regionalized agricultural production, diets and population data), scenario analysis of effects of organic, healthy or vegetarian diet change, prevention of food waste and loss and the regional self-sufficiency.

Scenario Application

As one of the main objectives of the MAPS tool, various food demand-supply scenarios can

be applied to the reference situation. These scenario settings can include variations of the agricultural production system and intensity, such as extensive production, organic farming, intensive greenhouse production or forms of sustainable intensification. As an example of different agricultural production intensities, we have differentiated conventional production (reference system) and organic production. Therefore, the meta-analysis of Posinio et al. (2014), who have reviewed and interpreted a high number of empirical studies on yield differences between conventional and organic production. The authors found a range from in average lower yields of 19.2% to 8.5% (with multi-cropping and crop rotation) to conventional production.

In addition, potentials through the reduction of food losses and waste are taken into consideration. According to the Food and Agriculture Organisation (FAO) food losses and wastes sum up to about one third of the edible parts of food produced for human consumption, which is roughly 1.3 billion ton per year at the global scale. Consumers in Europe and North-America alone waste between 95-115 kg/year per capita, while it is way lower in sub-Saharan Africa and South and Southeast Asia (6-11 kg/year) (FAO 2011). However, food is also lost within the whole food supply chain, including (1) Agricultural production; (2) Post-harvest handling; (3) Processing and packaging; (4) Retail and distribution; (5) Households and catering (FAO 2011). At each of the single steps a certain share of the food gets lost, avoidable and unavoidable, increasing the demand in total. By implication, food losses and waste represent the potential to reduce the food demand and therewith the agricultural area demand. There are a number of studies, which aim at quantifying these shares at national, European or global scale (FAO, 2011; European Commission 2010). In our modelling exercise, we referred to the figure of the FAO (2011) as well as Buzby and Nyman (2012). These are translated into area factors. At the demand side, scenario elements can encompass changing (future) population numbers or changing diets, e.g. to estimate impacts of changing population composition (i.e. new dietary cultures through in-migration) or changing eating behaviours and trends (i.e. seasonality, healthy, vegetarian or vegan diets).

Self-sufficiency of food supply

Another application of the MAPS tool is the analysis of the local and regional self-sufficiency level (SSL), i.e. the percentage ratio between supply and demand expressing the extent of a territorial unit to meet its own food requirements. The analysis of the spatial distribution for each individual locality provides indications about their food self-sustainability and the possibility to satisfy urban demand through proximity agriculture. It gives therefore indications of local hotspots and of possible future food stresses. Figure 1 provides an overview of the SSLs in the CSRs. Values of 100% (green colour) and more indicate theoretical self-sufficiency in the respective area, whereas jurisdictions with values lower than 100% (red colour) cannot be supplied from their own territory and require “import” from outside. Regional differences regarding the spatial distribution of SSL is illustrated by the frequency of SSL class occurrence in figure 2.

2.5. Metropolitan Foodscape Planner (MFP)

The *Metropolitan Foodscape Planner (MFP)* represents a tool to spatially distribute land uses for food production within different zones (green, vegetable, protein, transition zone) within the metropolitan agri-food system. With its interactive GIS-g geared interface, it enables users to detect concrete spatial locations and the available amounts of suitable farmland (supply) for the most essential food groups and simulate them. Other than MAPS, MFP is a dynamic tool in the sense that users can directly undertake – by drawing with a pen on a digital table – land use changes in order to increase the self-sufficiency potential of urban food consumption. MFP allows the spatial allocation up to 12 food groups (depending on the respective case) making use of the European data sets shown in [Table 2](#). Making use of internationally harmonised data deriving in the ‘Chronic food consumption statistic (EFSA 2011), MFP identifies the urban food demand for 12 categories of crops/land use, namely: (1) wheat, (2) other cereals, (3) rice, (4) oil crops, (5) pulses, (6) potatoes, (7) sugar beet, (8) vegetables, (9) fruits, (10) wine grapes, (11) food crops and (12) grasslands. Building the *Metropolitan Foodscape Planner tool (MFP)* requires a series of data management and GIS operations to be performed in Excel and Arc-Info. MFP allows users to detect concrete spatial locations and the available amounts of suitable farmland (supply) around cities for the most essential food groups on the basis of urban population figures (demand).

Each zone calculation is based on the total demand in ha for the population and the total area available for agriculture per ring. The demand per capita can differ for different zones and for vegetable products and animal products. The total area available for agriculture is the area classified in Corine Land Cover as agricultural areas, sport and leisure facilities, green urban areas, natural grasslands and sparsely vegetated areas, minus the protected areas in Natura2000. The allocation of crops within the zones is based on the land cover, landscape typology and the protected area database. Table 2 provides an overview of the databases used.

Table 2: Data Layers applied in the MFP model.

Data Layer	Source
Cities_startpoint_Berlin	
Corine Land Cover 2006	http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster-3 version 8 april 2014, download 13 jan 2015 in arccat export.tiff als esrigrid in MFT.gdb
Natura2000	http://www.eea.europa.eu/data-and-maps/data/natura-5#tab-gis-data shapefile Natura2000_end2013_rev1.shp
Lanmap2v1	European Landscape Typology LANMAP (Mücher et al. 2006) lanmap2_v1_level_4_ls-cod

Multi-ring-buffer around city_startpoint: first calculate radii based on:	combine distance-raster and 3 rasters with the correct legenda and greyed areas total demand per ring
HSMU	Homogenous Soil Mapping Units (HSMU) as modelled by CAPRI (Kempen et al. 2005) and Eurostat crop area data disaggregated to hsmu's by CAPRI. Year per country: NL 2008, BL 2008, DE 2008, PL 2004.

Key to the approach is the Land cover disaggregation towards HSMU commodity groups by calculating the area for each crop category according to the crop category table, both absolute and relative to the total HSMU area (= density). We joined these data sets into the HSMU geometry and made a selection of it on the basis of crop data, extracting the HSMUs within the outer zones boundary. In a next step the result was merged with the zones (rings) defined previously and aggregate based on the zone-id and HSMU-ID. Making use of the European HSMU datasets introduces high levels of data aggregation to our method.

We were interested to run a validation of the results by comparing with national land use data at higher resolution and accuracy. The most recent Dutch land cover map is LGN (Landgebruik Nederland) version 7 (LGN7) which we re-classified for the selected area in Rotterdam within a 40km radius from the urban city central point (up to the boundary of the Metro-Food-Ring protein). This re-classification was necessary to ensure that we reach a high level of comparability with the HSMU-approach. When comparing the land cover areas of the two datasets, we found that 70% of the LGN-grassland matches the HSMU-dominant crop type grassland. And vice-versus, 73% of the HSMU-grassland is also LGN-grassland. In the case of 'rotation'-crops, 63%, 61% and 64% of LGN-potatoes, sugar beet and wheat are matching the HSMU-crop type 'rotation'. The validation exercise demonstrates that using European HSMU-data sets for assessing the spatial distribution of major crop types in Europe clearly compromises accuracy. We assume these observed cases of inaccuracy are mainly related to data inconsistencies in the relatively high levels of European aggregation, as compared to the more detailed and recent national inventory. The latter requires further validation efforts.

3. Results

3.1. Results of the Metropolitan Economic Balance Assessment (MEBA)

Case study regions show different profiles depending on properties of both sides of the system, consumption and production (Figure 1). The Milano region, even if covers 59% of caloric need, is able to comply not more than 42% of diet assumed by inhabitants and to produce 43% of the production value of goods allocated into the region. These values are dependent on different reasons. First of all, the polycentric shape of the metropolitan region matches a high density of population, coupled with a scarcity of agricultural land, mainly due to intense competition over

land use. Moreover, the productive agricultural sector results also show a strong degree of specialization, mainly devoted to the production of cereals (rice), milk and dairy products (Figure 2). This leads to an incomplete fulfilment of several food sectors as vegetables, fruits, meat, potatoes.

The area of Rotterdam has a strong level of specialization too, similar to that of the Milano region and concentrated mainly in milk, vegetables and potatoes, but it covers a higher share of diet (58%) and it is able to provide all quantity and types of calories needed by the population. The most impressive evidence emerging from the Rotterdam case study is the strongly positive economic balance (238%), due to a vast area dedicated to protected crops in Westland. It is noteworthy that in Rotterdam, the very high level of productivity reached with this production model, means this case study provides the only example of a region able to hold a largely positive agricultural economic balance. A different situation seems to be shown by Berlin and London. In the first case, the mono-centric shape of Berlin-Brandenburg allows this region to rely on a wide agricultural area, while a heterogeneous productive structure achieves productions rather diversified. The compliance with the diet rises to 72% and there are seven food categories, which cover more than 75% of requirements. All calorie needs are fulfilled and the production value is roughly equal to the value of staple food consumed. In the case of London, despite the low coverage ratio (47%), due to a large population, the agricultural system appears quite diversified, managing to cover significant shares of several food categories (cereals, vegetables, eggs, oil crops, potatoes, sugar). The low specialisation does not allow reaching a high value index (60%), though some products are widely spread in the region with a significant surplus (sugar beet, cereals, oilseeds, potatoes).

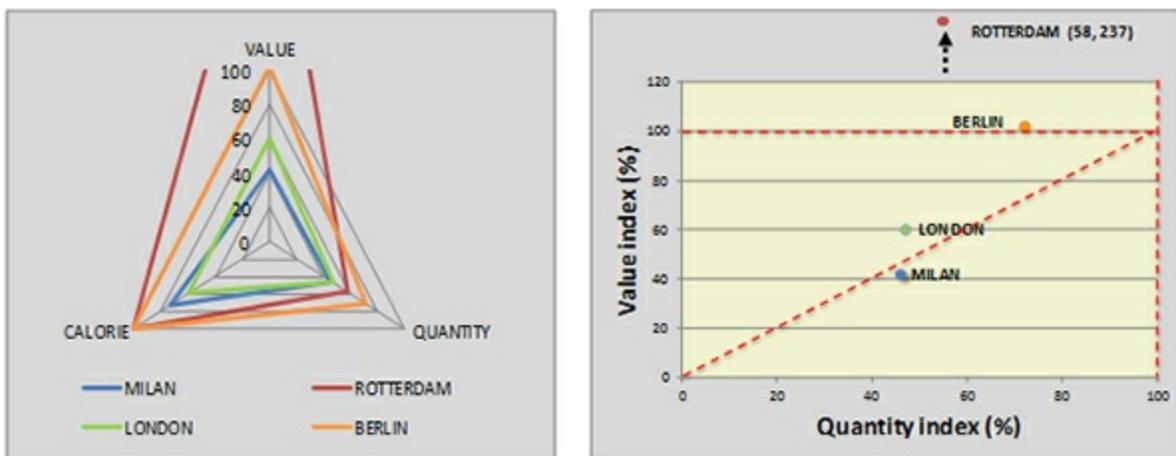


Figure 1: Radar chart comparing Quantity, Calorie and Value indexes (left) and scatter plot combining Quantity index and Value index of CSRs (right). Source: Sali et al. unpublished.

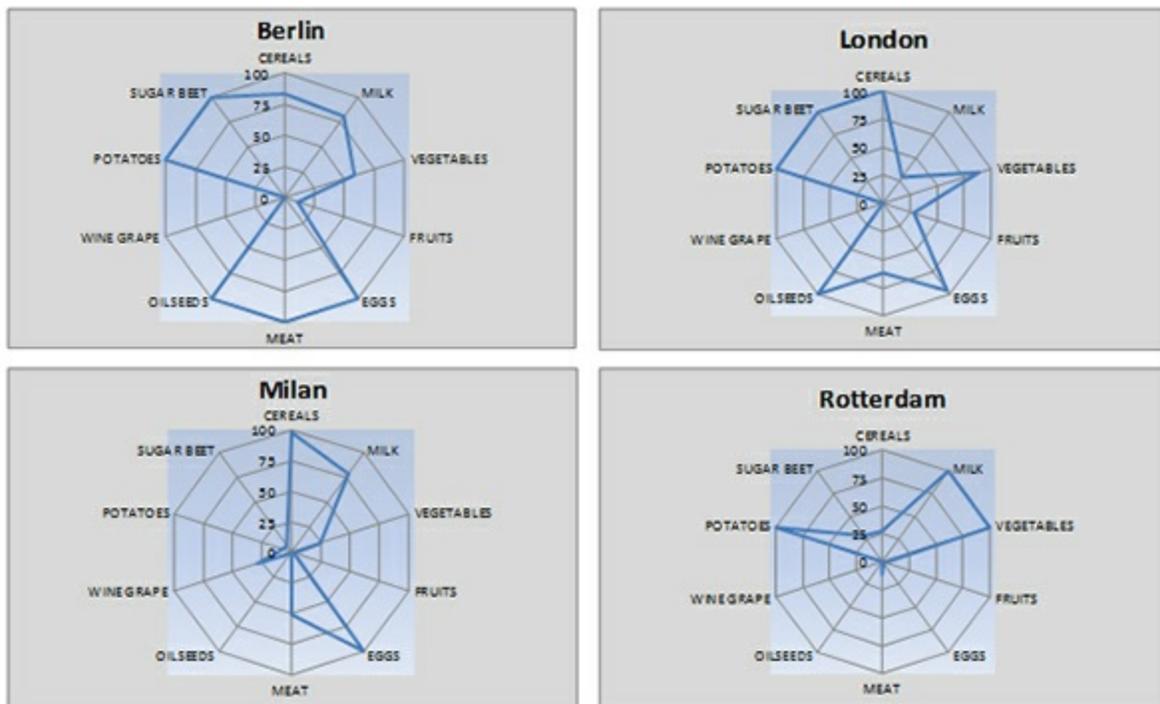


Figure 2: Quantity Indexes of CSRs broken down by food categories. Source: Sali et al. unpublished.

3.2. Results of Metropolitan Area Profiles and Scenario (MAPS)

3.2.1. Metropolitan Area Profiles

In the Berlin case 6,827 km² for the city of Berlin or 11,770 km² for the entire region is required. This equals a per capita area demand of 1,950 m² in the status quo situation (population and food consumption 2015). So despite the poor soil conditions (most or the rural area is designated as less favoured area), both city and regions can theoretically supply itself within their own boundaries, as the total farmland cover an area of about 13,230 km² (2012). Especially the relative low population density (and the related low food demand) of the surrounding region mitigates particular food stress.

The London case is characterised by a high demand for food from the urban core as well as other major cities in the region, resulting in an area demand of 13,989 km² (London) and 38,773 km² (London, South-East & East England). Per capita area demand is 1,711 m². Despite high agricultural area share with more than 26,500 km² farmland, the demand clearly exceeds the regional self-sufficiency potential by nearly 50%. Particularly due to the high population density in the direct vicinity of London as well as the area constraints of the footprint area of the

British Midlands and the island location, serious food stress can be considered.

The competition between the core city (Rotterdam) and surrounding region (South Holland) is even more pronounced in the Dutch case. Despite a farmland share of 60% (1,684 km²) and an area demand of 1,133 km² for Rotterdam, the regional demand of 6,713 km² overdraw the regional potential four times (per capita area demand 1,817 m²). A compensation of the resulting food stress from neighbouring regions can also not be expected (high population density in the Netherlands, Belgium and Northern France, which is already belonging to the Paris footprint area, as well as the coastal location).

Also the Lombardy metropolitan region is characterised by a mountainous situation in the North and agricultural plains in the South of the region. In addition, a small-scale administrative structure is noticeable. For whereas the area demand for food production of the city of Milano (2,548 km²) can be covered by the surrounding region (4,892 km²), the demand from the regional population (16,178 km²) is more than three times higher than the regional available farmland. The area demand per capita is 2,052 m². Circular representation of municipal and regional food production area demand is depicted in Figure 3.

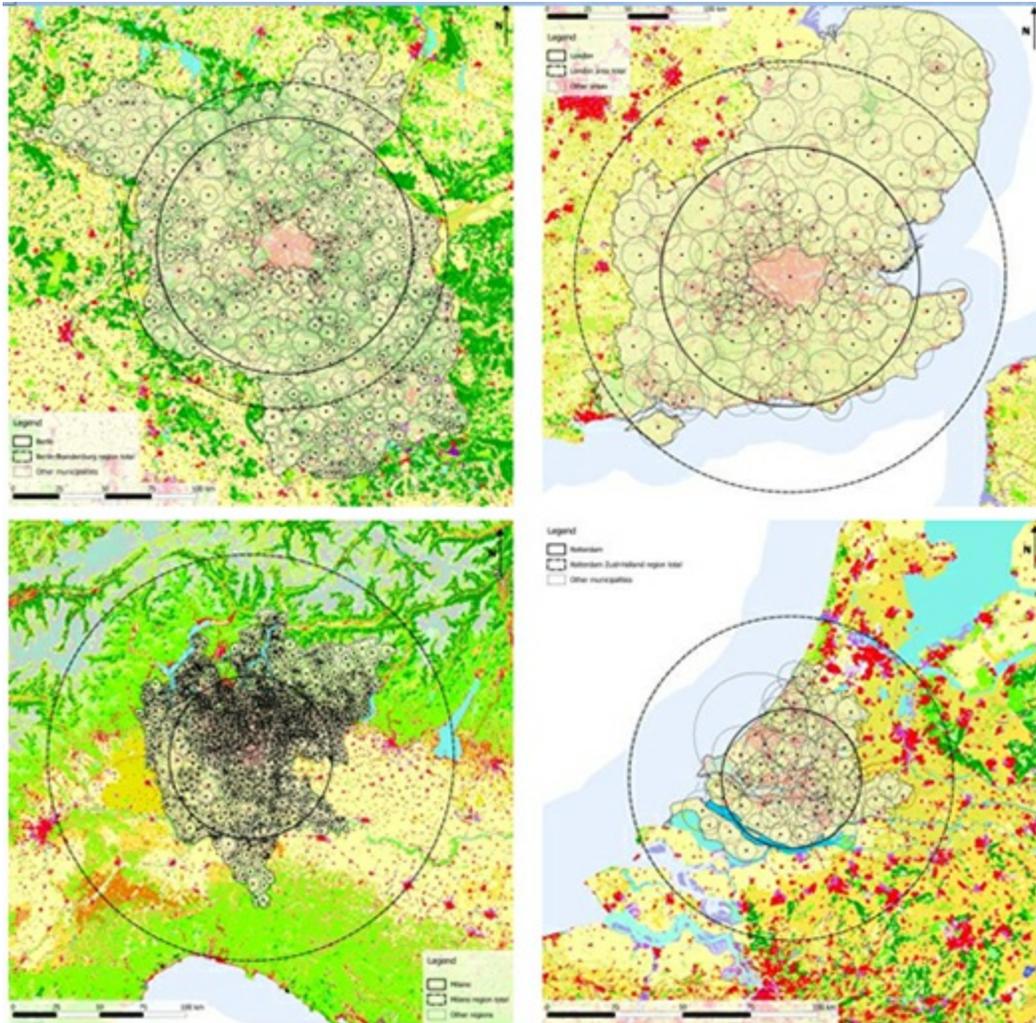


Figure 3: Area demand conventional food production for Berlin (upper left), London (upper right), Milan (lower left), and Rotterdam (lower right). Inner circle: area demand central city; Outer circle: area demand region. Based on population figures 2012. Source: Zasada et al. unpublished. Note: Both MAPS have different geographical scales.

In the scenario situations, first of all the agricultural area demand per capita is variable. These changes occur similarly throughout all CSRs into the same direction, even though with different amplitudes. Particularly impacts of food loss and waste reduction (S3, S4) as well as of conversion of production towards organic farming (S5) are clearly depicted. However, the scenarios also show the potential of certain organic systems (S9) or the combinations with food loss and waste reduction (S7, S8, S11, S12) to have a reduced area impact.

3.2.2. Self-sufficiency of food supply

The mono-centric Berlin metropolitan region is characterised by a by a concentration of municipalities which show undersupply of farmland for the city of Berlin and its direct

adjacency, whereas large parts of the peripheral rural areas can realise significant food production surpluses, being able to “export” to food stress areas. Whereas also in the London region, the core city faces a strong food deficit, the majority of urban places can be easily supplied by the near surrounding, which show an SSL of 100% and more. However, the absolute area demand through the high population number results in an undersupply at regional level. In the majority of municipalities in the South Holland region (Rotterdam) are characterised by an SSL of below 100%, often even not exceeding 25%, so that a rather continuous food stress can be expected in the region. Similarly, but less pronounced is the food stress situation of Milan and the Lombardy region, with a majority of municipalities without theoretical self-sufficiency. However, the specific administrative structure of Lombardy deserves attention, which is characterised by many urbanised communities with a small territory on the one side and large rural communities on the other. Figure 4 shows the self-sufficiency at municipality level in the four case study regions.

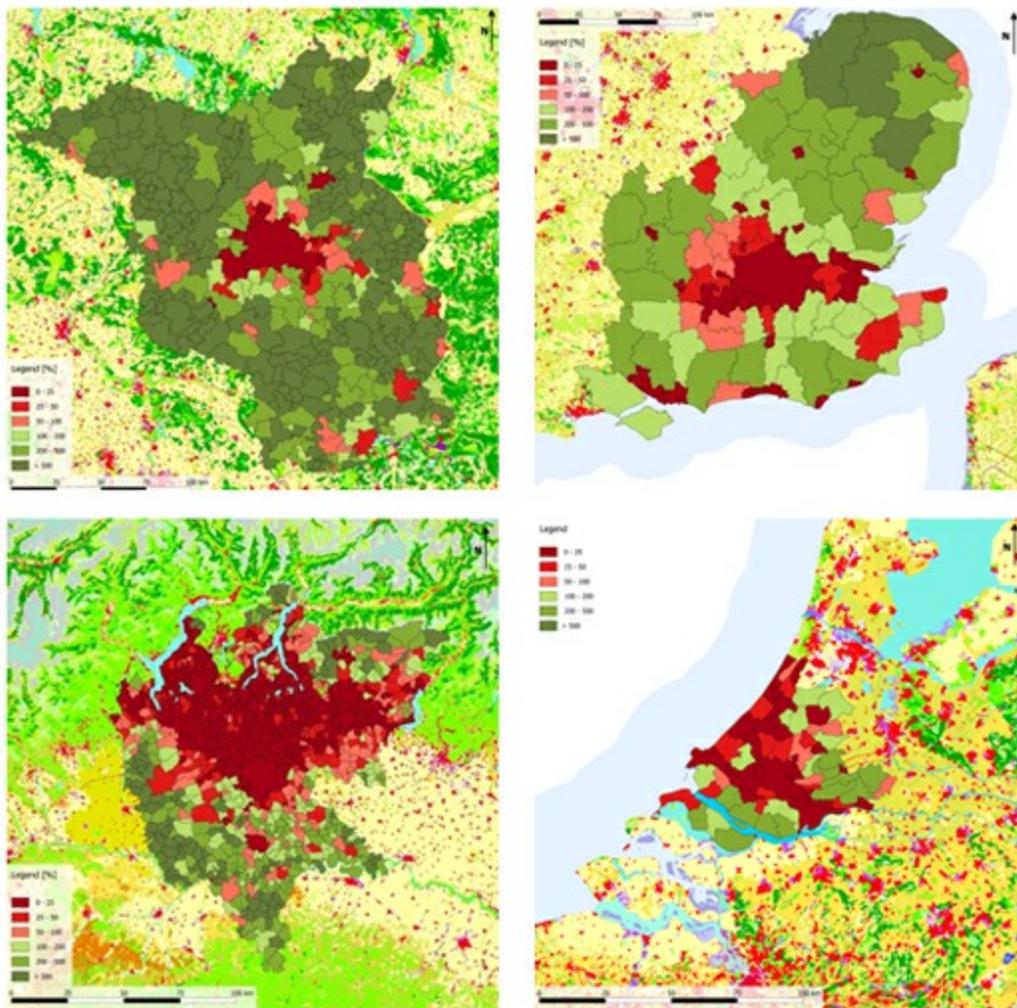


Figure 4: Self-sufficiency level at municipality level for Berlin (upper left), London (upper right), Milan (lower left), and Rotterdam (lower right). Red colour indicates under-supply, green colour over-supply. Based on population figures 2012. Source: Zasada et al. unpublished. Note: Both MAPS have different geographical scales.

3.3 Results of Metropolitan Foodscape Planner (MFP)

Due to the large share of land designated to nature protection (30%) large parts of the surrounding area of *Berlin* is not available for land or food production. However, as in the case for the urban fringe and the green buffer (about 13km wide), existing grassland is considered as being available for non intensive, ecological dairy farming with low density of livestock (ca. 1 livestock unit per hectare). Berlin still has a substantial amount of arable land incl. grasslands available in its direct urban periphery, namely a total of 65 tsd. ha (zone 1, see Figure 5). The metropolitan food production zone for plant-based products (zone 2) covers the area between 38 km and 53 km distance from the centre, providing a total of about 110 tsd. ha for food production. The livestock production zones reaches out to 80 km distance (equal to a production area of 450 tsd. ha), whereas the transition zones covers larger regions of Poland, requiring 1.5 Mio ha of land for plant- and livestock-based food production.

As Figure 5 shows, the *London metropolitan area* consists of an urban core of about 25 km in diameter. According to the planning scheme this translates into a green buffer of 12.5 km width. Within the urban core (periphery) and the green buffer we calculate a potential of about 100 tsd. ha for ecological forms of dairy farming on grassland. For the 8.6 million inhabitants of London's urban core, the metropolitan food production zone for crops used to provide plant-based food (zone 2) is contingent upon the green buffer, between 38 km and 61 km from the city centre, providing a total of about 320 tsd. ha of arable land. The metropolitan food ring required to provide feedstuff and facilities for livestock farming (zone 3) will need to span between 61 and 86 km distance from the centre, covering a total of 850 tsd. ha. Thus, almost three times the areas of the plant-based food ring. The city's location in close proximity to the North Sea implies, that the rings required for feeding the city of London need to be larger, because a great percentage is not available for food production because it is covered by sea water.

The demand-supply analysis (Figure 6) reveals that the available crop rotation contingent (potatoes-sugar beet-wheat) is exceeding the actual demand by a factor of three. Rotation crops dominate the regions northeast, east and southeast of London (from Kent up to Leicestershire). Grasslands are well represented in the southwest and west of London (from Sussex up to Northamptonshire) with a surplus of about 100 tsd. ha based on the actual consumption needs of the London population. Other surplus crops are non-wheat cereals and oilseed plants. Food crops are notoriously under-represented, pointing at the need for substantial feedstuff imports for livestock farming. The transition zone for both plant- and animal-based food crops (zone 4) requires an area of 1.2 Mio ha for food production, reaching out to a distance of 124 km from its urban centre.

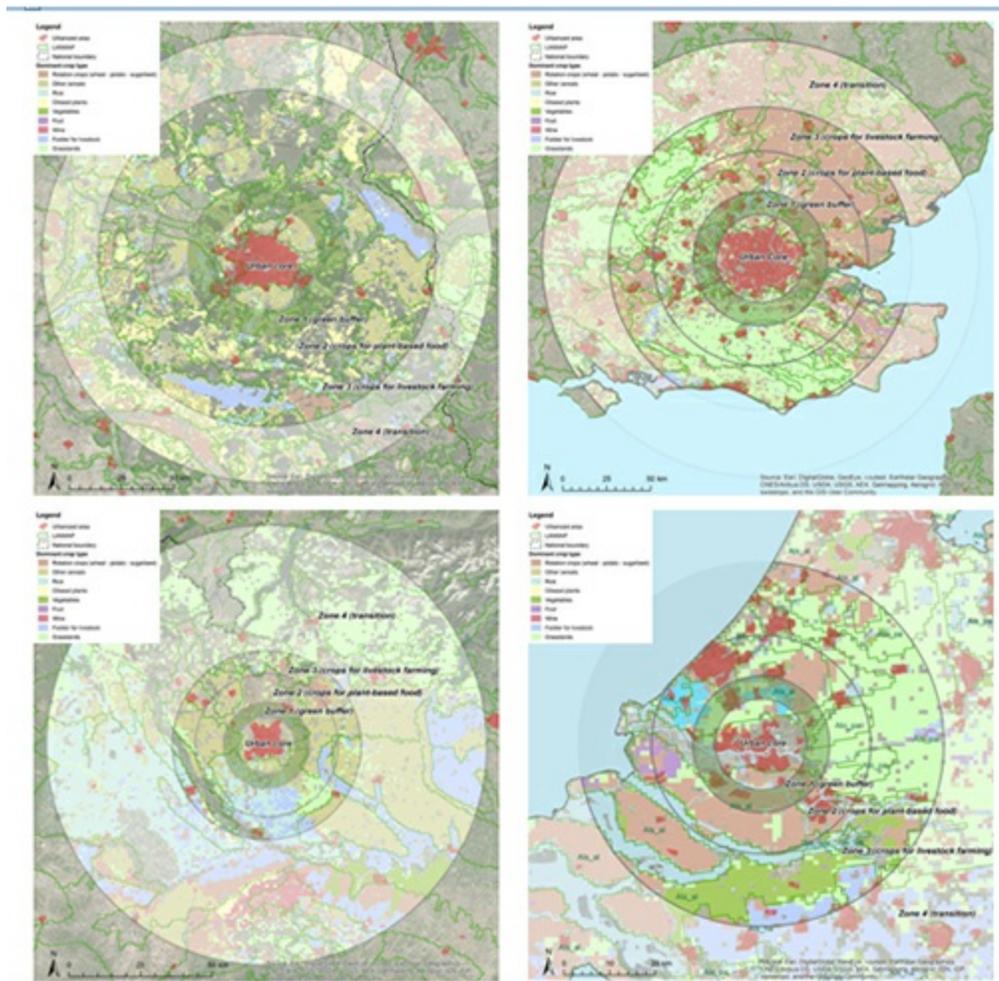


Figure 5. Metropolitan Foodscape Planner application for Berlin (upper left), London (upper right), Milan (lower left) and Rotterdam Metropolitan regions including the spatial extent of four food production zones: zone 1 (green buffer), zone 2 (crops for plant-based production), zone 3 (crops for livestock farming), zone 4 (transition).

In the wider *metropolitan region of Milan*, the presence of the Alpine high-elevation landscapes constitute a severely limitation for food production. Overall it is striking that the area demands in the Milano example are clearly lower which is due to another footprint calculation mode based on EFSA-data only. We see high surplus provision with other cereals as well as with rice – a crop that is unique to the Po valley region South of Milan. Most of the rice and other cereals are used for export. Surprisingly for Mediterranean location we see deficits for both, fruit and vegetables production.

In the *Rotterdam region* the plant-based production zone (2) extends between 15 and 24 km distance from the centre. The entire consumption needs arising from the 1.2 Mio inhabitants of Rotterdam can theoretically be satisfied within this zone. However, the current land use is still focusing strongly on livestock farming so that land for perennial and rotation crops, cereals and

oilseed plants are lacking. Due to the extensive glasshouse production in Westland and Oostland, the Rotterdam area shows a major surplus for vegetables (> 3,000 ha), when comparing to other European metropolitan regions. But today this production is dedicated to 90% for food export and is strongly dominated by a few lead crops. Given the resource intensity of animal-based food products it is not surprising that zone 3 (24-40 km distance from the city centre) requires a surface area four times as large as the one for plant-based production (> 160 tsd. ha). In this zone the largest deficit is for fodder crops (ca. 100 tsd. ha), which are normally imported from elsewhere (van Gelder and Herder 2012). On the other hand, we see a clear surplus of grassland production for dairy farming. The transition zone (4) spans over a distance between 40 to 150 km from the city centre, even covering parts of Belgium and Germany.

The results of the MFP model application is not only meant as assessment results for framing the impact of urban food production on the different metropolitan zones, but are also providing operational input to a stakeholder-oriented foodscape-planning device. For this purpose we introduce the data into the so-called ‘digital mappable’ (Wascher et al. 2015), which allows users to perform land use allocations by means of a digital pen. Addressing the surplus and demand figures resulting from the assessment, users can then propose where and how to change the existing land use (food crops) in order to better meet the demands identified by the tool.

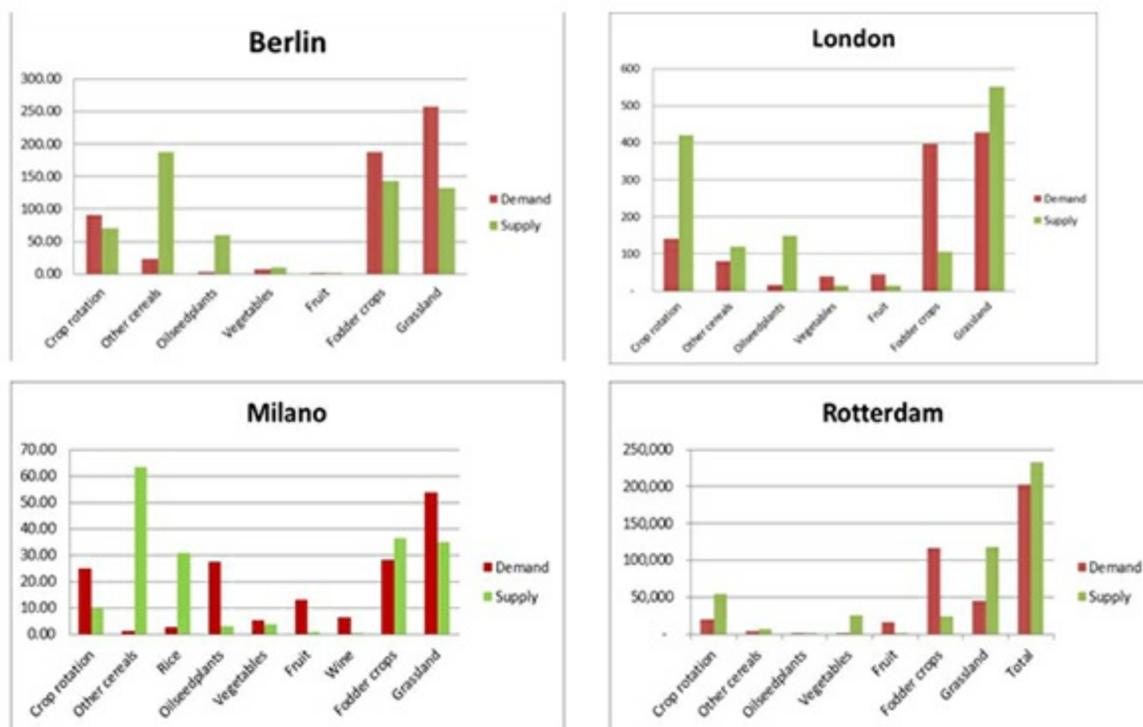


Figure 6: MFP output for the demand-supply comparison as total of protein- and vegetarian-based food rings for Berlin, Milano, Rotterdam and London

4. Discussion

4.1. Contribution of quantitative modelling approaches to metropolitan agri-food system planning

The results of the modelling approaches presented in this paper reveal strong commonalities across regions in terms of diets, area demands, etc., allowing for derivation of generic mechanisms and impacts of changing scenario situations and political and technological efforts to change the metropolitan AFS. The tools and models (MEBA, MAPS, MFP) deliver relevant information on the (i) food and area demand-supply balance, (ii) ex-ante assessment of changing scenario situations (population sizes and composition, diets), agricultural system and intensity (intensive, greenhouse, organic), (iii) the role of geographical framework conditions, and (iv) potentials to optimise production (spatial distribution, food chain organisation). These results and functionalities are essential as basis to inform food planning and policy making in the case study regions and elsewhere. They provide important knowledge on the “room for manoeuvre” in setting policy goals towards enhanced regional self-sufficiency through shortening of food chains and regionalisation of food production.

MEBA offers a basic set of information about the shape of agro-food system, revealing the relation between the first and the last step of food chain, production and consumption, at the level of raw products. The latter aspect strongly connects the diet profile with the cropping pattern decisions taken by farmers, revealing which sectors are lacking and what policy actions can be undertaken. Though production choices are driven by global market, new social pressures as well as security and environmental concerns could lead to rethinking of the land use planning role in defining what and where to produce.

Despite its spatial representation, the purpose and functionality of the *MAPS tool* is less a spatial analysis as such, but should be rather understood a mean of communication of the spatial dimension of food consumption and production. It shall raise awareness among stakeholders and decision-makers in urban and regional food planning and policy about the agricultural area required. It also provides the opportunity to assess the effects of future changes in either food consumption, e.g. healthy or vegetarian diets or population changes, reduction of food waste and loss or changes in the agricultural production systems, such as organic and expensive production or sustainable intensification. In this sense the MAPS tool can be used to explore difference regional scenarios and future pathways.

The main strengths of the tool lie in the attempt to explicitly delineate the specific agricultural area necessary to cover the food demand, but to model the necessary area and illustrate the actual extent through a mapping approach. It helps increasing of regional resilience by provide a broad and diverse basis stock of food supply across many commodities. It also supports the identification of hot and cold spot areas of food stress and help to quantify political targeting in terms of food policy. The MAPS tool can be used to develop a “food land

account”, which informs on the questions of the availability of food production area, its utilization, the necessary changes for regional supply (where the MFP tool links in).

The *Metropolitan Foodscape Planner (MFP)*, at the contrary, offers a (1) hands-on impact assessment tool for balancing commodity surpluses and deficits, (2) visual interface that depicts food zones to make impacts spatially explicit, (3) landscape-ecological allocation rules to base land use decisions on sustainable principles, and (4) European data such as EFSA, LANMAP, HSMU and CORINE Land Cover to allow future top-down tool applications for all metropolitan regions throughout the EU.

The concept of spatially allocating specific food groups for which a certain supply deficit has been recognised – e.g. vegetables or oil seeds are typically underrepresented in the metropolitan surroundings of cities – to areas with clear food supply surplus coverage, for example grasslands, points at the need to guide such stakeholder decisions by offering additional land use related references. We are aware that introducing clear spatial demarcations for different food groups in the forms of zones is drastically contrasting with the everyday situation in our current metropolitan regions. However, rather than intending to reflect the agricultural status quo, the MAPS-concept offers a quantitative look at agricultural resource potentials in which key issues such as the impacts and location of protein consumption, human requirements for recreation and nature, as well as availability of land to provide regional food is visualised in one scheme. Making use of the digital *Mappable* technology, stakeholders can engage in ‘serious gaming’ exercises and develop proposal for increasing the supply with regional food for up to 12 food groups on the basis of the urban consumption needs. In order to provide further guidance during this process, MFP offers the spatial references of the European Landscape Typology (LANMAP) to ensure that stakeholders receive ‘alert’ messages if their changes they propose are in conflict with the allocation rules laid down as part of the landscape- ecological references. Both the MFP-zoning concept and the LANMAP-based allocation rules are in principle open to stakeholder revisions prior to engaging in the Mappable exercise. This way, a high level of tool transparency and flexibility can be achieved – the basis for gaining trust and ownership throughout the process.

4.2. Towards a new food system paradigm

Despite the shortcoming, we found the underlying principles of the Urban Footprint Tool as a valid starting point when developing a European-wide approach towards footprint-based impact assessment. Though the tools described have been created to fill an important gap in quantitative assessments of urban food supply. Their main purpose is to stimulate a debate on *practical questions* of regional food supply. The large variety of methodological approaches on the one hand, and the more abstract notion of many global footprint assessments on the other; did not really help to improve our understanding of metropolitan food systems, but on the contrary, has resulted in the belief that existing agricultural lands around Europe’s cities will never be able to provide enough food for all citizens. Studies such as ‘How to feed Tilburg’

(Bruins et al. 2009) have demonstrated that a fair amount of the required global hectares is actually available, but is used for other purposes, among it exporting agricultural goods to remote locations.

Looking at the existing footprint assessments and reference in the light of a societal debate that seems to be polarised between two utopian world views, namely the grow-it-yourself philosophy of the urban gardening movement and the resource-efficiency paradigm of modern industrial agriculture, there appears a clear need to bring the symbolic and at the same time conceptual nature of *global* footprint assessments down to the level of real regional land use conditions, food chain actors and political opportunities. The idea was to develop traditional ecological footprint assessments further by allowing comparison between entirely different cities (MEBA), by breaking down the assessments to the level of small communities for showing local hotspots of possible future food stresses in a composite map-image (MAPS), and by making the regional food supply of major food groups (up to 10) not only spatially explicit, but by also facilitating hands-on land use allocations, supported by 'live'- impact assessments. In combination, these tools offer a substantially more complex and specific knowledge base for policy makers to set up regionally suitable food policies, for economic players to seize business opportunities and for civil society to benefit from a more resilient agro-food system. In this way, the proposed tools seem able to give back the actual comparison between food consumption and land use (MEBA), the territorial potential in providing food (MAPS) and the spatial allocation opportunities for optimizing land use and land planning (MFT). In particular, the Metropolitan Foodscape Planner tool allows users to detect the concrete locations and the available amounts of suitable farmland (supply) in relation to urban consumption needs for the most essential food groups on the basis of urban population figures (demand). If global hectares footprint assessments confront with images of enormous, yet abstract and homogenous spatial impacts, this new generation of local hectare footprint assessments – especially the MAPS and the MFP tools – depict simultaneously impacts and opportunities at the level of concrete land use in the direct vicinity of cities. Looking at the results which can come across as normative, it quickly becomes obvious that they point in the direction of rather unclear or even irritating questions, ranging from a blunt 'so what?' to 'are the observed imbalances seriously implying a fundamentally alteration to a mainly market-driven agricultural system?'. The latter question must be considered relevant because of polarisation in the current debate on food that surfaced during the IUFN conference on the 'Hungry City' in Paris (2013), where two conflicting paradigms were addressed in the following way:

The first one is the *agro-industrial paradigm* where food is considered as a commodity and food security equals resource efficiency interpreted as the combination between soil quality (if not footloose), production costs and technology, independent from the geographic location of food consumption. This is in essence about "going on with the productivity model with a further intensification and maximization in the use of natural resources".

The second is the *socio-ecological paradigm* where food is considered as a human right with a keener interest in product diversity and importance given to the workforce, knowledge and

abilities and where food security, safety and quality increases with the spatial proximity between production and consumption with urban agriculture being considered as its most successful model. This is in principle about “revolutionizing the agro-industrial paradigm with the goal of establishing a bottom-up self-support food system”.

Confronted with these two options, the EU opts for the first paradigm: Tassos Hanoitis (Director Economic Analysis, Perspectives and Evaluations, DG Agri) clearly states that “*in EU context food security is not linked to risks about the supply of food*”. This is echoed by a landmark UK report Foresight. The Future of Food and Farming (The Government Office for Science, London 2011): “*This Report rejects food self-sufficiency as a viable option for nations to contribute to global food security, but stresses the importance of crafting food system governance to maximise the benefits of globalisation and to ensure that they are distributed fairly*”.

Rather than subscribing to one or the other of the above directions, the FOODMETRES metropolitan footprint tools have been designed to support a third paradigm that can be outlined as a *agro-geographical resilience paradigm* where food security builds upon bio-geographic food planning strategies that aim for high levels of regional food supply and diversity adhering to the principles of circular/bio-based economy and in accordance with governance-controlled standards able to support the multi-functionality of the metropolitan landscape. Embracing innovation and resource-efficiency principles as crucial pre-conditions for optimizing agro-food chains at the level of metropolitan regions, the agro-geographical resilience paradigm (AGR-paradigm) considers large-scale food export only as appropriate where this does not negatively affect regional supply potentials, food safety issues, social cohesion, fair competition and landscape quality. The agro-geographical resilience paradigm ultimately seeks to grant these values by *increasing the basic regional food security* for all regions at the global scale. The AGR-paradigm does not suggest top-down land-reforms, but the development of metropolitan agro-food strategies that are able to defy external impacts triggered by oil-price or other drivers of food supply at the global level.

5. Conclusion

In this paper a metropolitan footprint assessment approach is presented, which consists of a set of three tools of analysis and planning that meet the growing interest around food systems at regional and metropolitan scale. This increasing level of interest requires adequate responses in terms of managing both the information complexity characterizing a food system and the multiplicity of scale levels to which the system relates. As a matter of fact, the issue of territorial reconnection between food production and consumption involves many aspects: from the cohabitation of global and local supply chains, up to the evolution in consumer preferences; from the environmental sustainability of food supply to the productive potential of territory; from the need to meet the growing global food demand, up to the point of valuing local products and supply chains. The work we carried out sought to tackle this complexity, on the

one hand by identifying common lines by which to address the food policies and on the other, by bringing out the differences among food chains. To this end, the proposed methodology, starting from the population's food habits, allows for an analysis of how local production can comply with consumption, which impact on the production system by way of changes in the relations between production and consumption and through the effects these in turn impart on agricultural land use.

The results allow for some methodological and operational considerations. These considerations are based also on the broader reflection accompanying the development of the project FOODMETRES, involving the role that innovation, in its various forms – technological, social, governmental – plays in directing the evolution of economic systems towards a horizon of security and sustainability. From a methodological point of view, the policies for agri-food metropolitan systems can rely on the availability of new decision support tools, such as the food balance at regional scale, the scenario analysis and the participatory approach to agricultural land planning. Each of the proposed tools is functional to provide specific information and support the formulation of policies on security, sustainability and resilience. In particular, the tool-set FOODMETERS offers can support a new generation of food planning policies in support of a *agro-geographical resilience paradigm* able to overcome the limitations of both the agri-industrial and the socio-ecological food systems.

Irrespective of the geographic, demographic, climate and farming differences of the analysed metropolitan areas, in all cases the tool has been able to highlight those sectors with a greater chance, compared with the others, of territorial rapprochement either for environmental reasons, or in order to simplify the supply chain in respect of consumer demand. This means that, if properly addressed, specific agri-food chains can be encouraged to embark on a process of adaptation to a greater proximity to the consumer. Similarly, the tested instruments have shown that supply chains already solidly operating in the global market can help meeting food demand by acting on international markets. In this case, the action of food planning aims at enhancing the role of global player of the most competitive food chains. This dual orientation of metropolitan food systems, local and global, is going towards a new equilibrium: if managed with appropriate policies, it might be the most important innovation for cities to improve security and sustainability of food supply.

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Conclusions

As the first paper reveals, while the claims made by the Expo about food, governance and smart cities may appear grand, when examining them against on such developments, they do reflect much of what is known about such matters. Although, while such representations of food systems are valuable in verifying the status of the Expo as a smart city, when opening up the possibility, which exists to leverage the truly transformative capacities of other cities also declaring themselves smart, it soon becomes clear that very little is still known about either the experimentation, or contestation surrounding the urban and regional governance of such infrastructure driven service developments.

The paper suggest the reason for this is simple and lies in the need for the transformational capacities of smart city food systems, not to be represented in strictly technical terms, but in relation to their wider social, cultural and environmental requirements. It suggests this means meeting the requirement for the digital infrastructures, data management, renewable energies and smart buildings of “climate smart food systems” to be something more than a matter of cities broadening their municipal strategies and capacity-building exercises to sustain growth. Something more in the sense, which such municipal strategies are also seen as bowing to the pressure that comes from capacity building exercises for infrastructure developments of this type to re-direct city food systems. In particular, redirect them towards a set of standards that not only meet human expectations, but rest on the social needs, cultural and environmental requirements of urban and regional governance and which for this very reason, provide good examples of where the infrastructure developments of city food systems are smart, sustainable and inclusive.

To meet these expectations, needs and requirements, in turn means mapping out the interdisciplinary landscape of the of urban and regional governance that underlies the infrastructural development of smart cities and deep restructuring of the ICT, energy, building, transport and food sectors, which this in turn supports. Infrastructural developments that include the models; networks, analytical frameworks and metrics, which allow cities to represent food governance as the municipal strategies of capacity-building exercises set within an ecosystem whose innovations are smart in holding onto the possibility of sustaining a fully resilient triple bottom-line.

As the second paper makes clear, this in turn means ensuring such urban and regional governance is sufficiently innovative for infrastructural developments to create horizontal connections of a trans-local nature and form a network of cities in food systems capable of spanning larger geographical scales. Examples of these including the Milan Urban Food Policy

Pact, the Sustainable Food Cities Network in the UK, the FAO's Food for Cities global network and the Food Policy Networks project developed by the Centre for a Liveable Future at Johns Hopkins University in North America. The latter developing an effective and robust food policy at this scale by working with existing food policy councils, national organizations and other municipalities interested in building the capacity to forge working partnerships and to become more effective players.

The third paper serves to highlight the other components also needed to broaden food governance and underpin such policy networks, vis-à-vis meet the requirement for cities to be smart in supporting the human, social and environmental strategies built to sustain such innovations. In particular, sustain them in a human, social, cultural and environmental configuration of municipal strategies aligned with the capacity-building exercises of smart city governance systems. Those able to not only forge partnerships capable of securing food, but also sustain the resilience of such transformations.

The fourth paper points towards the techniques of analysis available to meet the growing interest circulating around the governance of food systems in cities. In particular, as innovations, able to manage the informational complexity of the knowledge domains that make up the participatory governance of food systems in cities and multiplicity of scales, which the democratic qualities of such deliberations relate to. Which such deliberations relate to and that in turn give municipalities the strategic means for exercises in capacity-building to not only empower communities, but also augment their status as the participants of such a transformation in the governance of city food systems.

The Editors

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