OPINION ARTICLE

Food Systems Resilience: Towards an Interdisciplinary Research Agenda [version 1; peer review: 3 approved]

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Abstract

In this article, we offer a contribution to the ongoing study of food by advancing a conceptual framework and interdisciplinary research agenda – what we term 'food system resilience'. In recent years, the concept of resilience has been extensively used in a variety of fields, but not always consistently or holistically. Here we aim to theorise systematically resilience as an *analytical* concept as it applies to food systems research. To do this, we engage with and seek to extend current understandings of resilience across different disciplines. Accordingly, we begin by exploring the different ways in which the concept of resilience is understood and used in current academic and practitioner literatures - both as a general concept and as applied specifically to food systems research. We show that the social-ecological perspective, rooted in an appreciation of the complexity of systems, carries significant analytical potential. We first underline what we mean by the food system and relate our understanding of this term to those commonly found in the extant food studies literature. We then apply our conception to the specific case of the UK. Here we distinguish between four subsystems at which our 'resilient food systems' can be applied. These are, namely, the agro-food system; the value chain; the retail-consumption nexus; and the governance and regulatory framework. On the basis of this conceptualisation we provide an interdisciplinary research agenda, using the case of the UK to illustrate the sorts of research questions and innovative methodologies that our food systems resilience approach is designed to promote.

Keywords

Food Systems, resilience

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Introduction

Food provisioning, like that for other commodities, is today marked by the 'detailed disaggregation of stages of production and consumption across national boundaries, under the organisational structure of firms or enterprises' (Gereffi & Korzeniewicz, 1994). At the same time, the intrinsic qualities of food mean that its provision is distinct from other commodities. As Ben Fine (1994) pointed out more than twenty years ago, food stands out from other systems of provision because of its organic nature, which governs and constrains how quality and value is generated across the commodity chain. For instance, while it is now commonplace to speak of food production as 'industrialised', these processes are still tempered by issues of risk, perishability, seasonability and sustainability, all of which stem from food's organic qualities (Goodman & Watts, 1994; Kirwan *et al*., 2017). Similarly, while the modern food system is now synonymous with global agribusiness and industrial agriculture, this has changed but arguably not lessened food's dependence on the social reproduction of family and small-scale farming (Goodman & Watts, 1994). The 'embedded' character of the food system is also reflected in the governance and regulation of agriculture, which (globalising tendencies notwithstanding) is still marked by state intervention and economic protectionism out of step with the neoliberal policy norms that have prevailed in the last thirty years (Clapp, 2012; Marsden *et al*., 2000). At the other end of the chain, the consumption of food also stands out because it is essential to enable humans (and other species) to subsist. As such, the entitlement to food is a fundamental right, the struggle for which is often the catalyst for political mobilisation and social change (Patel & McMichael, 2009). Finally, what people eat, when and how is governed by a range of psychological, emotional, cultural and sociological factors that further distinguish food from non-food systems (Warde, 2005).

In this article, we offer a contribution to the ongoing study of food by advancing a conceptual framework and interdisciplinary research agenda – what we term 'food system resilience'. We aim to theorise systematically resilience as an *analytical* concept – especially as it applies to food systems research. To do this, we engage with and seek to extend current understandings of resilience across different disciplines with the overall aim of mapping out an interdisciplinary research agenda, capable of enhancing our ability to better understand and, where appropriate, to build up resilience in the food system, through an integrated approach. Accordingly, we begin by exploring the different ways in which the concept of resilience is understood and used in current academic and practitioner literatures - both as a general concept and as applied specifically to food systems research. We define the food system as series of 'structures, institutions and information that connect or divide food system stakeholders, and define the opportunities and constraints that they experience' (Doherty, 2016, p.20). The barriers to resilience, we argue, are a consequence of the mismatch between the implicit or explicit aims of stakeholders (food producers, supply chain actors, consumers and policy-makers), and the structural, institutional and informational obstacles that stand in the way of these outcomes. The *structural* obstacles stem from the spatial and organisational complexity of the food system; the *institutional* obstacles stem from the complex systems of governance that constitutes the food system; and the *informational* obstacles stem from the difficulties stakeholders have in capturing the sustainability (economic, environmental and nutritional) of their practices and communicating these to other food system stakeholders. On the basis of this conceptualisation, we provide an interdisciplinary research agenda, using the case of the UK to illustrate the sorts of research questions and innovative methodologies that our food systems resilience approach is designed to promote.

What is resilience?

Despite its growing usage, resilience as a concept is marked by ambiguity, the meaning of which remains 'essentially contested' (c.f. Gallie, 1956). Nevertheless, because resilience has 'boundary object' qualities - that is, a concept that can be used to bridge different academic communities to address a common problem (Wenger, 1998) - it has significant analytical potential, if defined properly. Typically, scholars distinguish between 'engineering' and 'ecological' perspectives on resilience (Folke, 2006; Holling, 1996; Martin & Sunley, 2015). On the one hand, the engineering perspective refers to how quickly a material or system returns to a steady state, or equilibrium, after a stress or disturbance. On the other hand, the ecological perspective allows for multiple equilibria to exist, and thus resilience could imply not so much a return to the original equilibrium but a dynamic transition to an alternative equilibrium - or even a point outside of existing equilibria.

The influence of the engineering perspective on resilience can be seen in areas like the preparedness for and responses to events such as natural disasters or acts of terrorism: that is, 'the need to develop resistance and foster recovery in response to extreme events' (Béné *et al*., 2014a, p.3; Sullivan-Taylor & Wilson, 2009). In this vein, Briguglio *et al*. (2006, p.6) speaks of economic resilience in small island developing countries as 'actions undertaken by policy-makers and private economic agents which enable a country to withstand or recover from the negative effects of exogenous shocks'. In other words, resilience is understood here as the 'speed of return' (Folke, 2006), or the rate at which a system settles down to the pre-existing steady state following a perturbation. Linearity is implicitly assumed, underpinning a 'command and control' management logic that presupposes stability, predictability and controllability of human and environmental systems (Folke, 2003).

The ecological perspective, by contrast, is rooted in the study of living systems, which are understood as complex, nonlinear and adaptive. The idea that a system has a single, normal state is rejected and replaced by the possibility of multiple equilibria between which 'regime shifts' are possible. A freshwater lake, for example, may equally persist as a productive resource offering access to fish and clean water, or as a turbid environment following over-fishing and uncontrolled nutrient runoff from farming. Resilience is concerned with the magnitude of disturbance that can be absorbed before a system changes its structure and function. In this example, the rate of fishing or nutrient run-off

constitutes a disturbance to the lake system. Change, when it does occur, is typically nonlinear, comes about when thresholds or tipping points are crossed, and leads to a transformation of the system into a new stable state (Walker *et al*., 2006). This perspective on resilience was originally developed in the study of ecology, but is now routinely applied to the analysis of social-ecological systems. As Walker *et al*. (2006, p.37) put it:

> A resilient social-ecological system has a greater capacity to avoid unwelcome surprises (regime shifts) in the face of external disturbances, and so has a greater capacity to continue to provide us with the goods and services that support our quality of life.

In complex systems, such as the system of provision for food, attention is directed to the potential for uncertainty, change and cross-scale interactions (for example, between different geographic, institutional or temporal scales). In these circumstances, interventions can yield unanticipated results and impacts that occur in times and spaces beyond their immediate application. The failure of 'command and control' approaches to provide predictable responses in the management of real, complex systems has in part driven research and policy attention towards social-ecological resilience.

Conventionally, resilience is held in contradistinction to vulnerability: that is, resilience refers to the coping mechanisms and adaptive capacities that provide the means to overcome the exposures and sensitivities associated with vulnerability. This usage, however, is not entirely consistent with a social-ecological understanding of resilience (Domptail *et al*., 2013), where the emphasis is on systems (rather than actors) and their thresholds. Significantly, the social-ecological understanding of resilience is a relaxation of its strict ecological antecedent, allowing for the possibility that human agents can monitor resilience and intervene to adjust system attributes in response to or in anticipation of disturbances (Folke *et al*., 2010; Walker *et al*., 2004). Adaptive capacity, or the 'preconditions that are necessary to enable adaptation' (Nelson *et al*., 2007), is therefore drawn into resilience thinking, establishing a link with vulnerability and bringing questions of agency, power and marginalisation into social-ecological systems resilience (e.g. Ensor *et al*., 2015).

The concept of resilience is often used interchangeably with that of sustainability, but it is more accurate to describe the former as a necessary but not sufficient condition for the latter (Domptail *et al*., 2013; Leach *et al*., 2010). Tendall *et al*. (2015, p.18) see resilience as an essential means to promote sustainability, because it implies the capacity of a given system to 'continue providing a function over time despite disturbances'. According to this view, resilience can be part of a pathway or trajectory to sustainability. Indeed, a resilient pathway would be one that is adaptable and flexible, which does not close off options or lead to 'lock-ins' (Leach *et al*., 2010). In this sense, adaptive capacity is central to resilience because it is this quality that 'reflects the learning aspect of system behaviour' (Robinson & Berkes, 2011, p.1186).

Resilience can be distinguished from both 'vulnerability' and 'sustainability' by its association with adaptation and transformation (e.g. Folke *et al*., 2010; Walker *et al*., 2006). Béné *et al*. (2014b) defines resilience as the emergent property of a system that encompasses the ability to not just absorb shocks, but to adapt and transform in response to or in anticipation of these shocks. Accordingly, resilience is dependent on three different social-ecological system capacities: absorptive (enabling system persistence); adaptive (enabling incremental system adjustments); and transformative (enabling profound system change by intentionally crossing thresholds). The understanding of resilience in terms of capacities offers a potential toolkit applicable to a range of practical problems. The caveat, however, is that because the three 'modes' of resilience - absorptive, adaptive and transformative - interact, stakeholders need to be mindful that action to support one may reinforce or deplete the potential of the other two (for example, where a focus on the ability to adapt reinforces functional persistence, inhibiting the potential for transformation; see also Matyas & Pelling, 2015). Pelling *et al*. (2014) focus on the case of climate change and, similarly, see these 'modes' forming an adaptation spectrum, from resistance to incremental adjustment and ultimately transformation. Where transformation is frequently defined as occurring when the limits to adaptation are reached, Pelling *et al*. (2014) point out that transformation can be a choice and an expressed preference to shift the system onto a new development pathway. This view of transformation is valuable as it draws attention to the 'potential to open the political possibilities' for adaptation and resilience (Pelling *et al*., 2014 p.3).

Resilient food systems

So far, we have engaged with and synthesised different conceptions of resilience. In doing so, we have shown the social-ecological perspective, rooted in an appreciation of the complexity of systems, carries significantly more analytical potential than the more commonly invoked engineering perspective. In the following section, we apply the theoretical insights derived from the social-ecological perspective to the food system. We begin by defining the food system and then applying our resilience framework to the illustrative example of the UK.

What is a food system?

It has become something of a truism in the burgeoning field of food studies to describe food as constituting a 'system' (Ericksen, 2008; Kneen, 1993; Sobal *et al*., 1998; Tendall *et al*., 2015). Yet this concept is invoked far more often than defined satisfactorily. Although food studies lay claims to interdisciplinary research - as the 'food systems' concept implies - in practice traditional disciplinary divisions of work have created and maintained a range of methods and approaches to the study of food. This does not mean that researchers have deliberately ignored or dismissed food research stemming from other disciplines. Rather, it is suggestive of the deep-rooted obstacles - epistemological, ontological and methodological - standing in the way of genuine interdisciplinary research without prior commitment to a shared conceptual and analytical framework. The first step to overcoming these obstacles is therefore to commit to constructing such a

framework by engaging with and extending the extant food systems literature - especially those accounts that have sought to delineate an explicit and interdisciplinary food systems research programme. While the literature is now voluminous, there are still relatively few contributions that succeed in delineating an explicit conceptualisation of the food system. Examples of the latter include: Ericksen (2008); Gregory *et al*. (2005); Sobal *et al*. (1998) and Horton *et al*. (2017). These contributions share an understanding that food needs to be studied holistically in order to capture the multiple activities, interactions and outcomes associated with its production, exchange, consumption and governance. This task, however, is easier said than done given the complexity of the food system and the various ways it intersects with other social, health and environmental systems.

Applying a conception of resilience adapted from social-ecological systems, we underline that the food system is not just characterised by separate activities producing collective outcomes; it is the dynamic interaction between these subsystems that defines the systemic properties of the food system. In other words, the presence or absence of resilience cannot be attributed to or measured by changes in one unit without considering how those changes influence behaviour in the other units of the system. The food system is thus defined by its dynamic properties, which involve information flows between the system and its components and between the system and the external environment beyond the system boundary.

An illustrative case study: promoting UK food system resilience

The UK provides us with a suitable case for comparing and contrasting different understandings of resilience – and for illustrating some of the ways in which an integrated food systems approach can be used to delineate real-world problems. In this section of the article, we therefore turn to this case to offer some brief, illustrative examples of how the theoretical and conceptual insights gleaned above can be put to work. By most measures, the UK constitutes one of the world's most food-secure countries (Economist Intelligence Unit, 2016; House of Commons, 2014). Despite this, the period since the global food crisis of 2007–8 has witnessed a plethora of government commissioned reports and policy initiatives framed in terms of food security and resilience (Defra, 2010; Defra, 2018; Foresight, 2011; House of Commons, 2014; House of Commons, 2018). As Kirwan & Maye (2013) note, while the UK policy discourse surrounding food security has, since the early 2000s, been increasingly couched in terms of environmental sustainability, responses are firmly rooted in neoliberal framings, wherein food security is interpreted as a 'supply-side' problem to be addressed through a combination of sustainable intensification, trade liberalisation and better risk management.

Agriculture and farming. While the UK's approach to farming from the 1980s onwards envisaged a limited role for small farms, policy today increasingly understands small farms as necessary for social sustainability in rural areas (Shucksmith & Ronningen, 2011). According to the Farm Business Survey (2015/16), one-third of the 58,370 farms in England are classified as 'very small' (in terms of on-farm employment), while 50% of holdings are smaller than 100 hectares and 19% below 50 hectares. Environmental stewardship is well established across the sector: while organic farming only accounts for 6% of land area, or 11% of farm businesses, the vast majority (74%) receive some form of payment for providing environmental services. A resilient food system lens draws attention to dynamics that connect across different scales (from the field to the farm and beyond) and the interconnections within and between different production systems. Rotz & Fraser (2015, p. 3), for example, provide an analysis of farm resilience in relation to diversity, connectivity and decision making autonomy - that is, 'the degree of control that producers have over production as well as their ability to observe and respond to feedback mechanisms'. The functional diversity on farms is significant as a bulwark against ecological change or other external shocks. For instance, particular crop yield vulnerabilities due to environmental changes have been observed in relation to climatic fluctuations (principally temperature and rainfall), pests and pathogens, rising salinity, deteriorating soils, new pests and decreasing pollinators. Livestock are similarly susceptible to climate, disease and declines in forage quality (Bullock *et al*., 2017). The industrialisation of farming has been linked to declining on-farm crop and species diversity, a trend that many observers recognise as driving down field- and farm-scale resilience (e.g. Altieri *et al*., 2015; Bullock *et al*., 2017; Hart *et al*., 2015; Rotz & Fraser, 2015). For example, the decline in UK bee populations, linked to agricultural intensification, threatens crop production (Breeze *et al*., 2011; Potts *et al*., 2010), while projections suggest that with climate change, epidemics of blight in wheat crops will become more severe (Madgwick *et al*., 2011). The pressures of industrialisation frequently lead to the consolidation of agricultural production into fewer, larger farms with high spatial connectivity (monocrops in tightly packed or larger field sizes), increasing the potential for the development and spread of pests and diseases.

In short, the UK and other comparable cases illustrate the clear tension that exists between the demands of industrialisation and intensification of agriculture and the need to ensure that farms remain both socially and environmentally sustainable. Unequal power relationships arise between the majority of farmers and a much smaller number of large actors that operate at wider scales further along the supply chain. This political imbalance restricts decision making opportunities, as farm businesses look to maintain access to the market, and is evident in the retreat of public information and extension systems, and the growth of agricultural knowledge that is framed by private actors. Rotz & Fraser (2015, p. 9) suggest these trends have critical consequences for resilience, as it becomes very difficult for producers to engage in long-term strategies, such as shifting toward more ecologically adaptive production systems. Overall, it is notable that downward pressures on farm resilience emerge from shocks and stressors embedded in the dynamics of systems at multiple different scales.

As Neufeldt *et al*. (2013) suggests, the prospect of transformation of the global social-ecological food system, while necessary, represents a major challenge. Yet at smaller scales,

there is considerable evidence for drivers of resilience that can and are in some cases being acted on. Multi-functional and agroecological approaches - promoting diversification at the field, farm and landscape scales - increase resilience, in particular to a wider range of temperature and rainfall conditions and through improved pest resistance. For example, a farm-scale study in the UK demonstrates that farm management practices that take an ecosystem-based approach to enhancing pest control and pollination can maintain or increase yields (Pywell *et al*., 2015). Underpinning these approaches is adaptive capacity and, in particular, a sufficient quality, quantity and diversity of information and services to enable farmers to build the ecological and practical knowledge necessary for a more diversified, resilient farm system (Kremen *et al*., 2012). Rotz & Fraser (2015) suggest that comprehensive farmer education and skill building for agroecological practices are possible through publicly and community supported workshops, mentorship programs, and farmer-to-farmer training. Bullock *et al*. (2017, p.883), meanwhile, draw attention to knowledge transfer to and among farmers, building capacity and enhancing social networks, in order to support adaptive decision-making for resilience. The case studies reviewed by Pelletier *et al*. (2016) similarly draw attention to the centrality of learning to resilience (see also Walker *et al*., 2006), and the role played by the broader social, institutional and governance context.

These settings can drive forward responsive decision making and locally appropriate innovations that emerge from the integration of farmer and scientific knowledge. It is in this way that collaborations such as producer movements can have a significant role, leading the transformation of farming systems and landscapes towards resilient and multifunctional social-ecological settings (Hart *et al*., 2015). Yet, as noted, the space for knowledge and information has contracted as the power of commercial interests has increased in contemporary food systems. Indeed, Rotz and Fraser conclude that knowledge and information have 'long been politicised for commercial interests' with public information and extension following the lead of dominant actors 'to remain relevant' (p12). The emergence of alternatives is linked to the capacity, capability and willingness of motivated public and private food system actors at different scales to converge and confront the dominant discourse, as has been seen in the success of producer movements, alternative food networks (e.g. Kremen *et al*., 2012) and the food sovereignty movement (e.g. Aguayo & Latta, 2015).

Global value chains. Food and drink is the UK's most significant manufacturing sector and the world's fourth largest (Food & Drinks Federation, 2015; GFS, 2017). Although the UK is historically one of the world's most food secure countries, it is notable that its reliance on food imports has been steadily rising, which currently account for almost half (48%) of consumption. The UK is especially reliant on food imports from the EU - one of the reasons why analysts are predicting that Brexit will have a major and negative impact on the nation's food security (Lang & Schoen, 2016). In short, the UK's food system is inextricably tied to the operation of global value chains. The analysis of resilience within value chain studies has been mainly taken up by the sub-fields of supply chain management (SCM) and logistics. The focal point for these perspectives is the company - primarily the buyer – rather than a broader range of actors within the value chain. The analysis of resilience in supply chains originates from the early 2000s in the wake of supply chain disruptions resulting from natural disasters like the Indian Ocean tsunami of 2004 (Christopher & Peck, 2004; Datta *et al*., 2007; Sheffi & Rice, 2005). More recent studies have concentrated on improving resilience in supply chains to improve the ability to manage and minimise risk so as to improve firm efficiency and hence performance (Azevedo *et al*., 2013; Elleuch *et al*., 2016; Pettit *et al*., 2010). This body of work has prioritised the development of supply chain capabilities for firms, such as optimisation, efficiency, robustness, redundancy, responsiveness and continuity, rather than, say, environmental and social sustainability (Schmitt *et al*., 2017). Pettit *et al*. (2010) note that supply chain resilience is synonymous with these aforementioned performance capabilities. The increased efficiency of sourcing, however, has arguably made supply chains more vulnerable to disruptions, specifically through 'lean sourcing' approaches, just-in-time systems (JIT), standardised components and reductions in the supply base, as these approaches have tended to neglect within chains both collaboration and social and environmental embeddedness (Christopher & Peck, 2004; Lee & Rammohan, 2017). Moreover, most studies on supply chain resilience have been dominated by non-food case studies. The limited number focused on agrifood supply chains tend to adopt the 'risk and performance' management bias of focal firms in their approach. According to Knickel *et al*. (2017), this focus on maximising buyer profits has tended to be at the expense of British farmers, which have tended to pay the costs with falling incomes and complaints of unfair supermarket buying practices. There are some rare exceptions, such as the study by Leat & Revoreda-Giha (2013) of Asda's pork supply chain, which highlights the importance of collaboration with both farmers and animal welfare charities to raise product quality. In this case, however, the overriding objective for Asda was still competitiveness. There is an emergence of work on the 'greening' of supply chains (Tachizawa & Wong, 2015) but, again, non-food supply chains dominate the case studies and the main focus is the reduction in energy use.

The analytical blindness regarding the intrinsic complexities of agrifood value chains is problematic on a number of levels. Firstly, according to Rueda *et al*. (2017) agrifood value chains are diffuse and seasonal, meaning supply chain actors can source from a large number of producers and in many cases from smallholders (cocoa, coffee, vegetables plus tropical and citrus fruits) from a wide diversity of climates and social conditions (temporal and spatial). Therefore, there is a wide range of risks regarding production conditions, including political (e.g. Brexit), social (e.g. gender inequality, child labour and modern slavery), climatic (e.g. changing weather patterns), ecological (e.g. deforestation and biodiversity loss) and biological (e.g. pest and diseases). There also appears to be a difficulty in identifying illegal, unsafe and unethical practices of second or third tier suppliers, as illustrated by the 2013 'horsemeat scandal'. There is also a concentration of power at certain nodes of the supply chain

- for example, just three supermarkets in the UK now account for over 70% of the UK grocery market. A recent Oxfam (2015) report shows the producers share of value is decreasing - e.g. farmers receive an estimated 4% of the value added to green beans while supermarkets receive 40%. This is at a time when cost of inputs for producers is increasing. This unfair distribution of value brings into question governance and transparency in supply chains. For example, 50% of tea grown in Malawi is exported to the UK yet 50% of tea workers in Malawi receive wages below the extreme poverty line of $1.25 per day (Oxfam, 2015). Growing concern regarding malpractice by UK supermarkets led to the setting-up of the Groceries Code Adjudicator in 2013 as an independent office in government to investigate unfair practice. Complexity is further compounded by embeddedness of inputs, which can lead to incorrect assumptions regarding the resilience of local foods such as UK cheddar, whose origin of inputs in animal feed include the high risk commodity soy sourced from Brazil and Argentina (Schmitt *et al*., 2017). There are also difficulties with aggregation in studying agrifood value chains as indicators are not comparable because they are measured at different scales.

It is clear that the complexity of agrifood value chains means any discussion of resilience needs to be much more than just a short-term risk management approach and requires an in-depth understanding of the consequences of different production, exchange and distribution practices. Current approaches to resilience in supply chains fail to account for the complexity and the temporal and spatial dimensions of agrifood value chains. Furthermore, value chains tend to obscure the relationship between producer and consumer. All this can lead to oversimplification regarding building and measurement of resilience, and create unintended negative social and environmental consequences. A number of authors argue there is an urgent need for a more inclusive multi-dimensional view of resilience that acknowledges the complexity of agrifood value chains (Kirwan *et al*., 2017; Schmitt *et al*., 2017). Amid rising concern, civil society organisations, some shareholders and consumers have put pressure on retailers and manufacturers to provide products that meet higher social and environmental standards. Over the past decade this has spawned the proliferation in private governance standards based on social and environmental criteria e.g. own company farm assurance schemes. These corporate investments in supply chains have, however, been criticised for enabling supermarkets to accrue even more value through premium pricing, while adhering to standards that are seen as minimal in terms of social and environmental performance (Rueda *et al*., 2017).

Consumption. From a food systems perspective, consumption is arguably the least studied and therefore least understood aspect of the resilience framework. Yet in the UK it is the role of the consumer that has been front and centre of what have probably been the two most prominent food policy debates in recent years - namely, obesity and food adulteration. As the *Guardian* newspaper reported in April 2016, on current trends, the UK's share of EU-wide obesity - already the region's highest – is projected to reach 38% by 2025. Yet this 'obesity crisis' is not simply a matter of poor diet and lifestyle choices. As Julie Guthman (2011) argues in *Weighing In,* the *aesthetics* of obesity (i.e. shape, size and body image) are often conflated with the *epidemiology* of obesity (i.e. adiposity, or excess fat tissue, as a cause of illness and premature death). It is this conflation that has fed the moral economy of the obesity debate in the UK wherein consumers (invariably the poor or those from lower socioeconomic groups) are blamed for being 'fat' (see Glaze & Richardson, 2017) rather than, say, apportioning blame to food producers, retailers or the advertising industry. On this reading, the preference of successive governments for dealing with obesity through targeting the individual with health promotion and healthy eating campaigns rather than through direct market intervention or industry regulation (the anticipated introduction of a 'sugar tax' notwithstanding) can be seen as an attempt to create 'resilient consumers'.

Theoretically speaking, this chimes with Jonathan Joseph's (2013) critique of resilience. Although resilience is usually presented as operating at the systems level, at least in the Anglo-Saxon world, it is 'best understood as a form of neoliberal governmentality that places emphasis on individual adaptability' (p. 38). The treatment of power and the structure of societal relations within resilience has long been a source of criticism: for some, the language of resilience inevitably shifts the responsibility for coping with shocks and stressors onto those who are least able to assume the burden, and in so doing recreates and reinforces unequal social relations (MacKinnon & Derickson, 2013; Robinson & Carson, 2015). In a similar vein, Iain Pirie (2016) has linked the moral economy of obesity to the contradictory demands of neoliberal systems of food provision and public health regimes (see also Guthman & DuPuis, 2006). On the one hand, the public health regime demands that individuals take responsibility for the management of their own bodies; on the other hand, the deregulated food system encourages patterns of consumption incompatible with this self-management. Pirie, drawing on Clarke *et al*. (2010), argues that the contradiction between neoliberal food and health regimes is resolved through the practice of 'biomedicalisation' - that is, a shift from a focus on the treatment of illness to the prevention of possible illness through individualised risk profiling. Individuals thus 'face a moral imperative to act as responsible informed medical consumers who purchase the appropriate medical technologies to enhance their lives and effectively manage risk' (Pirie 2016, p. 3). Each of these cases are illustrative of Brassett *et al*.'s (2013, 222) suggestion that 'resilience is fast becoming the organising principle in contemporary political life'. Yet the focus on individual responsibility is at odds the perspective of food system resilience, which requires as a starting point for analysis an appreciation of the complex socio-cultural, political-ecological system from which health and wellbeing outcomes for consumers arise.

The contradictory demands of modern food systems are also revealed in the recent policy debates about food adulteration. These debates are, of course, not new and can be traced back to the 'food scares' around Salmonella in eggs in the 1980s and BSE in the 1990s (Miller & Reilly, 1994). Yet it is more recent cases, especially the 'horsemeat' scandal of 2013, which best illustrate modern food system complexities (Jackson, 2015). In

this particular case, beef products sold in a number of the UK's leading food retailers including Tesco, Aldi and Lidl were revealed to be contaminated with horse- and pig-meat. This revelation led to a widespread public backlash with retailers forced to withdraw thousands of products from sale and to take out expensive advertising campaigns to reassure sceptical consumers that their produce was indeed safe (Jackson, 2015, p. 88-9). The official inquiries in the UK that followed the 'horsemeat scandal' concluded that the contamination of beef had resulted from fraudulent behaviour rather than accidental contamination. Critical commentary at the time quickly pointed to the imperative to cut costs as the key driver of the scandal with the *Guardian's* Felicity Lawrence (2013) pointing to the fact that, in 2015, an 'economy range' beef burger retailed for as little as 25 pence. As Jackson notes, at no point during or after the scandal was there any suggestion that contaminated meat posed a health risk; horsemeat is, after all, perfectly safe and consumed widely in many EU countries. Rather, Jackson suggests, what gave the scandal its political salience was the way it fed into prevailing consumer anxieties concerning what Bové & Dufour (2005) call 'food from nowhere' - that is, food produced through industrial processes and densely internationalised supply chains. A similar set of social and cultural forces can be seen at work in the case of 'chlorinated chicken' originating from the US, which has become something of an unlikely symbol of popular opposition to the (currently stalled) Transatlantic Trade and Investment Partnership (TTIP) initiative (See De Ville & Siles-Brugge, 2015). As with the horsemeat scandal, the prospect of chlorinated chicken being sold in UK supermarkets is controversial not because it poses a risk to consumer health - it is in fact quite safe - but because it taps into consumer anxieties around industrialised food.

Issues governance & regulation. Returning to the horsemeat scandal, Jackson (2015, p.96) argues that the upshot of the scandal revealed more than just the level of consumer anxiety around industrialised food; it also shed a light on the complex landscape of food governance and regulation in the UK. A notable feature of the UK's regulatory environment - which is also present to greater or lesser degrees in comparable cases - is the shift in political and economic power along the supply chain from agricultural production policy to, first, food manufacturers and then, later, food retailers (Marsden *et al*., 2000). As discussed above, food retailers now occupy a position at the apex of the food system where they are able to use their near monopsony position to control and coordinate the entire supply chain. Yet the role of retailers in the food system is not just an expression of economic dominance. As Marsden *et al*. (2000) argue, the power shift has gone hand-in-hand with a regulatory shift from public to private rule-making and enforcement. Retailers thus now have a dual role in the UK food system: on the one hand, they are responsible for the social provision of food in sense of meeting consumer demand for low prices; on the other hand, they are also responsible for upholding consumer-based rights in areas such as responsible sourcing and food safety.

It is the presence of these contradictory pressures that explain the popularity of private standards, third-party certification schemes and ethical audit regimes touched on earlier (Fuchs *et al*., 2011; LeBaron *et al*., 2017; Rueda *et al*., 2017). Private standards are the principal mechanism by which retailers and other lead firms square the circle between the need to meet simultaneous consumers demand for low prices and highly quality products. In the UK case, Dolan & Humphrey (2000; see also Henson & Humphrey, 2010) use the example of the African horticultural sector to demonstrate that, in practice, retailers square the circle by using their economic dominance and market power to force the adjustment costs onto their suppliers, which have to accept low prices while meeting the high compliance costs associated with private standards. From this perspective, one of perverse consequences on the proliferation of private standards, when combined with complex global supply chains, is to raise rather than lower the risks of food adulteration, as the horsemeat scandal illustrates (Abbots & Coles, 2013). An example pertinent to the food system resilience framework is the potential clash between private certification as *a differentiation* strategy for retailers versus private standards as a form of benchmarking of *common* ethical, social or environmental standards. In the case of fair trade labelling, for instance, the UK retailer Sainsbury's and chocolate manufacturer Cadbury (owned by Mondelez) announced in the last year their intention to withdraw their tea and cocoa respectively from the independent Fair Trade labelling scheme, and instead to establish 'in-house' certification (see Vidal, 2017). Whatever the motives for these decisions and future impact on the Fair Trade label, the effect is to add to the growing problem of 'regime complexity' (see Alter & Meunier, 2009) in the global food system. By this is meant the proliferation of different, overlapping and potentially competing standards, rules and regulations that provide opportunities for firms to 'venue shift' and 'forum shop' to further their interests. In the present context, this trend thus adds yet another layer to the complexity of the food system.

Returning to Marsden *et al*.'s (2000) model, one of the consequences of the shift towards retailer-led governance in the UK - if indeed this model is accurate - is that it serves to externalise and therefore depoliticise food systems outcomes not amenable to privatised governance. This tendency has taken many and varied forms, but the example of the 'obesity crisis', discussed earlier will suffice to illustrate the point. As we argued, the approach of successive governments in the UK to the problem of obesity is to frame it as a problem of individual responsibility - a framework, moreover, entirely compatible with retailer-led food governance. Yet the policy interventions informed by this framework have been found to have little to any effect on the prevalence of obesity in the UK. As epidemiological studies show, while obesity is now a worldwide problem and the drivers of it are multi-causal, its prevalence is strongly correlated with income inequality (Pickett *et al*., 2005). In the UK, there is also mounting evidence of a link between obesity rates among lower socioeconomic groups and increasing levels of household food insecurity associated with welfare conditionality and the growing use of food banks (Lambie, 2013; Power *et al*., 2017). The more important, theoretical point that these two cases - obesity and food adulteration - illustrate is the ways that the traditional equation of governance with government has served to reify subsystem boundaries between production, trade and consumption and to obscure the system-wide

properties of food. But, as a *concept,* governance can be understood more widely than this. For Rosenau (1995: 13), governance refers to all 'systems of rule at all levels of human activity', encompassing both public and private rule-making, and state and non-state intentionality. Conceptualised in this way, governance provides us with a key analytical tool for mapping the structures that exist beyond the system boundary that need to be accounted for when addressing the resilience or otherwise of the subsystems of production, trade and consumption.

Conclusion

In this article, we have sought to delineate a conceptual framework and interdisciplinary research agenda for studying food - what we have termed 'food system resilience'. We have shown that, while the concept of resilience has been used extensively used in a variety of fields, it is rarely applied consistently or holistically. Accordingly, we proposed an augmented social-ecological perspective, geared towards understanding the dynamics and interactions, feedback loops and adaptive capacities in complex systems. Applied specifically to food, we defined this complexity in terms of the structural, institutional and informational obstacles and asymmetries that confront stakeholders embedded in one or more of four levels or subsystems - agriculture and farming, the value chain, consumption, and the governance and regulatory framework. We then applied this framework to the illustrative case of the UK to show some of the ways in which an integrated food systems approach can to be used to delineate real-word problems. Although this case is illustrative rather than substantive, it hints at the analytical value of interdisciplinary approaches to studying food and food systems - and the extent to which integrated thinking can help to elucidate more sustainable, equitable and, indeed, resilient pathways as they apply to the production, exchange and consumption of food. Clearly, more conceptual and applied research is required to understand fully the determinants of food system outcomes. In particular, further work needs to be undertaken to understand how different food subsystems interact, the nature of system boundaries and the various ways in which the food system relates to other social and environmental systems. These and other questions will thus form the basis of our ongoing research agenda, as we seek to understand and address the increasingly complex and multi-faceted challenges of food provision in the 21st century.

Data availability

No data are associated with this article.

Grant information

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Version 1

Reviewer Report 18 February 2019

https://doi.org/10.21956/emeraldopenres.13916.r26296

✔ **Tim Hess**
Cranfield Water Science Institute, Cranfield University, Bedford, United Kingdom

This paper provides a useful framing of food system resilience, bringing together the debates about the definition, and usefulness of the resilience concept and food systems. It contrasts the terms resilience, vulnerability and sustainability which are widely, and often inappropriately, applied to studies of food production, distribution and consumption. One aspect that is less well developed in the paper is the potential conflict between the resilience of different actors within the food system and how there characterise the resilience of the system as a whole.

Is the topic of the opinion article discussed accurately in the context of the current literature?
Yes

Are all factual statements correct and adequately supported by citations?
Yes

Are arguments sufficiently supported by evidence from the published literature?
Yes

Are the conclusions drawn balanced and justified on the basis of the presented arguments?
Yes

Is the argument information presented in such a way that it can be understood by a non-academic audience?
Yes

Does the piece present solutions to actual real world challenges?
Yes

Is real-world evidence provided to support any conclusions made?

Yes

Could any solutions being offered be effectively implemented in practice?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Agriculture, food production and water

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 15 February 2019

https://doi.org/10.21956/emeraldopenres.13916.r26294

David Barling
Centre for Agriculture, Food and Environmental Management (CAFEM), University Of Hertfordshire, Hatfield, United Kingdom

The opinion article articulates a growing research focus on the use of more systemic approaches to understanding the workings and dysfunction of contemporary food provision. The elaboration of resilience as a key element of the food systems approach is presented embracing the social ecological approach that is becoming more common in resilience work in the related areas of foods security, sustainability transitions, as well as food systems based research. The authors make a clear case for the importance of this approach, linking the complexities of the impacts of disturbances and shocks to food provisioning, and of the types of responses, to the need for a multi disciplinary framework and approach to analysis.

Alighting on the UK as an area to exemplify the need for a more complex research based approach to understanding food systems resilience, four key and related areas are identified as sites to interrogate for evidence: agriculture-farming, global value chains, issue governance and regulation, and consumption. Here limitations of space in the article lead to some inevitable simplification in the case study illustration. The section on obesity omits that some public interventions have been made in the food manufacturing process by the Food Standards Agency (FSA), prior to the sugar tax, in addition to the prevailing individual responsiblisation of consumers approach to public health. The FSA, in the mid 2000s, directed food manufacturers to reduce, voluntarily, the salt content in the composition in 85 different foods products, as well as setting up nutrient profiling of food products to be restricted from marketing to Children's television times. While such changes are quite timid and reflect a "hesitant state," susceptible to industry-capture, they do illustrate the more nuanced public-private governance interface in food policy and public health. Of course, these examples serve to echo the authors' own call for deeper study.

The authors make a important contribution to showing that understanding, and so resolving, the often poor outcomes of our contemporary food provisioning will be taken forward only by addressing the dynamics and complexities of the interactions of actors, institutions and society. There is a pressing need for more work seeking to model and capture these complexities and to help identify how their non-linear impacts affect differing responses within and across the food system. The authors present a very clear imperative for such a research agenda, which is vital as we stand in a period of profound environmental and political change and uncertainty.

Is the topic of the opinion article discussed accurately in the context of the current literature?
Yes

Are all factual statements correct and adequately supported by citations?
Partly

Are arguments sufficiently supported by evidence from the published literature?
Yes

Are the conclusions drawn balanced and justified on the basis of the presented arguments?
Yes

Is the argument information presented in such a way that it can be understood by a non-academic audience?
Yes

Does the piece present solutions to actual real world challenges?
Yes

Is real-world evidence provided to support any conclusions made?
Yes

Could any solutions being offered be effectively implemented in practice?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Food policy and food systems governance

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 12 February 2019

https://doi.org/10.21956/emeraldopenres.13916.r26297

Peter Jackson
Department of Geography, University of Sheffield, Sheffield, United Kingdom

This is an interesting and original paper which outlines an agenda for interdisciplinary research based on the concept of food systems resilience. Taking what they call a social-ecological perspective, the authors then use the UK to illustrate the kind of questions that might be addressed by using this approach.

While the paper has much to commend it, there are several areas where greater clarity and specification might improve the argument.

The authors identify four subsystems: the agro-food system, the value chain, the retail-consumption nexus, and the governance and regulatory framework. Arguably, however, these sub-systems are not commensurate: the former could be said to subsume all of the others and the latter describes the context within which the other sub-systems operate. More importantly, the four subsystems are presented separately when the theoretical imperative of the paper is to demonstrate their interconnections. While this is accomplished, to some degree, in the UK case studies that follow, the question of how the subsystems connect and interact also needs to be addressed at a conceptual level.

The authors acknowledge some of the limitations of 'resilience' as a concept. Deriving from ecological and engineering roots, the concept is not well suited to dealing with the asymmetrical power relations and inequalities that beset the agri-food system. There authors discuss whether 'resilience' refers to the system's ability to return to a steady state following exogenous shocks or whether multiple equilibria can coexist. But the language of tipping points, feedback and thresholds is more readily applied to natural systems than to the complexities of contemporary agri-food systems where trade-offs and contradictions are routine occurrences rather than exceptions.

The authors cite four previous conceptualizations of agri-food systems: Eriksen et al. (2008)[1], Gregory et al. (2005)[2], Sobal et al. (1998)[3] and Horton et al. (2017)[4]. But the opportunity is missed to provide a systematic comparison of these accounts. Some, but not all, provide a visualization of the system they describe; some address the challenges of interdisciplinary working and the methodological, epistemological and ethical issues that such research entails; others provide worked examples of the kind of integrated thinking that is required to achieve a healthier and more sustainable agri-food system. Some have a specific focus (on nutrition or climate change, for example); others are more wide-ranging. Some attempt to identify common units in order to model system dynamics while others focus on the issue of scale and system dynamics. Assessing the strengths and weaknesses of these different analytical frameworks would have made a valuable contribution, also highlighting what is novel about the authors' own proposed framework.

A good case is made for showing how food, environment and health are interconnected in

contemporary agri-food systems. This requires the kind of 'joined up' thinking that governments seem ill-equipped to provide, as Doherty argued recently in his critique of the proposed reforms to European food policy (https://theconversation.com/europeans-deserve-a-food-policy-that-focuses-on-the-environment-and-peoples-health-97622). These are issues that members of the public frequently struggle to grasp, where more emphasis on effective communication of complex ideas would be valuable.

The best parts of the paper, in my view, are when the argument moves from the programmatic to the analytical via case studies of the horsemeat scandal, the introduction of private standards of certification and the 'obesity crisis'. While each case demonstrates the complexities of the agri-food system and the need for interdisciplinary thinking, they do not all work equally well in showing why resilience is the key conceptual lens for examining these issues. System complexity and a lack of supply chain transparency clearly contributed to the horsemeat scandal in 2013 – but what, apart from the ability of supermarket sales to bounce back to their previous levels after just a few months, does the idea of resilience add to the analysis? Would other examples have worked better as illustrations of the authors' argument? What about soil health, for example, as an issue that links food production and consumption, with multiple actants subject to an inadequate regulatory framework, where system resilience is approaching breaking point and where dire consequences can be anticipated in terms of agricultural productivity and, ultimately, human health and wellbeing?

Finally, I was surprised that food waste was not given greater prominence in the paper. A systems approach clearly leads to different conclusions about the locus of responsibility than conventional thinking, with greater emphasis on post-harvest food losses rather than an inordinate emphasis on blaming consumers for their alleged profligacy. But what would the concept of resilience add to current thinking about this key issue? Greater attention to these conceptual and substantive issues would, in my view, help move the paper forward from programmatic statements and conceptual frameworks to more systematic analysis of real-world problems and possible points of intervention.

References

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Is the topic of the opinion article discussed accurately in the context of the current literature?

Yes

Are all factual statements correct and adequately supported by citations?

Yes

Are arguments sufficiently supported by evidence from the published literature?

Yes

Are the conclusions drawn balanced and justified on the basis of the presented arguments?
Yes

Is the argument information presented in such a way that it can be understood by a non-academic audience?
Yes

Does the piece present solutions to actual real world challenges?
Yes

Is real-world evidence provided to support any conclusions made?
Yes

Could any solutions being offered be effectively implemented in practice?
Yes

Competing Interests: I co-supervise a PhD student with the lead author (Doherty) and he is a co-investigator on a research Centre proposal that is currently in review where I am PI. I don't believe this has influenced my review of this article.

Reviewer Expertise: Human geography with a particular focus on agri-food systems and sustainable consumption.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.