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Feeding relations: applying Luhmann's operational theory to the food system

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Abstract
Current, prevalent models of the food system, including complex-adaptive systems theories and commodity-as-relation thinking, have usefully analyzed the food system in terms of its elements and relationships, confronting persistent questions about a system's identity and leverage points for change. Here, inspired by Heldke's (Monist 101:247–260, 2018) analysis, we argue for another approach to the "system-ness" of food that carries those key questions forward. Drawing on Niklas Luhmann's systems theory, we propose a model of the food system defined by the relational process of feeding itself; that is, the food system is made of feeding and only feeding, and system structures are produced by the coupling of that process to its various contexts. We argue that this approach moves us away from understandings of the food system that take structures and relations as given, and sees them instead as contingent, thereby helping to identify leverage points for food system change. The new approach we describe also prompts us as critical agrifood scholars to be constantly reflexive about how our analyses are shaped by our own assumptions and subjectivities.

Keywords Food systems · Systems theory · Niklas Luhmann · Complex adaptive systems · Food regime

Abbreviations

CAS	Complex-adaptive systems
IPES-Food	International panel of experts on sustainable food systems
OPEC	Organization of petroleum exporting countries

Introduction: food as relationships

Philosopher Lisa Heldke (2018), reflecting on the indispensable role gut microorganisms play in human functioning, asks: what happens to our mental models of the world "if we take seriously the degree to which all life on this planet, including human life, is threaded through with relationships in which one creature sinks its 'teeth' into another and hangs on for dear life, deriving vital sustenance from that second creature, but sometimes imperiling the life of it as well?" (p. 247). We cannot continue to live without our gut microbiota, and thus, "at the (literal) bodily center of us," Heldke writes, "we find not some solid, essential core, but *the rest of the world*" (p. 248, emphasis in the original). Heldke concludes that we should understand both human individuals and food as not just *having* relationships but actually as *made through relationships*. As Heldke explains (p. 252), "Re-conceptualizing the world using 'with-ness' recognizes that connection is fundamental to, not derivative from nor oppositional to, a thing's 'thing-ness.'" And, further, this focus on 'with-ness' must include the acknowledgement that destructive, exploitative relationships are no more aberrant than beneficial or benign ones.

In this paper we offer a new conceptual model inspired by Heldke's call to go deeper into a critically relational view of food and the food system. Our model draws on the work of German social theorist Niklas Luhmann, in particular the framework elaborated in *Introduction to systems theory* (2013), a lecture series delivered in 1990–1991 and published in English translation in 2013. In it, Luhmann draws on systems thinking in biology and other fields to elaborate a definition of the social system as arising from a

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self-reproducing process (an "operation") of communication. This process is what distinguishes the system from its surrounding context, and system structures are created and reproduced as the system is coupled to its environment. Luhmann's decision to restrict the system's identity to the active relation itself [Heldke's (2018) 'with-ness' of food] affords a new and insightful perspective on the food system and its structures. For our model, the central, defining process of the food system is feeding, and food system structures are created and reproduced as the feeding process is coupled to its contexts in individual ("psychic" in Luhmann's terms), political, social, economic, and ecological realms.

Current, prevalent models of the food system draw on either complex-adaptive systems (CAS) theories or commodity-as-relation thinking to identify core elements of the food system (such as people, institutions, and many kinds of non-human actors) and their relationships to one another. CAS theories understand food systems as webs of diverse actors that continually adapt to changes around them, producing somewhat unpredictable system behaviors. Commodity-as-relation models focus on the roles of capital and capital accumulation in bringing diverse elements into relation. We instead, informed by Luhmann, propose a model of the food system that is made only of the relational processes of feeding, coupled with their individual, social, political-economic, and ecological contexts. We argue that this emphasis on context holds out "the sense of the possibility that things could be different" (Luhmann 2013, p. 235). By defining the food system in this radically relational way, space is opened up to see the contingency of the system—how it is coupled to various contexts—as leverage points, potentially transforming our analysis from one of intractable, historically persistent structures to one of dynamic, ever-changing openings for intervention. By shifting the focus from the actors and institutions of the food system to the feeding process itself, we hope to carry forward relational thinking in the field in a way that could make food systems analysis legible and actionable for policy makers, and perhaps most importantly, prompt us as individual scholars and scholarly communities to reflect critically on how our own models of the food system are mediated by our assumptions and subjectivities.

The next section of this paper reviews two widely used models of the food system in critical agrifood studies (CAS models and commodity-as-relation models) to explain how, despite their different assumptions and approaches, they both confront similar questions about a system's identity and how system structures can change. In the following section we offer a summary of Luhmann's theory of social systems, as described in *Introduction to Systems Theory* (2013), highlighting its reliance on a relational process and its insights into structural coupling and contingency. Next we posit a Luhmannian approach to the food system, elaborating a model centered on the feeding relation and discussing four theoretical consequences of this approach. Finally, we discuss two undeveloped areas of the framework and how they might be addressed.

Literature review: conceptualizing food systems

Relational thinking is not new to agrifood studies. Indeed, the entire intellectual project seeks to explain how agriculture, fishing, food-chain work, marketing, eating, and embodied affective experiences are all part of an interconnected web both within and beyond the production and consumption of food. In Heldke's (2018) terms, agrifood studies focuses on food's "with-ness" as well as its "thing-ness." As one landmark example, Mintz's analysis of "the place of sugar in modern history" (1985) explained slavery and plantation farming in the Americas and the changing lives of working-class Europe as two facets of the same process, connected by a commodified sugar trade that structured a global regime of racial terror. Mintz's paradigm-launching work charts the contours of an emerging global food system and its reliance on multiple forms of oppression. It aligns, then, with Heldke's challenge: to take seriously "relationships that run the gamut from mutualistic to parasitic" (2018, p. 249). Historian Vincent Brown (2008) draws an even closer connection, arguing that enslaved workers were "*themselves consumed* in the creation of wealth," and that "[s]omewhere between the literal and metaphorical, then, cannibalism is an appropriate term for the process outlined in *Sweetness and Power*" (p. 119). Brown's insight raises questions about our contemporary context, where the high illness and death toll of COVID-19 among workers in farm fields and food-processing plants in the United States (Douglas 2020), including some incarcerated workers (Biscobing 2020) seems essential to the operation of the food system.

The very notion of a food *system* has garnered some limited but illuminating critical reflection. For example Bell (2008) worries that the term "system" muddles analysis because of its two-fold legacy in agrifood studies; sometimes highlighting the relationality driving critical inquiry and sometimes the near totalizing force of dominant structures, i.e. "the system." A system framework, Bell argues, may unwittingly reproduce the "static, top-down conservatism" (2008, p. 84) of functionalist systems thinking, obscuring important disjunctures and apertures. Bell writes, "There was a time, not too long ago, really, when the social sciences were choking on the word 'system,' and pretty much decided in the end to spit it out." (2008, p. 83). In response, Hinrichs notes that "What commends many 'systems' approaches is their attention to comprehensiveness, connections, juxtapositions, places of leverage, and potential feedback." (2010,

p. 26). She continues, "They avoid the implied linearity of 'food chains' and conjure a bigger picture than 'food networks'." Nevertheless, the use of systems metaphors, Hinrichs argues, requires that we remain critically reflective in how we draw boundaries around a system and what such boundaries might exclude from our analyses (2010, p. 27).

Two prevalent frameworks of food-system thinking have emerged in the late twentieth and early twenty-first centuries to make sense of the complexity and dynamism of food systems that Hinrichs (2010) describes: complex-adaptive systems thinking and commodity-based approaches. Despite their different assumptions, both approaches model the food system in relational terms and arrive at two shared analytical problems. First, they face the challenge of defining a system's identity. What is inside and outside a (global, national, regional, or local) food system? And, as questions of system resilience come to the fore, how do we know when a food system has fundamentally changed from one form to another, or, alternatively, collapsed and been replaced? Second, and relatedly, they grapple with the problem of how to imagine and achieve greater equity and justice, accounting adequately for both self-reinforcing inequalities of power and apertures for change. This latter question returns recursively to the first one. In this section we review and compare the two most prevalent models to explain how both confront these twin questions and arrive at something of an impasse.

Complex adaptive systems: stability, resilience, and transformation

Many food systems scholars have drawn on theories of complex-adaptive systems, a line of thinking originating in the Post-World-War-II era and evolving markedly in the decades since. Initial post-war models tended to assume that systems were stable, or at least tended toward equilibrium, and were materially closed. In both economics and ecology, "the key image of science … was one of smooth and continuous returns to equilibrium after shock, an image derived from different vintages of classical mechanics and thermodynamics" (Walker and Cooper 2011, p. 145). This kind of systems thinking was concerned with stability, developing ideas around feedback loops and input/output dynamics to explain the persistence of systems and to set the stage for high-modernist rationalized planning, free of political considerations (Scott 1998). However by the mid-1970s developments in the natural and social sciences called these assumptions into question. Global financial crises following the OPEC oil embargo of 1973, burgeoning social movements along new coalitional lines, and the dangerous environmental outcomes of industrial production (such as those documented by Rachel Carson in *Silent Spring* 1962) dispelled the assumption that complex phenomena could be understood with simple, mechanistic ideas (Walker and Cooper 2011). Resilience in and transformation of systems became open and pressing questions.

As the simplified, mechanistic models proved unworkable, theories of complex adaptive systems (CAS) arose, emphasizing the large and changing web of actors, all continually adapting to changes within the system and, in a non-linear way, shaping overall system behaviors. The CAS model assumes neither order nor chaos as fundamental tendencies, and, in acknowledging the agency of participating actors, recognizes that the behavior of the whole system cannot be perfectly predicted. With these more realistic assumptions, efforts to analyze and influence complex systems continued in realms such as Keynesian economic policy, positivist Chicago School economics, and the landmark *Limits to Growth* report to the Club of Rome led by famed ecologist Donella Meadows (Meadows et al. 1974; see Walker and Cooper 2011).

In food scholarship, ideas from complex adaptive systems inspired efforts to build comprehensive, multidimensional accounts that identify troublesome lock-ins, promising leverage points, and effective policy proposals to push the food system into a more sustainable and resilient state. Three recent, prominent examples illustrate this approach. First the US National Research Council's Institute of Medicine fielded a committee to develop a framework for food-systems assessment. That report (2015, p. 6) explicitly adopted a CAS model. The authors write, "The food system is composed of a variety of actors, including human actors (e.g., farmers, workers, researchers, consumers), institutions (e.g., governments, corporations, universities, organizations), and organisms (e.g., microorganisms or insects). The decentralized behavior and interaction of these actors shapes and modifies the food system; at the same time, actors respond and adapt to changes in the system around them." They confine themselves to the domestic US food landscape, and they organize their framework according to the sequential stages of food production. Similarly, a well regarded public health textbook emerging from interdisciplinary work at The Johns Hopkins University defines food as "a system composed of many different actors at many levels of scale, interacting with each other in subtle or nonlinear ways that strongly influence the overall behavior of the system" (Neff 2014, p. 5). They similarly confine their portrait to the US and describe the system in terms of stages. A third example, operating on a global scale, comes from the foundation-funded International Panel of Experts on Sustainable Food Systems (IPES-Food) which defines the food system as "the web of actors, processes, and interactions involved in growing, processing, distributing, consuming, and disposing of foods, from the provision of inputs and farmer training, to product packaging and marketing, to waste recycling" (IPES-Food 2015, p. 3). IPES-Food reports rely more explicitly on CAS language of lock-ins and leverage points

in order to characterize and advocate for a transition to a more resilient state.

This notion of resilience focuses the lens on the performance of a system. Walker et al. (2004) argue that a resilient system is one that changes so as to "retain essentially the same function, structure, identity, and feedbacks" (p. 5). CAS thinking holds that the essential function of the food system is to deliver adequate nutrition in a reliable and just way, and scholars frame their work to inform and persuade the decision-makers that presumably pursue that goal. For example, the IPES-Food group, in reflecting on the first 100 days of the global COVID-19 crisis, argues that the crisis has "shown the fragility of people's access to essential goods and services" (IPES-Food 2020, p. 1). They explain that the global food system was strained but not yet broken, as various supply chains were disrupted by trade, labor issues, and unemployment, pushing many growers, workers, and consumers over the line from precarity to crisis (IPES-Food 2020). They argue that increasing the resilience of the food system at multiple scales, requires an overall "paradigm shift from industrial agriculture to diversified agroecological systems" at all levels of policy-making (2020, p. 9). Similarly, the purpose of the Institute of Medicine report (2015, p. 4) is to propose an analytical framework for analyses that "inform decision making in food and agricultural practices and policies in ways that minimize unintended health, environmental, social, and economic consequences." That framing too rests on an assumption that policy-makers share their view of the essential functions of the food system.

Here the definitional problem—what is the food system?—connects to the other key dilemma: how to understand and intervene in the stark inequalities of power that shape food system outcomes. Wittman et al. (2017), illustrate the link between these questions in their "socio-ecological systems approach" (p. 1292), encompassing both human society and ecological contexts. They posit "agricultural landscapes" as key units of analysis, defined as "complex adaptive systems nested across scales, which affect both human well-being–including food security–and ecosystems" (p. 1293). These systems are made up of "a set of foundational system properties" that are both biophysical and social-institutional in nature. The role of theory, then, is to "identify leverage points by evaluating the interaction between, and relative importance of, these properties" (p. 1293) in order to guide policy toward interventions that maximize the positive feedback loop between ecological biodiversity and human food security.

While CAS thinking recognizes how food system dynamics reflect their political contexts at multiple levels, it struggles with the problem of how to effect change. Kate Clancy, a leading CAS-inspired scholar in food systems acknowledges "no matter how compelling scientific findings might appear, they are not adequate by themselves to engender legitimacy" in the eyes of policy-makers (2016, p. 8). The challenge, Clancy argues, is to truly change how power-holders think to "find new language to describe agroecology, as well as offering ways to engage new ethical underpinnings as the arguments for a new norm" (2016, p. 8). However, if the problem is that CAS arguments have been insufficiently persuasive to policy-makers, it is not clear that persuasion itself is an appropriate solution. We argue below that Luhmann's model, by recentering the analysis to the *process* of the system rather than its constitutive elements, helps us identify the most promising leverage points in the system.

Commodity as relation: phenomenon and lens

The other major model of the food system comes from a markedly different approach but grapples with the same problems of defining a system and accounting for both power inequalities and apertures for change. This approach focuses on food commodities and the spatial and institutional relationships that they instantiate and reproduce, looking to capital and capital accumulation to explain the dynamics that enrich a few and immiserate many (Bonanno 2017; Howard 2016). Scholars using this commodity-as-relation (McMichael 2009) approach tend to define the food system according to the web of commodity chains, themselves envisioned as a linear series of stages, beginning with agricultural inputs, progressing through production, processing, and transport, and ending with retailing, consumption, and waste disposal. Unlike their CAS counterparts, scholars using a commodity model do not tend to target a policy-making audience, but they grapple with the same twin problems described above: first, how to define the core identity of food systems (and what is inside or outside of them) and, second, how to imagine and promote change.

One source of commodity thinking arose with the new political economy of agriculture in the 1970s (Buttel 1982), which replaced questions about the adoption and diffusion of modern agricultural technologies (an early focus of rural sociology) with critical questions about the political-economic forces impacting food producers and other stakeholders. Clare Hinrichs (2010, p. 19, emphasis in the original) recounts, "Rural sociologists entered new and productive conversations with geographers and anthropologists initially, and later with nutritionists, planners and others about the *food and farming system*." This approach has yielded critical analyses of agricultural industrialization (Friedland et al. 1981), the international division of labor (Cook et al. 2005) consolidation in the food system (Howard 2016), the "disappearing middle" in agriculture (Lyson et al. 2008), and the financialization of food and farmland (Clapp 2014; Fairbairn 2014).

One of the most well-known applications of the commodity-as-relation model to the global food system is food

regime analysis. Its purpose is to "explain the strategic role of agriculture and food in the construction of the world capitalist economy" (McMichael 2009, p. 139). Initially, a food regime was defined as a "a rule-governed structure of production and consumption of food on a world scale" (Friedmann 1993, pp. 30–31). Food regimes mark distinct periods of capital accumulation, each containing its own self-reinforcing structures alongside inherent conflicts and vulnerabilities, leading to cycles of "crisis, transformation, and transition" (McMichael 2009, p. 140). As food-regime scholarship unfolded, the concept's definition shifted. It became "not so much an episodic structure, or set of rules" but rather "a method of analysis" (McMichael 2009, p. 148).

As simultaneously a phenomenon and a lens, the food regime concept confronts the question of food-system identity and boundaries, but from a different vantage than CAS models. When is it analytically productive to draw temporal boundaries around a food regime? In developing the model, Friedmann and McMichael (1989) identified a colonial food regime emerging around 1870 and ending around 1930 and an industrial food regime emerging around 1950 and ending in 1973. Since then, the two authors have followed divergent paths, with McMichael (2005) detecting the emerging contours of a corporate food regime emerging in the late twentieth century in immanent confrontation with food sovereignty and Friedmann (2016) shifting focus to multiple forms of agency at work in moments of crisis and reorganization. Ultimately, Friedmann argues, "food regime analysis is most useful today as part of a wider set of analyses of *transitions*" (2016, p. 672, emphasis in the original), and, in particular, the role of food and agriculture in a post-capitalist world.

In this reframing, Friedmann brings food regime analysis into similar questions of resilience and transformation that CAS thinkers confront. When can it be said that the food system has changed in a fundamental way, and how can those changes be characterized? Some critics allege that the concept itself is ill equipped to imagine and inform efforts at social change because it is overly "structural, universalizing, and homogenizing" (Niederle 2018, p. 1460) and places "excessive weight on processes of hegemonic regime formation, crisis, and succession" (Wilkinson and Goodman 2018, p. 2). Some have proposed, similarly to Friedmann (2016) that food regime analysis could be reformulated to more fully recognize multiple, and perhaps contradictory, processes at work in the food system, including a complex relationship between transnational corporations and the state (Niederle 2018; Pritchard et al. 2019; Werner 2019). Such a multivalent approach can usefully broaden the role of the food regime concept beyond understanding the role of the food system in capital accumulation. Here too we argue that Luhmann offers a distinct but ultimately compatible approach that takes existing structures of power seriously but also underlines the many and shifting contingencies on which they depend.

System as relation

Both CAS and commodity-based approaches to defining and studying the food system are relational in that, in Heldke's terms (2018, p. 252), food's "with-ness" is taken as seriously as food's "thing-ness." CAS approaches delineate the relationships among the human and other elements in the system while commodity-based approaches, like food regimes, examine the relationships instantiated by food production and trade within the capitalist world economy. In different ways, they confront a problem of defining a system's identity in both space (what defines a system, and where are its boundaries?) and time (when has a major transition taken place?). They also both confront the challenge of imagining and promoting greater equity in the food system. CAS thinkers seek to persuade policy makers to effect a system transition, while food regime analysis informs a broad critique of pernicious inequalities on a global scale.

We propose that Luhmann's startlingly different approach to systems marks a productive path forward. First, his operational approach to systems leaves out elements and their relations, instead defining the system in terms of a self-reproducing process, answering the question of system boundaries in a way that goes deeper into the radically relational perspective that Heldke (2018) argues for. Second, his notion of structural coupling directs us to look for power relations in where and how the food system is coupled with other systems, including our own systems of scholarly communication, offering a way to use both CAS and commodity-based insights to imagine and effect change.

Niklas Luhmann's systems theory

Niklas Luhmann's systems theory offers critical agrifood studies a parsimonious, agile, and radically relational model that is both coherent and exquisitely sensitive to context, all while insisting on the core sociological insight that society is something distinct from the individuals who participate in it. Before elaborating a Luhmannian model of the food system, we explain the four interlocking ideas that make up Luhmann's theory of systems: (1) its operational approach, (2) system-as-difference, (3) structural coupling, and (4) the resulting notion of causality.

Operational approach to defining a system

Luhmann (2013) calls his approach to systems thinking *operational*; that is, instead of defining systems in terms of irreducible elements and their relationships to one another,

Luhmann identifies a central process or "operation" that constitutes a system. For Luhmann, the operation that makes the social system is communication. There are two important points about communication in Luhmann's theory. First, Luhmann understands communication as an instance of "autopoiesis": a process that, once set in motion, will recreate itself as long as conditions permit. That term comes from theoretical biologists Maturana and Varela (1980) who observed that life begets more life and that, since the one-time biochemical sparking of life, its self-recreation has given rise to a huge diversity of species. Luhmann sees a useful parallel in communication. Communication prompts more communication, and the one-time invention of language has given rise to a huge diversity of cultures. For Luhmann, communication is what society is made of. Individuals are not part of the social system, but are their own psychic systems, coupled with society.[1]

The second important point is that communication is inherently relational. For Luhmann, communication occurs when there is (1) an utterance that (2) makes a difference, that (3) is understood by another. A meaningful utterance, not received by another does not qualify as communication. Nor would an utterance that conveys no meaningful information. All three are required, and "a social system emerges when communication develops from communication (Luhmann 2013, p. 53). In this way Luhmann theorizes society as thoroughly relational, but without including elements (such as human individuals) in the social system itself. This is a notable departure from CAS theories which define a system in terms of irreducible elements and their relationships to one another.

System as difference

How does communication make a social system, according to Luhmann? Here too he departs radically from theorists who see the identity of a system as a set of elements. Luhmann is inspired by the formal analyses of mathematician George Spencer Brown (1969) to theorize that a system emerges when it is distinct from its environment. A difference must always be two-sided, Luhmann explains, because "there is no form without context" (p. xv). Communication creates a social system that is operationally closed (only communication is in the system) but (as we explain below) structurally open. Luhmann's understanding of "system as difference" provides an answer to the question of a system's identity and boundaries, scaffolding further questions about system structure.

To understand this system-as-difference perspective, we suggest visualizing a tropical storm system which exists as such when the arrangement and motion of molecules in the atmosphere become, as a group, distinct from the surrounding air. For Luhmann, the storm system is not defined by the molecules and how they interact, but rather by the autopoetic motion of air and moisture that leads to more motion as long as the needed environmental conditions persist. The fact that the system has boundaries (even fuzzy ones) marks its existence and draws the attention of meteorologists. When a tropical storm moves over land and dissipates, none of the energy or molecules have been destroyed, but their motion is no longer distinct from the surrounding air. The storm system exists no longer, and consequently one can not be within or outside of it. For Luhmann, a social system has definitively emerged when self-reproducing communication makes a distinction between itself and its context.

Structural coupling

While the system exists in its distinction from its context, it is also shaped by its connections to its environment through what Luhmann calls structural coupling. System structures are not *determined* by their environment or the autopoietic operation, but only those structures that are compatible with the environment can exist. For example, the circular structure of a tropical storm system is created by how the motion within the storm is coupled with warm surface ocean waters, a relatively cold upper atmosphere, the Coriolis effect and other important factors. Neither wind itself nor contextual conditions cause the storm, but the storm system cannot form as a distinct entity without both. Further, defining structural coupling this way, as Luhmann does (2013, p. 71), means that "structures are relevant only in the present." That is, structures are not the potential for or containers of processes, they are rather processes in operation, akin to Giddens's theory of structuration (Giddens 1984; Mingers 2004; Turpin 2017).

Importantly, structural coupling is incomplete. Luhmann argues that a persistent system is coupled loosely with its environment because in order to retain its distinctiveness, the system cannot be responsive to every stimulus (or as Luhmann says, "irritation") from its context or else it loses its defining distinctiveness. Luhmann explains (2013, p. 85), these couplings have "on the one hand, an exclusion effect—in this domain the system is indifferent—and, on the other hand, it brings about the canalization of causalities that can be used by the system." These structured channels of influence, Luhmann posits, mean that leverage points are found in where and how a system is coupled with its context. In this way, systems are characterized by "double contingency"; that is, systems are

[1] While beyond the scope of this article, it is worth noting that Luhmann's (2013) psychic systems and Heldke's (2018) individual are similarly not ontologically indivisible but rather comprised of relationships.

both contingent on certain conditions in their environment and express "the sense of the possibility that things could be different" (Luhmann 2013, p. 235). This is why Luhmann's systems are operationally closed but structurally open.

A third important point about structural coupling is how it frames information. Information, for Luhmann, is recognized and processed within a system only on the system's own terms. To persist, systems must be indifferent to most stimuli, and only those relevant to the system become information. This theory can explain the problem noted by Clancy (2016) above; that policy-makers are seldom compelled by the evidence that critical agrifood scholars find compelling. Scholars in public health have used Luhmann's thinking, and particularly his concept of "polycontexture" within subsystems in society, to explain their similar frustration: why "extremely important research findings (at least, important within public health) … are not taken up by policy-makers" (Meyer et al. 2015, p. 345). Structural coupling shapes which stimuli make a difference in a system. If the food system, for example, is coupled tightly with the financial system, and only loosely with the ecological system, then financial information will be more influential in shaping system structures than ecological information.

Observing systems

Following from his theorizing of information, Luhmann argues that causal claims are meaningful in the observing system, but not necessarily the observed one. He writes (2013, p. 65) that causality means "a judgement, the observation of an observer, a coupling of causes and effects, depending on how the observer formulates his [sic] interests and in what way the observer considers effects or causes to be important or unimportant." In short, "causality is a schema of world observation." Causal explanations have to be selective, Luhmann argues, "and can therefore always be assigned to an observer with specific interests, specific structures, and specific capacities for information processing" (2013, p. 65). Not all stimuli from an observed system (such as the food system) become information in an observing system (such as public policy), because they may be coupled only loosely or not at all, or they may take a different meaning within the observing system. Luhmann's formulation here does not automatically represent either a relativist or critical realist stance (Mingers 2004). Rather, it prompts critical scholars to be reflexive about what we pay attention to and why.

An operational approach to food systems

To build a Luhmannian model of the food system, we must first define the core operation that, in reproducing itself, makes the distinction between the food system and its context. Inspired by Heldke (2018) we propose that the core operation is feeding. Just as communication exists in the relation between the communicators (an utterance of information that is understood by another), feeding exists between multiple actors. Feeding occurs when nutrients are bundled, moved across social, ecological, or geographic space, and consumed.

We use feeding in two different senses: *feeding on* and *feeding of*. As humans, we *feed on* many other species and, as Heldke (2018) notes, other species feed on us and the stuff we take into our bodies enabling us to sustain our lives. As noted above, Brown (2008) reflecting on Mintz (1985) argues that it is meaningful to think of sugar consumers in the nineteenth century as feeding on the bodies of enslaved persons in the Americas. The other sense of feeding, *feeding of*, is more transitive. When a farmer grows vegetables for consumption by others, the farmer is participating in the *feeding of* other persons, and thus coupled to the feeding process on those terms. Or, as DeVault (1991) explains in her analysis of "caring as gendered work", the mother who prepares and manages meals is feeding both the bodies of individual persons and the family as a system itself. Both understandings of feeding are crucial because without the former, our scope would be unnecessarily narrow and anthropocentric, but without the latter we would lose the social, communicative aspect of the system.

The process of feeding–whether *feeding on* or *feeding of*–is what constitutes the food system in this Luhmannian model. Feeding serves well for three reasons. First, feeding, like communication, is relational. Just as a communication requires two participants to achieve both utterance and understanding, feeding requires at least the feeder and the fed-upon, and perhaps the fed. Second, feeding, like communication, is autopoietic. Feeding tends to lead to more feeding, as feeding individuals live to eat another day and as socioecological cycles are renewed through every turn. Third, this concept of feeding enables us to make productive use of Luhmann's concept of structural coupling, directing our attention to how the food system is coupled with its ecological, political, economic, and social environments in particular ways.

We note four consequences of modelling the food system in this operational way. The first, is that only feeding is in the system itself. Everything else is outside the system, and perhaps coupled with it in varying ways and degrees. Things like cultural norms around food and eating, fat phobia, agricultural commodity pricing, systemic racism, and pesticide resistance are not elements within the food system but rather reflect the structural couplings that the food system has with its social, political-economic, and ecological contexts. Similarly, individual human beings are not within the food system. Rather, each participating person or household is coupled with the food system on often multiple and shifting

terms. All living humans are coupled with the food system through their eating (*feeding on)*, and, globally, 60% of the world depends directly on agriculture for survival (*feeding of*) (Zavatta 2014).

A second consequence of the model is that the food system is not only recognizably contingent, but fully structured by its contingencies. That is, feeding relations persist neither by their own internal processes nor by pressures from the environment, but rather through the contingent compatibility of the feeding process and the relevant parts of its environment. To illustrate, we can return to Mintz's thesis from *Sweetness and power* (1985). Mintz's study revealed that the feeding relationship that connected Caribbean plantation slavery to sugar-fueled bodies of industrial workers in Europe is a persistent structure of the food system, and one coupled with anti-black racism in trans-Atlantic societies, emerging commodity markets in the colonial economy, and radical change in Caribbean coastal ecosystems. Luhmann's concept of structural coupling means that the contingencies are two-way. The sugar-based feeding relation did not cause slavery, but it could not have existed (and continue to exist) without slavery. Likewise, the slavery system was not caused by the sugar trade, but it was contingent on all of the systems with which it was coupled, and it would have been different in some unknowable ways if it were not coupled with the food system through industrial sugar.

Defining the food system as contingent is not to say that it is formless or unknowable. Rather, the notion of structural coupling offers us analytical purchase in two ways. First, because the food system is not coupled with its environment at every possible point, there is in Luhmann's words, "the canalization of causalities" (2013, p. 85). Some food activists seek to decouple feeding from other systems, such as disrupting how farmland is enmeshed in financial instruments (Ouma 2020). Others seek food system change by establishing new couplings or reshaping existing ones that connect feeding processes to public policy (Gupta et al. 2018), international human rights institutions (Bellows et al. 2016), political-economic systems (Cadieux et al. 2019), or ethical and cultural norms (Broad 2018). In this way, Luhmann's thinking is broadly compatible with other approaches to critical agrifood studies, offering a new framing for long-standing questions in the field about how to shape food systems that promote social and economic justice.

A third important consequence of modelling the food system this way is that it posits one complex food system encompassing conventional, alternative, charitable and non-commercial feeding relations alike. In this we are emboldened by powerful critical analyses of alternative food-system channels that show that even the most creative and impassioned projects do not fully escape the capitalist norms and institutions of conventional, industrial food (Guthman 2014; Poppendieck 2014; Sbicca 2018). Positing a single system does not preclude study of more specific feeding relations, demarcated by sector or geography. Rather, this Luhmannian approach aligns with the method of incorporated comparison as developed by McMichael (1990) in that these spaces of feeding relations and the food system as a whole are mutually constituting and continually contingent. Like McMichael, Luhmann's system is always in the process of becoming, and that becoming is contingent on the structural couplings of system and environment. Similarly, neither framework presupposes the parts, but regards the structures (Luhmann) or cases (McMichael) as continually produced by and productive of the larger whole.

A fourth important consequence is that Luhmann's framework encourages us to recognize that, as observers of the food system within a shared academic community, we can usefully see ourselves as an autopoietic social system. That is, we should recognize that information about the food system enters our own observing system incompletely, through selective couplings, and is made sense of in our own terms. For example, many food-systems assessments and analyses rely heavily on indicators available in publicly available datasets, often obscuring important qualitative and dynamic factors (Ludden et al. 2018), demarking particular connections among the food system, public-sector data collection, and academic practices. Similarly, a phenomenon that Porter and Wechsler (2018) pointedly name "academic supremacy" shapes how resources and power operate in collaborative community work in food systems and, ultimately, which observations and insights enter into scholarly exchange. On the other side, food system researchers have seen ideas and information enter into other polycontextural realms its producers did not intend, such as profit-seeking efforts to develop and promote "natural" labels or distracting programs to address food injustice with tax incentives for retailers (Alkon et al. 2019; Campbell 2009; Guthman 2014). In this way, applying Luhmann's theory to agrifood studies inspires a deeper-going reflexivity.

"All models are wrong, but some are useful"

Luhmann's operational approach offers a new perspective on perennial questions about the food system. We argue that defining the food system in an operational way with the relational process of feeding, coupled as it is with its social, ecological, and political-economic contexts, enables us to resolve the issue of a system's identity and scaffold further explication of system change. Putting people definitionally outside the food system counters how we usually think of human individuals as driving subjects in all of social life, but it is necessary to dismantle the ontological individualism that Heldke (2018) decries and unlock new insights. Nevertheless, we agree with

statistician George E.P. Box who has repeatedly pointed out that "all models are wrong, but some are useful" (Box and Draper 1987, p. 424). The Luhmannian model we describe, like all models, is "wrong" in some ways. Here, we address two areas for further conceptual development: (1) we need more precise and telling ways to characterize structural couplings in order to (2) develop and situate new insights about how the food system can change, and about the systemic exercise of power.

Luhmann's *Introduction to Systems Theory* (2013) gives us few conceptual tools to account for structural couplings, beyond characterizing couplings as "tight" or "loose" and asserting that systems must, to maintain their distinctiveness, be indifferent to most external stimuli. While useful, that insight in itself does not explain how structural coupling can be linked to system behavior. For example, the COVID-19 pandemic has revealed stark differences in outcomes for farmers depending on their connections to feeding relationships in the food system. As the virus disrupted the feeding relations coupled to the restaurant industry and institutional kitchens (such as schools), farmers more tightly coupled to that feeding relation lost their markets, resulting in massive food waste and acute financial hardship (Corkery and Yaffe-Bellamy 2020). On the other hand, farmers more tightly coupled to feeding relationships structured through CSAs, farmers markets, and similar networks have been thriving (O'Brien 2020). The Luhmannian framework helps set these couplings in relief but does not in itself provide a clear way of predicting whether and how this crisis will transform the food system as a whole and in what ways.

To address this lacuna, we note that existing insights from careful empirical work in CAS, commodity-based approaches, and other frames can be used to characterize structural couplings and understand them more fully in their systemic context. Wittman et al. (2017) give us one exemplar in their comparison of two distinct agricultural landscapes in Mato Grosso, Brazil. They find that while the soybean landscapes and small-scale family farm landscapes are agricultural systems embedded in the same geographic region, their interactions with social and ecological subsystems are so distinct as to have very different impacts on both human food security and biodiversity. In Luhmannian terms, both of these systems are defined by the feeding relation, but they are coupled to political and ecological systems in very different ways, producing very different structures and outcomes. The soybean landscape is tightly coupled to the global industrial meat complex, for instance, while the small-scale family farm landscape is tightly coupled to local food security concerns. The structures and outcomes produced through these couplings–rapid biodiversity loss and concentration of wealth in the former system, increased biodiversity and local food security in the latter–are contingent on these relationships.

However, studies like this still use a parts-and-whole conception of systems, and we argue that an operational approach can provide new insights into how these landscapes are relationally constructed through feeding. The model that we propose can guide empirical work that identifies points of contact between system and context, the resulting system structures, and the lock-ins and leverage points that allow for activists and scholars to direct our efforts most effectively for system change.

This leads to the second issue: the framework does not itself explain inequalities of power in the food system. Elsewhere in his huge opus, Luhmann (2017) addresses power in society, but only as one medium among several (such as trust, love, and money), and he rejects theories of power that he deems ideological (see Borch 2005), a move that would seem to confirm Bell's (2008) misgivings about the conservative bent of system-thinking in general. While Luhmann may not directly develop a theory of power that serves our model, we argue that relations of power are reflected in the way that systems respond (or not) to information, as we discussed above. The ability to convey information that is recognized as such by the system leads to influence over system structures. Borch (2005) addressing the question of how to bring power into Luhmannian theory in a more critical way, argues that "power is nothing but the name that is given to this communication" (p. 160), which the system recognizes as information.

Structurally, then, we can understand power in a Luhmannian system as a process of exclusion. As systems only let in certain stimuli that are recognized as information, by definition they also exclude and oppress all other signals from the environment. As Daly (2004, p. 13) explains "a system can only be instituted through logics of exclusion and antagonism that in providing the sense of limits are constitutive and affirming of its positive content (a 'notsystem' in order for a 'system'). Accordingly every system is a power construction that relies upon the repression of its Other". In applying Luhmann's framework to agrifood studies, then, we might look to the stimuli that are *not* recognized by the system as information for potential sites where power is contested. In their case study in Mato Grosso, Brazil, Wittman et al. argue that "the ability of a small number of people to maintain institutions favorable to their interests, and disrupt institutions that may in fact generate better outcomes for biodiversity and food security reflects the common problem of 'elite capture' and other inequities in power and governance" (2017, p. 1296). That which is outside the system is not shaped by it, creating, Daly argues, perpetual "antagonistic frontiers" (2004, p. 17) which undermine the naturalism and inevitability ascribed to the capitalist economy. If capitalism is a system, then it, and the feeding relations with which it is coupled, are as contingent as any other. Just as epistemological systems reinforce the supremacy of those in power

by determining what information counts as "knowledge," all social systems reproduce power relations by differentiating between what counts as signal and what is merely noise.

Conclusion

After decades of critical agrifood studies and the astonishing insights yielded in dialogue among cultural, political-economic, and ecological frames, why bother pursuing a new approach to food systems? Critical agrifood studies is not broken, after all, and scholarship stemming from commodity-based and CAS perspectives have revealed much about how the food system both reflects and recreates inequalities of power and privilege. We argue, however, that Luhmann's theory enables us to go deeper into a relational perspective. The operational framework inspires us to argue that we can productively conceive of the food system as the set of autopoietic feeding relationships, regarding everything else, including human beings (themselves their own systems), as structurally coupled with the food system. Just as Heldke (2018) asks us to think of the human individual, not as a billiard ball with a distinct inside and outside, but rather as a tube through which the whole universe passes, we use Luhmann to think of the food system, not as a whole made of distinctly identifiable parts, but as a process of feeding that orders both ecological and human life. To subsume structure to process may seem to leave us without any kind of grip on what the food system *is*, but we would argue that it frees us to look beyond structure-as-object to the relational processes that create it. While this perspective leaves us with some work to do in conceptualizing power, it gives us analytical purchase by encouraging us to, first, understand power in the food system as always relational and, second, look to what is excluded from the system as possible leverage points for change.

With this framework, we see expanded opportunity to integrate multiple critical perspectives on the food system into a common conceptual space. In Luhmann's ruminations on complexity (2013, p. 87), he notes that "language excludes a lot in order to include very little, and that it can become complex only for this reason." A spoken language, he continues, has "only a few standardized pitches and acoustical signs. But it is precisely because these signs or sounds are so reduced that they make possible highly complex combinations which, in turn, have an effect on conscious and communicative processes." We hope, in a similar way, that a process-driven, relational framework anchored on three simple points—(1) the food system is made of feeding relationships, (2) distinct from its contexts, but (3) structurally coupled with them—enables us to construct coherent accounts of the food system that speak strategically to our concerns. In doing so, we also appreciate this Luhmann-inspired framework for prompting us as individual observers and scholarly communities to be continually reflective about which structural couplings we have chosen to focus on and how we make sense of them within our own system and also to be mindful that prompting change means engaging other systems on their own terms.

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