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Studying food systems as embedded, sensory phenomena

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This article offers a theoretical foundation for pursuing transdisciplinary food systems research, informed by deep sustainability and equity, across various scales of the system. It weaves together ontologically aligned, food-relevant social theory from ecofeminism, agroecology, ecological economics, systems theory and food systems scholarship, sensory studies, geography, and sociology. The epistemologies and associated methodologies of this literature all take seriously the physical laws of nature, while also recognizing that knowledge is situated in persons and places, and that people's experiences of the world are an important part of what we can know. They all recognize the urgent need to reorient Western mental modes and their destructive, attendant material relationships. Epistemological integration rests upon ontological convergence of embeddedness, embodiment, and the context for change, calling for a methodological approach of ethnographic, qualitative, and sensory research. No conception of the food system is complete without attending to the visceral, human experiences that shape it. Embeddedness and embodiment therefore offer an avenue for connecting information across different scales of the system, from the individual to the biosphere, allowing for the macro level to help make sense of the micro, and for the micro to reflect, resist, and alter the macro. Here, a new and better world is imagined and created through our bodies, in dialogue with and resistant to hegemonic power, and sensory research is key to understanding how things must and could change.

KEYWORDS

food systems, transdisciplinary, sustainability, embeddedness, social theory, methodology

Introduction

How do we imagine a better world? This is, arguably, a fundamental question of our time, perhaps of any time. It can be interpreted two ways. What do we imagine a better world would be like—what components would make it preferable to our current reality? And, equally, how do we go about imagining something that does not exist, stretching our imaginations past what appears immediately possible?

Those of us in science, particularly the applied sciences, spend a lot of time thinking about problems and grasping for solutions. Our culture has been shocked out of its illusion of progress and wellness and into an increasing awareness of what critical scholars, advocates, and disenfranchised communities have known for a long time: that the very structures of society and economy are eating away at any long-term sustainability of human civilization. The logic of accumulation, domination, and separation from nature that underlies Western society exploits humans, other species, and ecosystems alike (Mellor, 1997; Merchant, 2003). "One of the penalties of an ecological education," Aldo Leopold wrote nearly a century ago, "is that one lives in a world of wounds" (Leopold, 1993, p. 67). These days, we live in "a world of hemorrhage" (Brown, 2016).

Ecological awareness does not by itself solve anything. The trouble is, all major problems we face—in energy, environment, climate, food security, and economics—can only be fully understood when seen as interconnected and interdependent (Capra and Luisi, 2016, p. 362). We see reformist remedies fail time and again because they do not root out the underlying worldview that originates the issues.

One of the most effective places to start dismantling the perception of hierarchy and the manifestations of domination is with food. Food is the immediate, visceral locus between human and environment, the place where the boundaries of our bodies are so clearly permeable, in constant physical dialogue with the world and culture around us. It blurs the boundaries between self, society, and the entire world. This fundamental relationship is a critical place for repair—our existence depends on it. It is also a site of ongoing resistance against the alienations of capitalism, as people are already trying to change the world through the way we grow, share, and eat. Food cannot truly be understood or leveraged, however, with the same objectifying and distancing lens that causes crisis in the first place. We must remove the assumptions of domination from our work. We must do so with the intentional choice of theory, questions, and methods that see the world in its whole, connected state.

Food systems is a developing field, and how to more effectively and equitably pursue its study remains an open question. Those of us practicing transdisciplinarity have nearly endless methodologies available and no traditional pathway for rigorous processes occurring at the intersection of established fields (Creswell and Plano Clark, 2007). The field has not yet attended carefully to the sensory and embeddedness insights inherited from anthropology and social theory broadly. We have an incomplete conception of the system when we leave out the human body, and I argue here for integrating social theories of embeddedness and embodiment and ethnographic methods into systems framing and analysis. These material and social aspects must be tied together using a coherent theoretical framework, for truly transdisciplinary research that attends to lived experience: the root of human reality and our understanding of the wider world.

This article therefore offers a theoretical weaving of aligned, food-related scholarship as a framework for researching food systems as they are now, and as we might strive for them to be. The weaving includes a justification for action-oriented research and a blending of literature on feminist studies and ecofeminism, agroecology and sustainable agriculture, ecological economics, systems theory and food systems scholarship, sensory studies, geography, and sociology. This diverse literature ties together through notions of embeddedness, embodiment, and the context for action, which build to a cohesive transdisciplinary methodological approach. It is an argument for and invitation to study food systems with particular attention to the social and environmental values they manifest. Precisely because "systems" are far-reaching and enormously complicated—and thus abstract in our attempts to represent them—attention to relation requires sensory and social interrogations. A better, more sustainable world currently exists only in our imaginations: which is to say, in our bodies.

Food's connective power

Food is a natural place for reimagining human-natural systems. It is an obvious, tangible, constant connection between humans and the rest of nature. It is both emblematic of, and a material contributor to, distressed environmental and social relations. There is a huge corpus of literature on how food, particularly agricultural production choices and food waste, negatively affects the environment. For instance, a systematic review of climate change causes found that food is one of the largest contributors and, therefore, one of the ripest places for change (Hawken, 2017). Although estimates differ, many agree that food systems contribute between about 20 and 30% of all greenhouse gas emissions (e.g., Vermeulen et al., 2012). Agriculture causes many other environmental harms as well, including soil degradation, water pollution, and decreased biodiversity, among others (Cleveland, 2017). Additionally, the effects of climate are both disproportionate in cause and effect: rich countries emit much more while poorer countries feel much greater climate effects, on average (Kreft et al., 2015; Piketty and Chancel, 2015). Thus, food is a place of relational crisis, both in terms of human relationship to the environment and also with each other. If we try to pick out anything about food, we find it hitched to everything else in the world (cf. Muir, 1911). It represents many aspects of human experience; it is both material and abstract, biological and cultural, ephemeral and ongoing, scholarly and domestic, theoretical and quotidian. It also possesses enormous possibility for reform, as seen in recent efforts to re-embed food systems in ecosystems and cultural practice.[1]

Because it touches so many arenas of human and non-human life, we must examine the connections to see the whole picture; food's multi-faceted and interconnected nature requires us to see it through more than one discipline at once, and at vastly different scales. Its environmental entanglement, cultural primacy, and biological imperative mean that we must study it in terms of the systems in which it operates. As a body of study, food systems encompasses all the physical and social components, actions, and consequences of food. It involves interaction between human and biophysical environments, including many activities (from production through consumption) and many outcomes (from food security to environmental effects to social welfare; Ericksen, 2008). Outcomes range in scale from individual wellbeing to the human breaching of planetary natural resources boundaries

1 Recent efforts are especially notable in agroecology, food sovereignty, and regenerative agriculture research and action. Agroecology, a science, movement, and practice (Wezel et al., 2009), both studies and advocates the application of ecological concepts and principles to food production, for better environmental and health outcomes (Food Agriculture Organization of the United Nations, 2019). The field of food sovereignty, intricately connected to agroecology, asserts "right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Via Campesina, 2007). More recently, the buzzword of "regenerative agriculture" has reached mainstream conversation in the United States (e.g., Feldman et al., 2020; Velasquez-Manoff, 2018; Drawdown Solutions, 2017). For a review of how agroecology and food sovereignty's struggles and opportunities to more fully embed practices in local culture and practice, see Morgan and Trubek (2020).

(Ingram, 2011); even on the small scale, food activities are linked to global challenges. Primary areas of concern often identified in food systems—all complex and multidisciplinary in their own right—are the economic, social, and environmental, also known as the "three pillars of sustainability" (Allen and Sachs, 1991; Van Cauwenbergh et al., 2007). Whenever possible, attending to all three as intertwining strands, rather than standalone pillars, creates a more comprehensive picture of causes and effects.

Food's connective power means that understanding it requires not only seeing systems' manifestations, but also the values and relationships driving those outcomes. As Tsing (2015) writes in her treatment of foodways and capital accumulation, the global history of wealth concentration has been a history of alienation, of both people and things. "Alienation obviates living-space entanglement" in which we all exist (p. 5). Yet food contradicts attempted alienation. Some of us may be able to distance ourselves from how food is produced, distributed, but at the supply chain's end, we arrive at the most intimate moment of connection: we absorb that alienated thing into our own bodies, and remake ourselves with its matter (Alaimo, 2017). Even scalable, capitalist modes of production cannot fully erase living-space entanglement.[2] Worthy food systems scholarship incorporates such patterns of connection and reconnection. Whether people are trying to reconnect through food or to food is an open question—but narratives of separation and connection weave throughout empirical analysis I have conducted on these questions (Morgan, 2021).

Connections across disciplines

The Anthropocene era of human-dominated earth systems requires particular ways of thinking: economically heterodox, transdisciplinary ontologies and methodologies, ways of seeing both the problems and potential alternatives (Crownshaw et al., 2018). The same conceptual orientation is needed for food research in this era. Traditionally, agriculture, for example, has been highly disciplinary and focused on natural sciences, measuring success primarily in economic terms and not accounting for environmental, social, or unequal economic impacts (Francis et al., 2008). At the most egregiously disembodied end of the spectrum, a Nobel laureate economist has argued, for example, that because agriculture only accounts for a small amount of GDP, destruction from climate change will be of minor impact on the economy—as if that would not end all human life (and the economy with it; Daly, 2000). Food disciplines "from anthropology to zoonosis" remain relatively siloed in different parts of the food chain (From Silos to Systems, 2020), siloed away from social considerations. Food systems study, on the other hand, is by nature transdisciplinary: a cross-boundaries attempt at holism, informed by systems theory. For systems thought leader Meadows (2008), the "right boundary for thinking about a problem rarely coincides with the boundary of an academic discipline" (p. 98). In food, from seed to waste, that system leads from ecology and its subdisciplines through agronomy, technology and physics of distribution, economics, labor, food culture, food regulation and policy, geographic context, health and nutrition, gastronomy, social practice, nutrient cycling, and biosciences from climate to waterways—to name just a few. Transdisciplinary research can offer a better understanding of these kinds of complex contexts in socioecological systems than traditional academic silos (Knierim and Callenius, 2018). It is conducted explicitly to solve complex, multi-dimensional problems that involve the interaction between social and natural systems (Wickson et al., 2006; Knierim and Callenius, 2018). It is distinct from multidisciplinary and interdisciplinary research, which are organized around themes or around groups of people (Wickson et al., 2006). Transdisciplinary research is instead an integration, not merely a collection, of several disciplines all brought to bear on the same subject (Méndez et al., 2017). A wide diversity of recent food-and landscape-related studies take a transdisciplinary approach and defend it as critical for understanding their subjects' complexity (e.g., Farley et al., 2011; Morse et al., 2014; Mares, 2017; Méndez et al., 2017; Trubek et al., 2017). Despite this increasing recognition, the human bodily experience has generally not been integrated into data collection or analysis, although there are important and instructive exceptions, especially from geography and critical food studies (e.g., Turner, 2011; Slocum and Saldanha, 2016; Sarmiento, 2017).

The transdisciplinary field of ecological economics has long debated the merits of free-for-all methodological pluralism vs. a reasoned and intentional selection of complementary epistemologies and methodologies: complementary in that they share an overarching ontology and are not in foundational conflict, lest the resulting findings be essentially meaningless (Spash, 2012). Complementarity is necessary for new transdisciplinary fields to conduct good science outside the established processes of a particular tradition. It is also, I believe, the only way transdisciplinary researchers will convince academic traditionalists that the knowledge we generate is legitimate and enduring, particularly those of us in social and especially qualitative sciences. Developing rigorous food systems methods involves connecting knowledge bases that are compatible enough to generate coherent results. The epistemologies and associated methodologies reviewed below all take seriously the physical laws of nature (Spash, 2012) while also recognizing that knowledge is situated in persons and places (Haraway, 1988) and that people's experiences of the world are an important part of what we can know, in line with a lineage of feminist thought that exists in a space between realism and relativism (Koggel, 2007). In the context of empirical work, the balance between these stances may arise in a number of ways, including the complexities between different measures of environmental impact when considering "sustainability" in agriculture; or recognizing that people's food and diet choices are socially meaningful, involving, but not reducible to, discrete measurements of nutrient intake or carbon emissions. It also means incorporating practitioner and citizen knowledge as legitimate and significant (Scott, 2016).

Such a multi-faceted perspective shows up in various inter- and transdisciplinary fields linked to the study of food systems, including ecological economics, agroecology, food agency theory, and systems theory. I draw upon all of these—along with anthropology, geography, sensory studies, sociology, and

2 For example, even highly automated, conventional dairy farms rely on human care work for cows to survive and produce milk (Overstreet, 2018). In this case, capitalism relies on, rather than erases, connections between people, other species, and the places they produce food.

philosophy—as complementary ways of understanding agriculture, the food economy, embodied experiences, the relationships between them, and the larger systems within which they exist (different food systems scholars may assemble different groupings, but they should be similarly compatible). One way of framing this approach is "ecological thinking," as offered by feminist theorist Code (2006) as a response to the reductionist, atomistic, Cartesian tendencies that dominate much of science (Merchant, 2003; Plumwood, 2003). The features of this approach are the braiding of epistemological, moral, and political research implications; use of multiple disciplines; knowledge as provisional, dynamic, and changing; possibilities and limitations arising from context; "responsible knowing" as a product of engagement with the world and with critical reflexivity; and the upholding of material and embodied realities (Koggel, 2007, p. 180). "Ecological thinking, then, can be said to have promise for capturing the complexity of a world that reflects the continued effects of histories of oppression, colonialism, and imperialism and the ways in which global factors are increasingly shaping and reshaping people's lives, communities, ecosystems, and the world as a whole" (p. 179). In other words, it reflects the complexity of causes necessary for repairing the effects. This way of thinking is imperative. It is also a tall order for a scientist who needs to draw a boundary around a research subject. I discuss methodological approaches to grounding such an encompassing view in practicable empiricism.

Sensory and change-oriented research

A world in crisis and transition will, of course, affect academia along with everything else. The world is in third-wave countermovement to privatization; a global reaction against the commodification of nature, land, and natural resources (Burawoy, 2009).[3] Living in such a countermovement reframes the understood role of the scientist. The trend toward research intended to make an impact is happening in various social science fields, both theoretically and methodologically (Pink, 2015). Intellectuals have a dual task, both analytical of the world as it is and normative about how it could be (Burawoy, 2009). It is not accurate to posit research as value-neutral, because the act of attention to a problem is itself a value judgement, as is any analysis of its possible solution. And if research is not value-neutral, scholars have the responsibility to choose their subjects to reflect both reality and what could yet come into being. Because of our own inherent subjectivity, interpreting the world is ultimately inseparable from changing it (Shotwell, 2016). I therefore rely on scholarship concerned, explicitly or implicitly, in diagnosing and repairing problems in the food system related to "white supremacist, colonial-imperialist, hetero-patriarchal capitalism" and problems in the Anthropocene (Khasnabish, 2019, p. 6), as I subjectively and with extensive evidence diagnose these as the most damaging drivers of environmental and social exploitation in our time.

Awareness of human-generated crises in ecological and social justice has arisen alongside what has been called the "sensory turn" in ethnographic scholarship, in which scholars pay greater attention to what can be learned from the human senses. This "turn," detailed below, is part of a wider shift in how academics understand the world and how we might intervene in its workings, through design, education, policy, education, or community engagement (Pink, 2015, p. xii). Paying attention to these future possibilities, as they play out in daily efforts, can be termed "ethnographies of the possible" (p. 47), inherently linked to change-based research.

Huge research gaps remain in this process. Although the idea that we need to radically transform human systems is becoming more widely acknowledged, it does not necessarily come with the knowledge about how to get from here to there (Gobby, 2019), or even where there is. What, exactly, are we working toward? While we ponder this, the world continues to transform. In a world of constant upheaval, the question might not be how to create change, but how to shape it (Gobby, 2019), through deep knowledge of what is being attempted and its odds of success.

Embedded, embodied, emplaced

In line with a transdisciplinary systems lens, in line with ecological thinking, this approach to food systems study is at its core informed by a theory of human embeddedness in the broader world. Theory is an underlying component of any scientific endeavor, whether explicit or not, and how we make sense of the world's "infinite manifold" (Burawoy, 2009, p. 13). The approach is also framed by the normative ideas that sustainability and justice are important in their own right and critical to the thriving and survival of humans and the rest of nature. Again, this framework is informed by theories from various complementary disciplines, which are necessary for understanding food in all its complexity—as a system, a material object, a cultural phenomenon, and a personal and universal experience.

The term embeddedness originated in social theory to describe how the market economy functions within, not independent from, the larger social world (Polanyi, 1971). It has since been used more generally as a way to understand the context of various social phenomena (Schmidt, n.d.). In current food systems literature, embeddedness may refer to the relationship between economic and social behavior (Migliore et al., 2014) or more broadly to "the context in which actions take place, the values that drive those actions, and the manner in which the two affect and are affected by one another" (Ament et al., 2022, p. 6). The market is embedded in social contexts, and likewise our social contexts include market sensibilities (Hinrichs, 2000).

I also follow categorizations from ecofeminism and cultural anthropology, which argue that human activity takes place within broad environmental and social contexts and must be understood as such. In ecofeminism, embeddedness goes beyond "shallow

3 The process by which nature and "natural resources," itself a contested categorization because of its anthropocentric framing (Brown, 2004), become exchangeable, both in terms of trading private property, and in terms of being indistinguishable from each other. The counterpoint to this is that nature and place are highly specific, not under the pure domain of humans, and valuable in their own right far beyond market mechanisms. For an overview of how (Western) humans developed this idea of nature, see *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet* (Patel and Moore, 2017). A "classic example" of the commodification of household activity is food (Wright, 2010).

ecology"[4] to say that humans not only rely on the physical environment, but are interconnected and interdependent with the entire natural world (Mellor, 1997, p. 1). The fact of *immanence*—that humans live embodied lives, embedded in physical worlds—has serious implications for understanding food as both a relational and physical object. As ecofeminist scholar Mellor (1997) writes:

> Awareness of immanence makes the concrete relations of any product virtually infinite. Who grew/extracted the raw materials? Who made the components? Who made the transport that brought it here? Who drove it? What energy was involved? How do all those people live? What do they consume to support their work? What emissions or elements will the object and the processes that created it break down into? Where will they go and with what effects?... the life history of a product destroys the neoliberal notion of the independent consumer and the autonomy of economics processes. (p. 195)

Ecofeminism argues that the logic of domination and accumulation that capitalism applies to natural resources is mirrored in its treatment of women, people of color, and other exploited groups. Therefore, true sustainability can only be achieved by reconfiguring our cultural and economic relationships both to the environment and to human citizens. After nearly a decade of pause in the field, young scholars (e.g., Abatemarco, 2018; Ruder and Sanniti, 2019; Ament, 2020) are taking up ecofeminist theory and allied scholarship (e.g., Shotwell, 2016; Alaimo, 2017) as it is uniquely suited to connect and explain the multiple forms of domination and exploitation we see across humanity and more-than-human lifeworlds; it is likewise uniquely suited to get at the root causes and therefore possible solutions. While it has been justifiably critiqued at times for being overly white-centric in its outlook and authorship, ecofeminism is, and should be, intersectional (Kings, 2017); it recognizes domination to be spread across identities including gender, sexual orientation, class, and color (Mellor, 1997). Ament (2020), writing in the tradition of ecofeminism and ecological economics, argues that an ontology of social and environmental embeddedness comprehends that "an objective biophysical reality exists independent of humans, ecological and social processes are interconnected and co-evolutionary, and facts about social and environmental reality are inseparable from values" (p. 171). We are products of the social and environmental contexts in which we operate, affecting and affected by them.

Embeddedness underlies other fields directly applicable to food. Ecological economics, for example, argues for understanding the economy as nested within the biosphere, taking in materials and expelling waste (Daly, 1992), subject to the realities of resource flows and of physical laws (Georgescu-Roegen, 1975). The current ecological crises of agriculture occurred because agricultural and economic systems do not allow for the physical realities of ecosystem functioning (Farley et al., 2011). In agroecology literature, agriculture is understood as embedded in ecosystems (agro-ecology) and in broader social systems, integrating ecology, society, and economics (Simón Reardon and Pérez, 2010). Embeddedness is especially important to understanding alternative food systems projects, which are often driven by explicit acknowledgment of the contexts in which they operate, and by social and/or ecological values rather primarily by profit (Sonnino and Marsden, 2006; Galt, 2013; Jones and Tobin, 2018; Ament et al., 2022).

The goal here is to identify which fields' methodology will illuminate the parts of the system we deem most important to consider. This is the reason ecological economist Spash (2012) argues strenuously against using neoliberal economic methods, because the underlying ontology and epistemology imports foundational assumptions about the world that are directly at odds with research on nested biophysical and social systems. Similarly, agroecologists would not argue for purely economic measurements of agroecosystems because the approach ignores the very systems, ecology, and resiliency about which the field is most concerned. Transdisciplinary food systems scholars must lay out its guiding lens and design research accordingly.

As Mellor's explanation of immanence makes clear, notions of embeddedness lead to notions of embodiment, connecting human-natural relationships across scales. As a term, embodiment has a complex lineage throughout social sciences, including anthropology, cultural studies, philosophy, and sociology. In anthropology especially, it refers to the "porous, visceral, felt, enlivened bodily experiences, in and with inhabited worlds" (Harris, 2016, para. 1).[5] Like feminist critiques of Enlightenment science, embodiment inherently rejects mind-body dualism, which puts (supposedly male) mind-based rationality above felt, "feminine," more animal bodily concerns. Instead, embodiment integrates different methods of cognition in the world (Lock, 1993). Embodied epistemology has been called "knowledge-in-action that is the basis of social practice and world making" (Wolputte, 2004, p. 258), similar to the multifaceted understanding of agroecology as a science, social movement, and (embodied) practice (Wezel et al., 2009). This is a strategy for linking broad domains of inquiry about food systems and ensuring that they are ontologically compatible.

One of the most direct, tangible ways of reconnecting to the realities of food is through our human senses. An embedded, embodied understanding of ourselves—as in and of the biosphere, as beings with breachable boundaries—changes one's perception not only of what to study, but how. Three decades ago, Haraway (1988) called for a "feminist objectivity" in science. This was, she claimed, the recognition that all knowledge is situated in a particular place and is partial, because humans are not all-seeing. One could call this "science from somebody." Other scholars have since called for generating knowledge, rigorously, from our selves. Feminist legal scholar Scott (2016), for instance, collaborates with citizen scientists on polluted indigenous land reserves in Canada. There, where the government and industry do not collect adequate

4 The implication that ecological function is only important insofar as it relates to human interests.

5 There are many ways in which embodiment shows up in anthropological literature, let alone in other disciplines. Broad sub-fields of embodiment in anthropology include aesthetics, autoethnography, bioethics, biopower and politics, social/material/spiritual aspects, gender, kinship, race, economics, cultural/national identity, and sensory studies, including taste (Mascia-Lees, 2011). Social/cultural aspects of embodiment, taste, and sensory studies are especially relevant to empirical work on sustainable food systems. A review of relevant sensory studies literature follows.

data about ongoing chemical contamination, residents use their own bodies to generate knowledge about their environment, monitoring pollution through their physical senses. Scott explores this body-place dialogue through "paying attention to and with" the body (p. 277, emphasis original).[6]

In studying the margins of global capitalist food chains, Tsing (2015) contemplates that it "is time to reimbue our economy with the arts of noticing" (p. 132), in an anthropological sense—to make again personal and immediate what has become distant and homogenous, and consider that process of knowing to be legitimate. We need to take this approach not only with the economy, but also with the entire food system. Scholars, notably also from anthropology, have begun this work (e.g., Gould, 2005; Trubek, 2008; Højlund, 2015; Mann, 2015; Mares, 2019). It is time to bring such observations from the anthropology of food into food systems analyses more generally.

To this end, as mentioned above, social sciences and humanities in recent decades have undergone a "sensual revolution," necessary for a full understanding of cultural and personal experience (Howes, 2005a), both fundamental aspects of the study of food. Sensory ethnography in particular has been used across disciplines, both scholarly and applied (Pink, 2015). Such new efforts undermine historical Western hierarchies of the senses, starting with Aristotle and Plato and continuing through Enlightenment Europe, which posit sight and hearing as "higher" senses, associated with rational thought because of their distance from perceived phenomena; and smell, taste, and touch as "lower," associated with women, workers, and non-Westerners, in part because of the immediacy and more "animal" nature of these senses (Howes, 2005a,b; Mazzio, 2005).[7] These are, of course, the senses most directly related to the sensations of eating food. This philosophical tradition actively advocates a separation of humans from the world and puts more trust in the senses understood to be distancing and abstracting of that which is perceived. Medieval, Renaissance, and Enlightenment thought continued this trend, establishing "a subjectivity separated from nature, protected by mediation, and propelled by a desire born out of the very estranged relation thus created" (Stewart, 2005, p. 62). The historical suppression of sensory powers in Europe corresponded with patriarchal science's oppression of women, "witches," and domestic and healing knowledges (Classen, 2005b)—like ecofeminism, linking patriarchy with the suppression of diverse ways of being and knowing. Even a socially-oriented field like agroecology, for instance, has not fully integrated the embodied and sensory practices of cooking and eating into the analysis of agroecosystems (Morgan and Trubek, 2020).

Scientists now, however, may engage with all senses as ways of knowing through the body, with the recognition that the senses mediate "between self and society, mind and body, idea and object" (Bull et al., 2006, p. 5). A sensory approach to science blends the different theoretical traditions on which this article draws. Using the senses to generate knowledge rejects the classical mind-body dualism critiqued by ecofeminism, by recognizing that the mind is itself embodied (Bull et al., 2006). Cultivating the senses is a way to recover power over the body from the economic alienation of capitalism (Stewart, 2005). Understanding place, in particular, is a multisensory endeavor, involving not only sight but all the senses (Feld, 2005; Bunkše, 2007). According to some sensory scholars, an extension of embodiment is emplacement, which "suggests the sensuous interrelationship of body-mind-environment" (Howes, 2005a, p. 7)—another way of seeing nested systems, or the body-scale within the landscape-scale. Even the question of sustainability may rely on human sense, for it is through our senses, directly or through the extensions afforded by technology, that we track environmental damage (Scott, 2016). Human meaning exists "in the contingencies of the body itself, and with its environment" (Connor, 2005, p. 230); embodiment can be understood as the biological process of relating to the environment (Pink, 2015).

The sensory turn in science shifts not only what we can imagine, but how we might intervene in the world. As sensory anthropologist Howes (2005a) argues, social revolutions are sensory revolutions. Put another way, "the way a society senses is the way it understands" (Classen, 2005a, p. 161). Changing the world, and especially the food system, cannot be accomplished without the integration of human sensation—how we connect to that wider world.

Reconnecting across scales with the senses

Following conceptions of human embodiment and embeddedness, I argue that food systems scholarship should explicitly attempt to reconnect across scales: the body and the system, in relational crisis, linked through food. Often, when people write about "the food system," they refer to the global or national network that encompasses all food activities from seed production through growing, harvesting, processing, distributing, selling, preparing, eating, and disposing of food—and all the macro forces that influence those activities. Within larger systems, however, are always smaller, nested, embedded systems (Meadows, 2008). A country's entire agricultural system is one, as is the immediate food system of a surrounding community, and the dining program of a local institution. Each system has its own goals, dynamics, and specific contexts. And each exists within, and in reference to, the larger system around it. This does not mean that a nested system always acts in perfect concert with a larger one (Meadows, 2008). Sustainable agricultural projects, for instance, can express multiple kinds of values, including relational ones, while operating within a larger economic system mostly driven by instrumental, market-based values (Jones and Tobin, 2018). But neither do nested systems operate entirely independent of the whole. To understand any particular food system, or aspect of a food system, requires not only multiple disciplines; it requires comprehending multiple scales, and the power inherent to each, even while attending to one in particular. Understanding what

6 While in some theoretical treatments, "the body" is distinct from "embodiment," many people writing about embodiment use the two terms almost interchangeably, or at least in reference to each other (e.g., Lock, 1993). Bodies, anthropologists have argued, are "a matter of meaning, experience and identity" (Mol, 2011, p. 467).

7 The "five senses" are a Western cultural and philosophical categorization, not a universal one, as various anthropological studies have revealed (e.g., Classen, 2005a; Geurts, 2005).

is at play, and what is at stake, connects everything from global biophysical limits to food production and economic activity (e.g., Meadows et al., 2004; Rockström et al., 2009; Raworth, 2017)[8] to the rich, sensory relations of places including landscapes (e.g., Bunkše, 2007; Ingold, 2009; McGregor, 2009)[9]; to the immediate experience in a human body (e.g., Carolan, 2008; Emerson et al., 2011; Tsing, 2015).[10]

The sensory realm is the primary place people engage with food; the sensory therefore is key to understanding what food means and how it manifests in people's lives. This is true not only of eating, as farming, processing, distributing, and selecting foods are also sensory endeavors. Attendance to sensual realities is especially important when we are considering alternative food systems, and where people's actions are at odds with mainstream economic logics, where meaning is interpreted and manifested through the body's engagements with the landscape and its sometimes-injured abundance. In previous research on why people participate in a high-cost, high-labor local farm, one participant pointed to health and environmental reasons, and still claimed they weren't enough to understand the full rationale, which was rooted in bodily enjoyment: "In reforming essentially local food systems, there's got to be other things involved [beyond freshness or low-input practices]… The pleasure of cooking. The satisfaction of good food" (Morgan, 2021, p. 88). In many cases, sensory experience itself is the reason for action: the search for food that tastes better, that feels better, in multiple senses of the word. In these circumstances, an abstract model, based on resources flows or neoliberal economic theory, could neither capture nor predict people's choices and their outcomes (Ament et al., 2022).

Sensory and embodied methods are necessary to illuminate what is happening in these sensory and embodied contexts. "When you look at a farm from the outside, it looks like [hard] work is the cost. From the inside, you find that the work is the reward, or, rather, the work is all there is, and it's a beautiful thing," writes one farmer, memoirist, and local food systems research participant (Kimball, 2019, p. 282, emphasis added). For researchers, such insight comes from being on the inside, embedded. Such illuminations can even come from a less embedded but still sensory approach. The aesthetics—the design principles that appear in a sensual experience—of a particular phenomenon reveal fundamental cultural inclinations (Bourdieu, 1984). This can be a direct way in to discerning (sensing) the goals and differences between alternative food projects (Morgan, 2021).

Additionally, because our senses are the way we perceive and interact with all reality, not just food—and because food always represents more than its physical manifestation—attending to the sensory in food systems studies provides data beyond the sensory information itself. As Korsmeyer (2014) writes, "…intense sense experience is not accurate described simply as bodily indulgence, it is a means by which spiritual, perhaps even mystical truths about life's transience and splendor are realized" (p. 209–10). The sensory can illuminate aspects of everything from morality (Miller, 2005) to late capitalism (Howes, 2005b).

In attempting not just to represent but to remake the world with our scientific attention, recognition of embeddedness and embodiment further allows us to reintegrate the pieces of reality broken apart by Cartesian dualism. These scientific divisions between mind/body, man/woman, and human/nature (Mellor, 1997) are the same hierarchies that underlie social and ecological damages wrought in and by the food system. Dualism is the removal of the body and therefore of sensation, and in such a view food is reduced to a mere energetic input. The visceral aspects of life, of the "fully minded-body" (quoted in Hayes-Conroy and Hayes-Conroy, 2008, p. 462; understood as both minding the body and in understanding that body and mind are one) thus move us away from atomism and toward holism: a fully inhabited, rather than disembodied, view of complex systems.

In the U.S., descriptions of embodied practice and connection with nature have been used for over a century to argue for a different way of living, growing, and eating (Gould, 2005). Sensory methods, discussed more below, can help show where, how, and even why people connect to the world, the ways they connect despite the alienations of capitalism, and through this lens we can better see the realities, the resistances, and the ways forward those resistances illuminate. Through close attention, they can also show where gaps between ambition and action in pursuing multiple goals in food projects (Morgan, 2021).

The goal of maintaining connections across scales informs a critical methodological approach in food systems. Conducting research requires a boundary around the research subject, even when the subject is understood in context (Yin, 2013). In choosing

8 Rockström et al. (2009) lay out the "safe operating space" for humanity in terms of global use of natural resources. Industrial agriculture is one of the largest contributors to breaching the boundaries of safe human operation. In *The Limits to Growth,* Meadows et al. (2004) offer a 30-year update to their original, sensational argument that endless economic growth on a finite planet is impossible because of biophysical limits. Raworth (2017) draws on these and many other scholars in *Doughnut Economics*, which argues for a new economic approach that provides quality of living for all humans—including enough food—without breaching planetary resource boundaries.

9 Anthropologist Tim Ingold argues "against space," and instead for "place," a more full and inhabited definition, and holds that culture and science are not separate but together in a meshwork of practice; generated in situations, not emptiness. Anderson (2010) discusses human emotional connection to landscape, manifested through food choice, culture, and religion. Bunkše (2007) provides a wild sensory ride through the sensual ways a person can inhabit and commune with landscapes, which are all experienced differently through human feeling. Indigenous scholar McGregor (2009) breaks down White, Western assumptions of separateness from environment and instead honors the relations that humans have with other species and places.

10 Tsing's (2015) *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* traces the anthropological, human-level effects of capitalism in one mushroom's global food chain and shows the possibilities and the precarities of (human and non-human) life in global economic margins. Scott (2016) demonstrates how local indigenous ways of knowing, using sensory faculties, can become the legal monitoring processes for industrial chemical pollution, a locus of human interaction with larger webs of economy and toxicity. Carolan (2008) discusses the embodied aspects of knowing and posits human consciousness as situated in body and place. Emerson et al. (2011) in their guide to ethnographic fieldnote methods, remind us to hold up participants' meanings as critical, legitimate aspects of scientific knowledge.

a methodology appropriate not only for the research questions but for the theoretical orientation of a study, I have variously used mixed qualitative and quantitative methods, mixed qualitative methods, and holistic case study. Several scholars inform us on how to make such choices. Born and Purcell (2006) make a forceful argument that we cannot assume local food will generate particular outcomes such as sustainability or justice. They assert that because food systems are highly contextual, they must always be studied in context. Their argument relates to the "patchiness" of the Anthropocene era, as put forth by Tsing (2015), who uses ethnographic methods to explore the universalizing forces of capitalism and climate change and the diverse ways those forces affect different places. Sociologist Burawoy (2009) tackles multiscalar fidelity through the "extended case method," which involves attending closely to a bounded research case while recognizing and teasing out its connections to related macroprocesses. Specific to systems, scales, and food, Bland and Bell (2007) propose the epistemological tool of "flickering." This agroecological approach sees farms as "holons," or whole entities that cannot be understood outside of the "ecology of contexts" in which they survive (p. 286). Flickering is the "trick to learn to continually switch back and forth between the perspective of the part and the perspective of the whole" (p. 287). Differences in scale can thus be somewhat rectified, and complexity and context can exist side-by-side with bounded cases of deep inquiry. Within empirical work, "flickering" involves a close attention to the cases at hand, and to participants' meanings and experiences (Emerson et al., 2011), while always attempting to show how they relate to larger cultural patterns and ecological realities.

Methods in service of this kind of knowledge include those from social sciences and qualitative traditions. Ethnography is "particularly well-suited to exploring the affective, embodied, and imaginative dimensions of social movements" (Khasnabish, 2019, p. 7). Interviews, for instance, are especially valuable for feminist researchers, as they happen in person (i.e., in embodied relationship; Pink, 2015). Participant observations, particularly when documented through fieldnote memos, can spotlight the sensory details that emerge from being embedded in one's research context (Emerson et al., 2011). Autoethnography, the rigorous examination of one's own lived experience of a phenomenon, provides corporeal and emotional information (Spry, 2001; Ellis et al., 2010), meaningful in its own right or as a way of triangulating participant explanations. Methods such as PhotoVoice combine participatory (i.e., socially embedded and responsive) research values with the visual illumination of meaning (Migliorini and Rania, 2017; Sitter, 2017). Tasting, whether as researcher or participant, can help us understand place, cultural practice, and increased food preparation skills (Trubek, 2008; Højlund, 2015; Hedegaard, 2018). A good starting place for these and other methods is the edited volume *Food Culture: Anthropology, Linguistics, and Food Studies* (Chrzan and Brett, 2017). Through all such methods, researcher positionality—the collection of identities that influence lived experience and social power—provides an important lens for examining how a researcher may (mis)understand or influence such richly subjective data; positionality, after all, is the recognition that we are embedded in social worlds and in relation to others (England, 1994; Rose, 1997; Merriam et al., 2001).

Of course, not all scientists will use such methods. In more disembodied research approaches, these principles may be maintained through careful interrogation of assumptions and of context. Such research should reject premises, models, and equations that assume placelessness, universality of experience or values, and "rational actor" economic theory, all of which erase particularity, which is to say, reality. It should account instead for specificities of history, culture, geography, and power. It should take seriously the importance of embodied and sensory experiences and desires, including taste and cultural practice, in how and why food systems manifest, and in who and what they might harm.

For a cohesive transdisciplinary approach, you must first identify your own theoretical lens, whether from explicit development in your own work or absorbed implicitly through your intellectual circles. Rely on information and methods from disciplines that align with this lens. You must represent multiple scales and facets of the system—although they cannot all be attended to equally, readers must see the links between your focus and the wider network of actors, influences, and outcomes. The work should comprehend food systems as both social and physical phenomena, with permeable boundaries. Ideally, the work reflects both social and physical outcomes as well. It is legitimate and even critical to engage with the need for solutions rather than simply describing situations. We transdisciplinary researchers can and should work with scholars with different disciplinary frames; but we can never discount the theoretical lenses employed. Our pursuit of knowledge itself is a nested system, and the goal is to see those layers as clearly as possible—for "better accounts of the world, that is, 'science'" (Haraway, 1988, p. 589–590).

While often discussed in meta-level abstractions, social transitions are not only systemic, they are personal, emotional, and felt (Feola and Jaworska, 2018). To achieve true sustainability, we must go further than the theorists of the past and integrate the sensory realm into our social and ecological transitions (Howes, 2010). The fields drawn upon here, especially ecological economics, agroecology, and ecofeminist studies, all acknowledge their normative natures (all fields possess inherent normativity; it may just not be overt). They are openly driven by relational values, from social and environmental justice in economics, to sustainability and sovereignty in agriculture, to equality and care in human relations. They detail and theorize what is currently true about the world, including how it falls short of what is needed. Meadows (1996) argued passionately for spending time on vision: what is the world we want? Can we boldly own our own deepest hopes? If we cannot answer these questions, we cannot chart a path forward. One vision she shared, for a hunger-free world, involved more than people simply having enough food; it went deep into reimagining the underpinning culture, relationships, and the commitments of global society. Meadows said her visions arose best when she disengaged her "rational" mind and instead imagined the sensations of a sustainable world.[11] After all, the body, with all its

11 Pink (2015) makes this exact point in her book on sensory ethnography: "Futures, however they are defined, are nonetheless not simply cerebral imaginings, but embodied and sensory ways of perceiving what is not known… We imagine not only with our minds, but also with our bodies" (p. 192). Similarly, Shotwell (2016), a Canadian philosopher and author of the

sensations, can be the ultimate site of resistance (Hayes-Conroy and Hayes-Conroy, 2008). We must keep both values and sensations close to even structuralist efforts in remaking the food system.

The world changes two ways, through cumulative and unintended consequences of status quo actions, or through cumulative conscious projects of social change (Wright, 2010). I believe we should pursue the latter, in part through the rigorous, intentionally transdisciplinary development of knowledge. What does the embodied experience of food allow us to understand about self, community, economy, place, and eventual sustainability? Imagine what we might find out.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

book *Against Purity: Living Ethically in Compromised Times*, writes about "...reaching toward concrete possibilities—a warm horizon imbued with possibility—prefiguratively practicing open normativities that might produce practices of freedom we cannot predict" (p. 193).

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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