A Grand Challenge for HCI: Food + Sustainability

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This year, at the ACM CHI Conference, we gathered as a group of HCI researchers, designers, and practitioners, to reflect on our role in designing sustainable food systems [6]. Designing sustainable food systems is a challenge that involves *all* parts and actors of the food system *[5]*, including: 1) production and agriculture, 2) processing and manufacturing, 3) wholesale and logistics, 4) retail and food services, 5) purchasing and consumption and 6) waste management. Fifteen participants represented and discussed ongoing investigations into designing technologies for food and sustainability *[1]*. We reconsidered the role of waste, the potential for food to be used as medicine, the repercussions of antibiotic resistance, the pervasiveness of poverty, and the tensions between local and global systems. The workshop culminated in a design session focused on techniques and paradigms for future components of a sustainable food system.

Designing sustainable food systems, including the socio-technical systems that work towards that ideal, is key to producing stable climates, societies, and economies. The ongoing and future changes in climate, food security, and socioeconomic issues are further complicated by a tenuous geopolitical context. Given this reality, it is imperative that we are deliberate in our design of food system components and supporting technologies so that we can better contribute to the sustainability of our food system.

HCI researchers have long engaged with issues surrounding “food + sustainability”. In 2009, Eli Blevis and Susan Coleman introduced the HCI community to concepts regarding sustainable food, and demonstrated how information technologies for food present both problems and opportunities [2]. Recently, there has been increasing interest in “disrupting” food through technology ranging from food delivery mobile applications and component-based cooking, to creating data-driven sustainability ratings. Such technologies are envisioned to improve aspects of the food system for some people, but are these technologies creating sustainable food systems for everyone?

In this article, we reflect on the core opportunities for HCI design and research within a sustainable food system. This article serves two purposes. First, we situate food as a grand challenge for HCI and discuss three emerging themes that challenge the paradigm and practice of technology. Second, based on these themes, we put forth a research agenda for food + sustainability within HCI.

Emerging Themes

What actually constitutes sustainable food systems is a complex question. At the FoodCHI workshop, we explored the potential of HCI in supporting various forms of sustainable food. Three themes dominated our conversations: trust and accountability, food sovereignty, and sustainable food policies. While these do not encompass the full range of issues, we believe that these themes allow for an initial framing of a research agenda on food + sustainability in HCI.

Trust and Accountability: For a food system to be sustainable, actors must form a web of trust and accountability regarding others' sustainability, in addition to behaving sustainably themselves. For example, consumers must trust in the retailer's practice, the retailer must trust in the distributor's practice, the distributor must trust in the manufacturer's practice, and the manufacturer must trust in the producer's practice. Because information flows through this chain, all actors of a sustainable food system are collectively responsible for generating and maintaining trustful information.

Trust is more easily formed in small scale interactions. However, when a single product is comprised of globally derived ingredients, trust relationships may be stressed as global supply chains hide harmful practices from decision-makers downstream. There is a need to support transparent flows of information through the food system, from the conditions of production, to processing, distribution, and waste management practices. This information sharing needs to be done while respecting the data ownership and privacy. For example, certified-organic farms in the United States are publicly listed, but may be family farmers' homes too [3].

Food Sovereignty: Unsustainability in food systems is predicated on inequality. For actors in a food system to retain and regain sovereignty, they must have an ability to control the production of their own food. Currently, a few global actors control a majority of global food production; this leads to inequality and unsustainability on several levels. Environmentally unsustainable farming, processing, transport, waste management, and food standards have powerful negative impacts on climate change, which in turn is destroying livelihoods around the world. Workers are poorly paid and small producers are forced to sell at low prices dictated by large bulk processors, supermarket chains, and buyers. Profits stay neither where food is produced, nor where it is purchased. The industrialization of the food system has led to the paradox that food is as cheap as it has ever been, yet there are large populations that can't afford to pay for food and go hungry or undernourished, or rely heavily on charities such as food banks. The economic growth paradigm coupled with techno-scientific attempts to 'fix' the environment reinforces these practices by focusing on automation and large-scale production.

To address these problems, methodologies and systems are being developed and implemented to leverage biodiverse ecosystems for food production towards food sovereignty. Food sovereignty asserts control over local production, ecological production and distribution practices for long-term environmental sustainability, and decentralization of the food system. For example, in many places, cash cropping driven by multinational corporations has replaced subsistence production, leading to food insecurity and ecological degradation. Organizations such as La Via Campesina [4] are working to restore subsistence production to ensure local food grown sustainably for the long-term health of local communities.

A sustainable food system includes both short and circular supply chains to enable access to food, as well as food waste reduction. Technology can, for example, be used to support distributed food networks and democratic governance structures that oversee and manage the production and distribution of food.

Sustainable Food Policy: Many government policies are enacted for food planning and regulation, from control of foodborne pathogens such as *E. coli* to organic certifications. These policies are created, regulated, and administered at various scales. At the international level, organizations such as the Organisation for Economic Co-operation and Development (OECD) and the Food and Agriculture Organization of the United Nations (FAO) develop programs to support sustainable development in agriculture. Most countries have agencies (e.g., the United States Department of Agriculture) that focus on national policies. The combined policies, actions, and programs of these organizations can result in positive change. For example, the chemical pesticide DDT was globally banned for non-vector use in 2004, in response to at least 26 national bans, and therefore is not used in agriculture in most countries around the world.

However, the present practices and legal standards of global food production and distribution systems remain deeply unsustainable. Policies in most food systems neglect to hold certain actors accountable for the environmental and social sustainability of their practices. Without policy, profits will trump sustainability in the current economy.

Policy regulations can level the playing field so that all corporate actors are held to the same standards, and so that smaller players can be supported in their efforts to implement sustainable practices which may have longer time horizons. For example, perennial polycultures, which make use of tree crops, berries, and vegetables such as rhubarb and artichokes, can be highly sustainable, but it takes a while for farmers to realize a profit with such crops compared to annual monoculture crops.

Any design work to support a sustainable food system will need to be sensitive to the associated policy context, as well as encourage participation in or compliance with sustainability-oriented policies.

Challenging Paradigms and Practices of Technology

How can trust and accountability to behave sustainably be built and maintained in a complex food system? How can food sovereignty replace lack of local control and poverty as defining characteristics of modern food systems? How can policy be changed or created to challenge the paradigm and norms of food production and distribution systems so that we can move to more sustainable practices? Working to address these questions is imperative. Without revisiting the paradigms and practices of HCI research, we risk perpetuating the shortcomings and unsustainability of current food systems. For example, despite declarations to “disrupt” food, many technologies perpetuate the environmental unsustainability and social injustices of current food systems. This is true even for technologies designed with sustainability intentions. Depending on how food is distributed, these systems can encourage or inhibit more sustainable food distribution practices. Some technologies intended to help fix food access issues instead support convenience and food-on-demand to consumers who already have access. Others try to encourage the consumption of organic or sustainably grown food, but also wind up perpetuating the exclusive availability of such foods in high-value markets. Systems that fail to account for the unsustainability of some actor or service they are connecting make it easier for that unsustainable behavior to occur.

Technologies may also perpetuate these challenges because they are ineffective at creating the flow of information needed in a sustainable food system. Technologies aimed at providing transparency at various points in food system are currently disconnected. For example, Open Food Facts is a consumer application providing nutritional data on certain food products, while Agri-Footprint is a food-focused life cycle assessment database aimed at food producers to engage in environmental impact assessments of their production practices. However, data do not flow between these consumer- and producer-facing tools.

We need to be mindful of the potential negative consequences of our design decisions. Without revisiting the paradigms and practices of HCI research, we risk perpetuating the shortcomings and unsustainability of current food systems. The anthropocentric nature of human-centered design is insufficient for HCI topics that intersect with environmental and sociopolitical challenges [7]. Human-centered design may improve things for some in the food system at the expense of others, or may provide something that an end user needs but with second- and third-order effects in the food system that negatively impact that end user.

To transform the food system, we will need to engage with assumptions about how food systems and supporting technologies should be designed, how they could be designed, and how they will interface with other aspects of industrial civilization. This process will sometimes be uncomfortable, forcing us to consider issues that are not easily resolved and realities that are inconsistent with our current understandings of the world. Nevertheless, without challenging prevailing paradigms and practices of technology, we are unlikely to create more than incremental change.

Research Agenda for Food + Sustainability in HCI

Before narrowing in on specific technological solutions, we must engage in and understand current food systems, what is failing in these systems, and how technology is already being used in these systems. There is much that we as a community overlook or are unaware of when designing for sustainable food. Until we have thoroughly explored the context for which we would like to design, and developed strong relationships with people working in those contexts, we will likely fall short of the mark in achieving our goals in supporting sustainable food.

Systems-thinking: A priority is to learn the many different purposes the current food system serves, of which providing nutritious food at affordable prices is only one. Whatever change is proposed, a conflict of interests may result in some actors attempting to counteract proposed changes. For example, a change that threatens revenue might be contested [4].

Accountability: A priority is to ensure that all actors of the food system are accountable for upholding sustainable practices. Producers, processors, distributors, retailers, and waste managers each have a unique arena of influence that can enable either sustainable or unsustainable practices. We should explore how to support them in enabling sustainable practices.

Policy: A priority is to include policy-makers as actors in the food system. Policy can be especially effective in holding actors of a food system accountable for sustainable practices. We must explore how policy makers come by their information about food systems and ensure that they are provided rich, accurate information to bear on policy decisions. We must support the voices that typically go unheard. When working to influence policy, we must confront the fact that the work of the greater HCI community has gone largely unnoticed by policymakers [8]. However, we have the capability of engaging with policy to inform and influence decisions related to sustainable food production.

Scale-sensitivity: A priority is to work with small, highly motivated social movements on bottom-up change towards food sovereignty, while considering the policy context. Recent food trends indicate there is consumer interest in local food production and in small-scale farming, which is interpreted as a sign of quality. In the wake of this interest, people in urban areas are rediscovering practices of growing food and producing vegetables and fruits. This renewed interest can help people connect to what they eat and to understand the kinds of resources and complex processes that are required to put food on the table.

Constraints: A priority is to understand the legal, regulatory, and social constraints we must work within. Many practices in the food system are enforced by policy and social norms. We can discover how to design sustainable food systems within political and social constraints. We have to be mindful that those constraints may, perhaps unintentionally, influence our designs towards more unsustainable practices. Also, this means that we cannot design something that move towards an ideal sustainable food system but is not legally or socially supported without facing significant pushback. We should also recognize that the make up of local political and social systems will yield additional and often unique constraints for sustainable food systems.

Conclusion

As HCI researchers, we can begin to engage with issues in food + sustainability by exploring food systems on land and at sea, across cultures and generations, presenting us with challenges that need to be addressed at global and multi-generational scales. To achieve this agenda, we must include the views and voices of diverse global populations to aid in the development of a representative knowledge base of challenges and solutions in the food systems at different scales and in different geographies. The impact of catastrophic events (e.g., scarcity, climate, disease) on food systems and responses in other parts of the world (e.g., problems with crop yield and supply chain, poverty and famine) has largely been invisible to food systems in parts of North America and Europe. These challenges and events provide the backdrop for considering future scenarios for sustainable food systems supported by digital technology, including uncertain and unpredictable climates, untrustworthy business models and supply chains, and challenges around increasing poverty and social injustice. By mapping these challenges and events to the roles of digital technology we will be able to make a start on HCI's journey into the design and development of sustainable food systems across populations, lands, oceans, and generations.

This article is our first step towards developing a new food + sustainability research agenda in HCI. We call on the community to take on the themes of sustainable food that challenge paradigms and norms of technology we have outlined for developing a sustainable food system. We must continue to challenge poverty and enable food sovereignty globally, to push for new policies and work on understanding and re-configuring the trust and power in the relationships in the food system. Designing a sustainable food system is no simple feat. It is a challenge that spans human and physical geographies that surpass both our current understanding in HCI and our lifespans.

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