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Seed commodification and contestation in US farmer seed systems

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Research Paper

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Abstract

Over the last century seed systems have undergone a process of commercialization, resulting in the transformation of seed from a common good into a commodity. Countries such as the United States are dominated by the private seed industry, which has succeeded in reducing crop diversity and increasing farmer dependency on commodity seed (i.e., seed that is bought and sold) through such mechanisms as seed hybridization, intellectual property protections, and the proliferation of genetically engineered crop varieties. Commodity seed has become necessary to support food production, but concurrently has created a positive feedback loop that solidifies corporate control within the seed industry while concurrently disincentivizing traditional agricultural practices such as seed saving. In contestation, growers nationally and globally have called for change both within and outside of market structures – advocating for the revalorization of the vast array of social, cultural, and environmental benefits that seeds have that are not being properly protected by those with the most power in the seed industry. Using insight from 31 semi-structured interviews with growers involved in Vermont's farmer seed systems, this study elucidates some of the non-commodity values that growers hold for the seeds they source from both non-commercial and commercial sources. Our results highlight how growers appreciate such non-commodity values as provenance and diversity and are working to provide a social and environmental safeguard for seeds through seed saving. At the same time, many growers also acknowledge the convenience and modern necessity of commodity seed, highlighting the importance of supporting alternative seed industry structures that are more socially and environmentally responsible. These findings stress the importance of acknowledging the multidimensionality of US farmer seed systems, whereby market and non-market exchanges can coexist and work toward creating more just and sustainable seed systems without ceding to complete commodification devoid of social import.

Introduction

Confronting issues such as climate change, social and political injustices, and decreasing biodiversity, communities are increasingly facing critical decisions related to how food systems can transform to better meet the needs of society and the environment. Agricultural inputs are central to these decisions – with land, water, and seeds forming the essential components necessary for food production. The management of these components thus garners substantial attention, including from companies seeking to profit from them. Yet, up until the early twentieth century, the reproduction of seeds was left relatively untouched by agricultural capitalist expansion due to natural barriers inhibiting their commodification, namely the inherent ability of most plants to reproduce themselves (Kloppenburg, 2005). The last hundred years have seen these barriers quelled by both biological (i.e., hybridization and genetic engineering) and institutional (i.e., Intellectual Property Protections (IPP)) means. Although for millennia the reproduction of seeds has been maintained within and across agricultural communities as common resources, countries such as the United States (US) are now highly reliant on commercial sources of seed.

Commodity seeds, defined for this paper as seeds that are produced *for* and exchanged *through* markets, have become nearly ubiquitous as the private seed industry (hereon referred to as 'seed industry') has grown over the last century. While some argue that private-sector interest in seed research and development (R&D) has led to innovations in seed technologies and increases in crop yields (Bonny, 2017; Deconinck, 2019), others raise concerns, pointing to the homogenization of the global food supply (Khoury et al., 2022; IPES-Food, 2017), overdependence on genetically engineered (GE) varieties and varieties requiring high levels of chemical inputs (Singh, Prasad and Reddy, 2013), and heightened degrees of seed industry concentration with just four companies now controlling 62% of global proprietary seed sales (Howard, 2022). Moreover, critics have likened the commodification of seeds to the enclosure of common land that facilitated the spread of capital into rural areas (Marx, 1867; Polanyi, 1944; Gerber, 2020). Core to their critiques is that, through mergers and acquisitions between seed companies and other actors in the seed/food supply chain such as agri-

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chemical and technology companies (Howard, 2022), the ability of farmers to save, share, and sell their own seeds has been constrained and disincentivized (Kloppenburg, 2010; Peschard and Randeria, 2020). Today, most farmers in the Global North rely on commercially procured seeds for their production, especially for major field crops (Fernandez-Cornejo, 2004; Kloppenburg, 2010). The commodification of seeds is thus inextricably tied to the ascendance of the modern seed industry of which hybrid, formally certified, and high-value GE seeds constitute the majority of what is commercially available (Bonny, 2017).

And yet, even in highly commercialized contexts such as the US, there are significant efforts to contest seed commodification by engaging in non-commercial activities such as seed saving and sharing networks (Lyon, Friedmann and Wittman, 2021), seed libraries (Atalan-Helicke et al., 2021; Soleri, 2018), and seed fairs and swaps (Campbell, 2012). An alternative seed economy (related to alternative food economies as explored by Goodman, DuPuis and Goodman (2012)), has also developed, leading to several commercial initiatives attempting to disrupt the status quo of a generally highly uniform and profit-driven seed industry. These include seed-commoning approaches such as the Open Source Seed Initiative (OSSI) (Montenegro de Wit, 2019), participatory plant breeding efforts (Healy and Dawson, 2023), and alternative seed companies – characterized as companies that sell open-pollinated seeds (i.e., seeds that can be saved and for which pollination occurs through natural mechanisms) and that are often guided by principals such as safeguarding biodiversity, promoting sustainable agriculture, and serving the needs of small-scale farmers and gardeners (Soleri, 2018). To varying degrees, these efforts demonstrate the human desire for seeds to be protected from capitalist markets, aligning with what Radin (1986, 2001) would consider *incomplete commodification*. Within seed systems, incomplete commodification is often achieved through the expression of non-commodity values, theorized as those that relate to pluralistic values of economic goods that contribute to social and environmental welfare (Stewart, 1983). Albeit seemingly contrary to its name, non-commodity values are expressed in both non-commercial and commercial seed systems (Tobin, 2022). Research that acknowledges the multi-dimensionality of seeds to be simultaneously not commodified in some contexts and incompletely commodified in others, and yet still contribute to non-economic goals, is critical to promoting seed systems that can meet both the instrumental *and* relational needs of the people that rely on them.

In this paper, we document and discuss some of the non-commodity values that growers hold and attach to the seeds that they sow, as well as explore the ways that they resist and, in some cases permit, commodification to varying degrees within seed systems. Within this paper, we define a seed system as 'the combined activities of actors, making use of plant materials and knowledge, that together are necessary for supplying seeds to farmers' (Louwaars and Manicad, 2022, p. 340). We specifically focus on farmer seed systems, which are principally operated by farmers (Louwaars and Manicad, 2022), and often incorporate non-commercial practices such as seed saving and sharing, but also interactions with commercial seed markets to varying degrees (Almekinders and Louwaars, 2002; Batur, Bocci and Bartha, 2021; Zimmerer et al., 2023). Based on 31 interviews with growers in the US state of Vermont, this article asserts that the commodification of seeds remains incomplete within farmer seed systems. Our findings illuminate the plural values that growers attach to seeds that circulate within and between both commercial and non-commercial channels, as well as foreground several non-commodity values that are not being fulfilled by commercial seed sources, including those within the alternative seed economy. This research suggests a need to reevaluate the commodification and commercialization of seeds, revalorize and support non-commercial forms of seed procurement, and facilitate the continued development of alternative seed companies, all of which can contribute to making seed systems more reflective of the social, environmental, and personal values of the growers that depend on them.

Background

The commercialization and commodification of seed systems

In the Global North, seeds are no longer universally farmer-maintained inputs but instead inputs whose production has largely been externalized off the farm. Historically, the outsourcing of seed production was precipitated by the entrance of both public and private interests within cultivar development which began in the early twentieth century, with developments in intellectual property law solidifying their commercial viability by the end of the same century. Starting with the Plant Patent Act of 1930, which first allowed for the patenting of new varieties of asexually reproducing plants (e.g., grafts and buds), the mass popularization of hybrid corn in the years following acted as a harbinger of things to come. Although F1 hybrids (i.e., first-generation offspring resulting from the crossbreeding of two different plants that exhibit enhanced vigor and uniformity) were fairly limited until the later part of the century, corn was perceived as a complete success story: by the end of the 1960s, hybrid corn constituted close to 100% of all corn cultivated in the United States (Duvick, 2001). By 1981, a time when federal funding for public agricultural R&D was declining (Lyon, Friedmann and Wittman, 2021), five companies controlled approximately 68% of the total market share for corn seed in the US (Kloppenburg 2005). Not only was hybrid corn a success in its widespread adoption but also in its potential for economic profit considering that hybrid seeds cannot reliably be saved and replanted due to reduced vigor in the F2 generation. Hybridization provided one form of assurance to plant breeders and companies that their varieties would continue garnering profits – however, considering not all plants can be hybridized, alternatives mechanisms were also required to ensure plant breeders would be compensated for the development of new varieties. The passage of the Plant Variety Protection Act of 1970 filled this need by providing plant breeders with the ability to gain legal proprietorship over sexually reproducing plants (e.g., seeds), thus encouraging and reinforcing continued innovation and investment in plant breeding by the private sector (Howard 2015).

Intellectual property laws and legal decisions made in the US from the 1980s onward have been crucial in shaping the seed industry over the last several decades, and intentional or not, have made it more difficult for farmers to save seed (Mascarenhas and Busch, 2006). By 1985, the ability to obtain utility patents, which give their owners the exclusive rights to produce a variety for up to 20 years, was extended to seeds, and by 2001, these utility patents could be used to prohibit saving seeds for varieties that had them (Howard, 2015). A confluence of horizontal and vertical integration in the agricultural input sector within this same time period resulted in a handful of agri-chemical/seed companies obtaining a wide-ranging suite of

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patents for genetic material and complementary technologies (Fuglie et al., 2012). As a result, IPP helped facilitate the high degrees of corporate consolidation within the seed industry and concurrently constrain the choices farmers have for obtaining their seed (Kloppenburg, 2010; Béné, 2022). Moreover, while it is argued that patents are necessary to incentivize innovation for new and improved varieties, the pursuance of patents which specifically prohibit usage by farmers and plant breeders has severely limited the impact of these varieties for producers and scientists alike over the last several decades (Glenna, 2023).

Corporate consolidation by way of IPP has also led to a highly concentrated and uniform seed industry that is comprised of seeds that have been bred in centralized locations (i.e., agricultural experiment stations) and are thus not adapted to diverse contexts across farm production types, geography, and climates (Bonny, 2017; Mastretta-Yanes in press). To increase profits and decrease production costs, the development of seeds suitable to a diverse set of landscapes and climates as opposed to seeds adapted to unique localities transformed the goals of cultivar development away from such things as diversity to instead favor yield and genetic uniformity (Montenegro de Wit, 2019). While generalized adaptability has been and continues to be a goal of public agricultural research, emphasis on yield as a primary breeding target and the concentration of resources for a small number of export-orientated crops is a distinct characteristic of private R&D that has characterized the seed industry for more than half a decade (Lyon, Friedmann and Wittman, 2021).

Seed hybridization, IPP, and the ability of seeds to be appropriated to diverse landscapes were necessary for the development of the seed industry in the US and globally (Braun 2021). These supposed advancements have not come without their consequences. Many have pointed to the commodification of seed as an antecedent of negative externalities which include crop genetic erosion (Khoury et al., 2022), environmental degradation (Kerr, 2012), corporate hegemony (Howard, 2022), biopiracy (Breen, 2015), and cultural imperialism (Wattnem, 2016), to name but a few critiques. For these reasons, commodification within seed systems has been articulated as a process that has not only separated farmers from the means of their production but also has contributed to widespread socio-cultural erosion, especially as the varieties with the least commercial interest are often some of the most important culturally and nutritionally (Aistara, 2011; Khoury et al., 2022).

Evaluating the commodity

As commodification and commercialization occurred nearly simultaneously in the evolution of the seed industry, dominant sources of commercial seeds are closely linked to the agro-industrial complex that has characterizied global agri-food systems for the last half-century. However, that is not to say that commodification and commercialization must naturally result in such an outcome – both concepts can reflect different values than they historically have. As Castree (2003) explores in his review of the usage of the term commodification, commodification is often reduced to *capitalist* commodification, whereby privatization, alienability, individualization, abstraction, monetary valuation, and displacement are all central to its conceptualization and perseverance even though other forms of commodification can, and do, exist. For example, the concentration of capitalist commodification within both academic and popular discourses ignores the common anthropological view that commodification is far from unique to capitalism. As emphasized by both Appadurai (1988) and Kopytoff (1986), commodification can also be viewed as a universal cultural phenomenon that simply entails some form of exchange based on social relations. In other words, commodities reflect the values of the society which they serve, or, perhaps more realistically within capitalism, the individuals who control their production and dissemination.

Thus, it can be argued that commodities are not inherently bad but instead *become* dangerous when they no longer reflect principles of the social systems, but rather economic systems that prioritize monetary accumulation above other social and environmental goals (e.g., capitalism) – what Polanyi (1944) coined as 'disembeddedness.' That is, if commodities are exclusively market-driven, they no longer (or only partially) reflect non-economic social goals and interests, resulting in the many negative externalities associated with the spread of commodities into traditionally non-market spheres such as the environment, or in the case of this paper specifically, seed systems. As an example, so-called terminator technologies (also known as genetic use restriction technologies), GE plants that produce seeds that are effectively sterile, caused such uproar at the end of the twentieth century to warrant an international memorandum against their sale by the United Nations Convention of Biological Diversity in 2000 (Srinivasan and Thirtle, 2000). This case also elucidates Polanyi's 'double-movement,' in that efforts toward marketization are often countered by renewed efforts of social protection, of which embeddedness (i.e., an economy based in social relations, rather than the other way around) is central.

Expanding on insight taken from Polanyi and other commodity theorists such as Appadurai and Kopytoff, Radin's (2001) theory of incomplete commodification is related to the concept of the double movement in that a commodity being incomplete relies on some sort of contestation or social protection. It also acknowledges the quality of commodities to hold pluralistic meaning even if sold within markets. By leaving room for commodities to be incomplete, she asserts they can still be exchanged through markets *without* being reduced to something without social significance (thus commodities being incomplete to the extent that they still are embedded with non-commodity values). The quality of commodification or commodities being incomplete is essential to advancing the goals of alternative food and seed movements, many of which may be reliant on capitalistic markets, at least partially (Matacena and Corvo, 2020). For example, many agricultural initiatives continue to utilize market forms of exchange, such as farmer's markets, community-supported agriculture, etc., but attempt to reintegrate other values into food that is sold through localizing production, promoting farmer-consumer relationships, and upholding agroecological practices (Fernandez et al., 2013; Hinrichs, 2000). Together, these efforts contribute to the development of an alternative food economy – a concept and set of movements that cover a wide range of food system models that attempt to disrupt common norms and relationships with the conventional industrial-based food system (Rosol, 2020).

Alternative food economies provide an example of embeddedness and incomplete commodification in that they attempt to incorporate concerns surrounding social justice and environmental sustainability within food systems (Goodman, DuPuis and Goodman, 2012). Alternative economies are also increasingly popular within seed systems, whereby the commercialization of seed by farmers and peasants, often mediated through alternative seed companies, is viewed as a way to enhance access to farmers' varieties (i.e., those that the commercial system has traditionally neglected) (Batur, Bocci and Bartha, 2021; Sperling and

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Almekinders, 2023) as well as to improve the resiliency of producers by having access to a diverse array of sources for seed (Isbell et al., 2023). Furthermore, The OSSI is another example that presents an alternative avenue for farmers, public plant breeders, private breeders, and non-governmental organizations to obtain certain rewards and protections over seed while still encouraging seed sharing and saving networks (Kloppenburg, 2014). By providing open source licenses that in some cases still provide royalties to plant breeders but do not restrict the use, reproduction, or exchange of seed, OSSI advocates for collaboration and autonomy for both farmers and plant breeders while also using seed industry tools (e.g., licensing and contract law) as a defensive action against the further concentration of power and capital in the hands of a few seed companies.

The ability of food movements to simultaneously engage with reforming markets and more transformative approaches is necessary to make progress toward sustainability within food systems (Holt Giménez and Shattuck, 2011). Of course, that is not to say that market solutions are the *only* solutions, nor should the goals of the market be prioritized above more transformative goals (e.g., promoting non-commercial forms of seed exchange), considering that doing so can do more harm than good to the long-term viability of alternative food movements (Béné, 2022; Pechlaner, 2023). For this reason, incomplete commodification should be taken to refer to the reintegration or persistence of non-commodity values into things that have already been commodified, not the other way around (i.e., goods that have traditionally been regulated outside of markets should not change to be managed by markets). Incomplete commodification is thus connected to the discourse surrounding decommodification, which refers to 'proactive approach[es] to reducing the power of the market by subjecting it to social, political, and moral limits' (Hernández Rodríguez, 2023, p. 990). In seed systems, this is particularly relevant to the recovery of crop genetic resources that have been stolen from peasant and Indigenous communities (Kloppenburg, 2010). Moreover, the decommodification of seeds entails maintaining farmer autonomy and protecting against its loss by providing alternative options for seed exchange that reinforce seed sovereignty instead of potentially eroding it (Hernández Rodríguez, 2023). In this way, seed sovereignty, which entails the autonomy of farmers over all seed activities, has stood at the forefront of the decommodification movement (Peschard and Randeria, 2020). Although incomplete commodification is not as ambitious as decommodification efforts, which may attempt to separate food and seed from markets entirely (Kuljay et al., 2021), incomplete commodification provides an avenue for food and seed systems to become embedded with the social context that has been infringed upon by markets historically by revalorizing food and seed for their non-commodity purposes even within commercial spaces (Hinrichs, 2000).

Following the assumption that non-commodity values can exist even within goods that are sold, and that this incompleteness allows opportunities for seed systems to better reflect both the values and needs of their growers, this study focuses on farmer seed systems in Vermont and the complex ways growers navigate aspects of commodification within and outside of commercial seed exchanges.

Methods

Research site and design

This study relies on a phenomenological qualitative approach that explores the way that growers relate to the seeds they grow, as well as the overarching seed systems in which they engage. More specifically, we utilize semi-structured interviews ($n = 31$) to interrogate commodification within farmer seed systems and the ways that actors attempt to embed non-commodity values into the seeds they save, exchange, and purchase. Our study focuses on the state of Vermont in the Northeastern United States. Vermont is a small agricultural state home to approximately 6808 farms with an average of 175 acres (USDA NASS 2017). The state is also home to several seed-saving groups and seed libraries. Moreover, Vermont has several alternative seed companies, the largest of which is High Mowing Organic Seeds, known across the US for its dedication to selling solely certified organic seed as well as guiding a coalition of nine other seed companies to create the Safe Seed Pledge in 1999, which over 370 seed companies have signed onto to attest that they are committed to never selling GE seed (High Mowing Organic Seeds, n.d.).

Population and sampling

The population of interest for this research included growers who both save and buy and/or sell at least some amount of seed, allowing us to capture how non-commodity values are reflected across involvement in seed systems that include at least some form of commercial seed exchange. We focus on farmer seed systems because of the overlap many growers within these systems have across commercial and non-commercial channels (Zimmerer et al., 2023), thus providing sites where commodity and non-commodity values are likely to coexist. We identified and recruited potential interviewees via one of two methods: (1) networks through previous research studies or (2) snowball sampling (i.e., after each interview we asked if there was anyone else the interviewee thought we should talk to), with approximately half of the sample resulting from each method.

Our final sample consisted of 31 Vermonters who grow food from seed for either personal (74%) or commercial purposes (26%). Of these growers, 20 (65%) identified as female and 11 (35%) as male. The ages of interviewees ranged from 27 to 75 years old, although the sample skewed older with 55% of growers being over the age of 50 at the time of interviews. In terms of seed system involvement, all growers reported consistently saving at least some seed (1–99% of all the seed they used within the last three years) and purchasing seed from commercial sources (likewise, 1–99%). Moreover, 32% reported being part of a seed library or seed-saving group, 13% reported being involved in selling seeds, and all respondents discussed either sharing or being gifted seeds in the last three years. These characteristics highlight a sample where all growers can be categorized as being involved in both non-commercial and commercial exchanges of seed but represent a wide range of involvement with both forms of exchange.

Data collection and analysis

We created an interview protocol over several months which sought to capture data related to seed saving and exchange habits, preferences for seeds, and experiences with seed systems overall. We drafted the interview protocol, reviewed it, and pilot-tested it with three additional individuals who are highly involved in farmer seed systems and have similar characteristics to the population of interest to enhance validity. After the University of Vermont Institutional Review Board approved the final interview guide, we held interviews remotely (over the phone or video chat), with the interviews themselves ranging from 40 minutes to two

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hours. Once all the data were collected and transcribed, we uploaded the data to NVivo version 20 for analysis.

We used an open-coding strategy to capture key themes as they emerged from the semi-structured interviews. The first author used a thematic analysis technique as informed by Braun and Clarke (2006) whereby codes used for this study were trimmed and recategorized to fit into central themes relating to the original research questions. The use of thematic analysis allowed for flexibility in rethinking and evaluating the core research question so that themes emerged generatively, even as all interviews followed a protocol that sought to get at values surrounding seeds and whether these values changed across involvement in commercial and non-commercial exchanges of seeds. We took care throughout data collection and analysis to develop as accurately as possible an account of each interviewee's experience through reflexive and constant comparison strategies (e.g., journaling before and after each interview and feedback on coding strategies by the co-authors and other experts) to ensure trustworthiness (Cope, 2005; Creswell and Cheryl, 2016).

We report themes so that those relating to non-commodity values are presented first, followed by themes that relate to commodity values and commodification more generally. Although we recognize and agree with the ability of commodities to exist outside of markets, we refer to commodities within our findings and discussion by their economic understanding – principally as goods that are exchanged through markets. Commodity values thus relate to the exchange value of a good (Marx, 1867) that is principally garnered through its commensurability, alienability, and profitability (Simmel, 1978). Following this understanding, we operationalize non-commodity values within the analysis as relating to both the intrinsic and tangible qualities of a good that are preferred and that may at least partially impede capitalist commodification (Radin, 1986, 2001; Braun, 2021) by reflecting other goals important to society (Stewart, 1983) or that may protect seeds from further capitalist appropriation (Hernández Rodriguez, 2023). While Marx (1867) would consider all non-exchange values of a commodity as use values (either direct or non-direct), this paper also acknowledges that goods, especially those that originate and exist independently within nature, have value beyond their usefulness to humans, as Chan et al. (2012) illustrate in their discussion of cultural ecosystem services. Thus, we expand non-commodity values within our analysis to include preferences for seeds that may fulfill other cultural, environmental, and social goals from the perspective of interviewees.

Findings

Non-commodity values

Throughout interviews, growers reported a wide assortment of penchants for the seeds that they plant which reflect values that fall outside the realm of what commodities are supposed to fulfill. Although mixed in terms of how well growers believe these values are being nurtured within commercial vs. non-commercial channels, the most prominent themes across involvement within farmer seed systems that emerged from analysis included: *Provenance, care for nature, social attachments,* and *diversity.*

Provenance

When prompted for reasons why certain varieties of seeds were important to them more than others, growers discussed a significant preference for seeds with a strong sense of origin. In contrast to the idea of a commodity being alienable (i.e., the ability of a commodity to be detached from its original owner), growers discussed the importance of maintaining linkages to other growers, cultures, genealogies, and agrarian histories as central to their values and ultimately, their decision making. While this applied to both non-commercial and commercial sourcing, the concept of provenance was most clearly articulated and positively framed when growers discussed seeds sourced from friends, family, and other growers as well as their own saved seed, as opposed to commercial seed. As one interviewee described seed saving, '*I guess I really do think of it as a connection, a really fundamental cultural connection with our past – with all the cultures that created the crops that we depend on that our ancestors created for us. And I guess I think of myself as kind of a link in a very fragile chain.*' (male, 70, plant breeder and seed group member).

Growers (particularly the growers over the age of 60 within our sample) felt concerned that other people – consumers, but also farmers and gardeners who don't save seed – were becoming increasingly detached from the source of their food and seed, which some attributed to the ready availability of commodity seed. As elaborated by one home gardener, '*I think we're really missing out when we just buy a seed packet and rip it open and push it in the ground, and we don't really think about where did this seed come from? Who grew it? Is it organic? And what does it mean if it's organic or not organic? And was it grown in South America, or Africa, or South Carolina? I just don't know*' (female, 60). In this sense, provenance for many related not only to historical and cultural linkages, but also to geographical and relational origins – foregrounding a deep desire of growers for information about not only where their seed comes from, but also how it is grown and whose hands it goes through before getting to them.

Regarding seed purchased from commercial sources, growers discussed a lack of transparency around seed provenance. Indeed, most growers discussed dissatisfaction with seed companies and the lack of information about the seed they sell, with one grower stating '*I often wish that … there was more information in the descriptions rather than just having to persuade us by the picture … I'd like to know how many seeds are in the packet, whether it's open-pollinated. If it's an heirloom, where did it come from?*' (female, 60, home-gardener). Likewise, many growers expressed widespread confusion among growers about where their seed actually comes from – with some pointing out the fact that even if a seed company is based locally, the seeds that the company sources may be grown far away by large-scale contract growers in other states and countries.

Care for nature

Growers within our sample expressed a personal affinity for nature that guides their choices, both as consumers and producers. Care for nature often came up in terms of a deep passion for growing food, caring for plants, and directly participating in all (or nearly all) of a plant's lifecycle. In describing her awe of seeds, one interviewee commented '*I guess it's always that little child in me, I love opening up those seed pods at the end of the season and looking inside. It's like it just fills me with awe and wonder. And I'll never get tired of it. You know, seeds are just so extraordinary*' (female, 68, home-gardener). Another grower discussed a similar sentiment when describing her garden, stating '*They've* [*the seeds*] *been with me for more than 40 years. I've got a place for everybody and everybody in their place, you know… It's all personal. You know, for me, it's all personal.*'

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(female, 70, home-gardener). Like ideas surrounding the theme of provenance, care for nature was also articulated most clearly when growers were discussing seeds that they saved themselves as opposed to commercial seeds.

Many growers attributed their care for nature directly informing their desire to start saving seeds, while others brought up the fact that they felt that their environmental values were not in line with those of most seed companies. This came up often in terms of being able to locate seeds that are bred and grown for the Northeastern region, which growers associated with being important to the wellbeing of local agroecosystems as well as long-term resilience strategies in the face of climate change. As one interviewee commented: '*many seed companies buy seed from all over the United States or all over the world or have it grown all over the world. And that's not really what I want out of my seed. I want my seed to be adapted to the zone for growing that I'm in*' (female, 42, farmer). This again contradicts the ideal of a commodity being broadly functional across diverse landscapes and climates, leading to the abstraction or lack of identity that characterizes generalized commodities.

Others pointed to a lack of availability for open-pollinated and organic seeds, with companies instead tending to prefer hybrid or GE varieties, which growers associated with a loss of diversity as well as contamination. In general, many growers discussed a distaste for hybrid seeds, which relates to environmentalism as one grower effectively summarized by stating that hybrid seeds '*feed a commercial cycle which is diminishing biodiversity and really commodifies seeds*' (female, 74, seed-librarian).

Social attachments

Given the fact that many growers within our sample reported being involved in some form of community-centered activity (e.g., community or school gardens, libraries, seed-sharing groups), it was not surprising that social attachments to seeds also emerged during interviews. What was surprising, however, was that growers expressed having relational attachments to seeds that came from non-commercial sources as well as commercial ones – although these attachments reflected different forms of relationships and interactions with other people and businesses.

For seed obtained through non-commercial sources, several growers discussed choosing to save seed for varieties that were gifted to them, as well as using seed saving and sharing as a means to elongate or bolster relationships with loved ones. This was the case with one woman who reflected on the reason why she continued to grow a tomato variety for more than 15 years, which she ultimately attributed to the fact that she associated it with a friend who had passed away more than a decade ago. Other growers shared similar stories, with some of the most important varieties almost always being associated with some form of interpersonal connection.

However, growers also discussed the importance of seed in general (regardless of being from a commercial or non-commercial source) as a point of common ground from which they could connect with other people and build relationships. Indeed, growers repeatedly discussed appreciating the ability to connect with other people who loved seeds, with one grower stating '*I really enjoy talking about it* [*seeds*] *with people. So that's maybe part of my identity. I think it's, like, another way to relate to someone, which is cool*' (male, 27, farmer). Furthermore, for seeds obtained commercially, social attachments also emerged, principally coming from a long-standing appreciation or commitment to a certain seed company. Even the most ardent seed savers within the sample acknowledged having preferences for certain seed companies. That said, nearly all of these prefered companies could be considered as alternative seed companies in that they tend to prioritize or exclusively sell organic, open-pollinated and/or heirloom varieties. In the commercial sense, social attachments thus have more to do with the trustworthiness and value-alignment growers associate with certain seed companies, while for non-commercial seed exchanges, relational attachments stem from interpersonal interactions.

Diversity

Diversity can be considered across multiple dimensions – variation among, within, and between crop species, varieties, and individual plants (Khoury et al., 2022) certainly, but also in terms of the organizational diversity of how many functions a single actor in a seed system is meant to fulfill (Soleri, 2018) and the number of sources a grower has at their disposal to obtain seed (Isbell et al., 2023). All these forms of diversity are important for resilient seed systems. However, commodities often lack diversity out of necessity: to be produced on a mass scale, meet quality standards, multiply large quantities of seed, and create crops that are amenable to mechanical harvesting, diversity often constrains efficiency within seed systems (Louwaars, 2018). Within interviews, however, diversity quickly arose as a value that growers appreciated and attempted to safeguard through their seed sourcing both within commercial and non-commercial channels. Furthermore, the theme of diversity came up as important concerning a wide variety of topics – diversity of seed genetics, sources of seed, and crop varieties and species were discussed at length by growers. Growers articulated a desire to be stewards of diversity through their seed saving and food cultivation, which they also discussed as important in terms of enhancing self-sufficiency and resilience. As one grower explained:

> 'I like the plethora. I like the diversity. I like the number. I like having a lot of seeds. I like having the security that is behind knowing that I have seeds and I am excited to see where the seeds go, you know, see how seeds change… I, like, grew an area of my garden and let it go into full maturity and then produce seeds and then drop the seeds and then now in the spring they're starting to grow, and I'm really excited to see how those plants differ or, you know, building resilience into the genetics' (male, 28, home-gardener)

Diversity in terms of commercial sources of seed was often discussed less positively. While growers discussed the importance of having commercial sources of seed as a backup or way to experiment with new varieties (among other positives, as will be discussed in the next section), they also expressed significant concern for what they had noticed as dwindling diversity within seed company catalogs. For many this was a key reason why they wanted to start seed saving, as one grower encapsulated: '*I was noticing that varieties were disappearing from seed catalogs. And realized that the best way for me to be able to have control over the varieties that I grew were to save seeds*' (male, 70, seed group member and plant breeder). The disappearance of varieties was brought up even for small or regional seed companies, which otherwise growers expressed gratitude and appreciation for, highlighting the pressures even alternative seed companies face to reduce the quantity that they offer to keep up with market demands.

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Forms of commodity acceptance and rejection

Acceptance: practicality and convenience

Acceptance of commodification most clearly came up within interviews in reference to the qualities or aspects of commodity seeds that growers value. Considering that all growers within our sample reported obtaining seed from both commercial and non-commercial sources, with the average amount of seed saved across respondents being 33%, some acceptance of commodification was expected. That is, growers inherently accept some forms of commodification by the very nature of purchasing (or in some cases selling) seed in that they interact with markets that are at least partially determined by economic principles. While our sample undoubtedly interacted less with markets than the average commercial grower in the US (who is unlikely to save seed or interact with farmer seed systems at all), reasons persisted for why growers continue to interact with commercial seed companies, even despite some of the dissatisfaction explored in the previous sections. For most growers, purchasing seed ultimately came down to practicality and convenience.

Across interviews, even the most ardent of seed savers acknowledged the tediousness of saving seeds for some crops, especially when done at a large scale. For this reason, when discussing why they continued to purchase seeds even when knowing how to save seeds, nearly all respondents discussed the convenience that came with being able to purchase seeds when needed. As one grower mentioned: '*seed saving is not the most ideal for many people … even avid gardeners are usually too overwhelmed by the amount of production*' (male, 27, home-gardener). Furthermore, many also discussed the impracticality of saving seeds at all for some people, namely farmers. As one grower stated, '*I don't know how commercial growers ever save seed because it's just, you know, your focus is elsewhere*' (female, 44, farmer and seed group member). Importantly, she did not say this to mean that farmers shouldn't save any seed, but that growing seed for every type of crop, especially for diversified farmers, is extremely difficult. However, several growers also brought up the fact that convenience went both ways: while some crops were too hard to justify the time saving, others felt too easy not to. As one grower stated, '*…some seeds are challenging to be practical, other seeds are really very practical for the small scale, kind of home gardeners that we are*' (male, 43, homesteader). So-called 'practical' crops to save seeds from that growers cited included beans, squash, and kitchen herbs, which often don't take a lot of skill, time, or space to save seeds from namely due to less stringent isolation, pollination, and cleaning requirements.

Rejection: seed saving as knowledge protection and support for alternative seed companies

Following the findings from the previous sections which indicate that growers use both commercial and non-commercial sources to obtain seed that is valuable to them, growers also expressed various efforts and aspirations to actively contest the seed industry and embed commodity seed with non-commodity value. The most common form of contestation that growers stressed was the importance of seed saving to provide a counterbalance to issues they perceived in the seed industry. As articulated particularly passionately by one grower:

> 'I see seed saving as a fundamental cultural skill that our culture is losing. And there are huge potential consequences for food security and adaptation during this time of changing climate. So, my motivation is to kind of try to be…to have some role in maintaining the skill to pass it along for the benefit of future generations, if we can do that to provide some food security for future generations. And to break the grip that global corporations have on not only our food supply but on our seed supply. So, it feels very fundamental, it also feels kind of revolutionary, in a way' (male, 70, plant breeder & seed group member).

This sentiment was held across growers – even those who saved seed for only a very small percentage of the total seed they grew. Moreover, many discussed the act of seed saving as a way to protect traditional agricultural knowledge and promote a general awakening among growers and consumers alike that might help people have greater awareness over where their food comes from and the implications something as seemingly simple as seeds have on the food system as a whole. As one older and experienced grower discussed in response to a question about why she began getting involved with seed libraries, she recalled where she believes problems began, but also how things were beginning to change:

> 'So, agriculture was converted, at that point, and separated from the soil and became a commodity. Food became a commodity to sell in bulk. And the propaganda that made the money-making work included some messages to people. And they worked. And we've been manipulated to think food should be cheap, that it should be available all the time, it should be the same, you know, uniform quality…But it is turning around now, as people recognize we've been fiddled with in a bad way.' (female, 74, seed librarian and home-gardener).

However, across interviews, growers did not view seed saving as the only way to contest characteristics that have become standard across the majority of the seed industry. On the contrary, not only was appreciation for alternative seed companies common (especially in the case of seed librarians, likely as that's where the bulk of their donations come from), but many advocated for other growers to use these sources to obtain more diverse, locally adapted unique seed. Although all growers interviewed expressed some degree of dissatisfaction with commercial seed sources, these sentiments and others connect to the desire for more people to be conscious consumers to instigate change in the seed industry – thereby qualifying as a form of contestation within, as opposed to outside, of market structures. As one farmer and seed producer mentioned '*if you're gunna buy from a seed company, there's some vetting involved, like you kind of know what their growing practices are, maybe where the source of the seed is*' (male, 34). Growers cited many instances where they actively sought out companies that they felt were more ethically responsible, most often in reference to the values they support or types of seeds they sell, highlighting a way in which individuals within the sample sought to nurture non-commodity values within commercial seed systems.

Discussion and conclusion

The commodification of food and seed sits at the forefront of many issues facing food systems globally – with individuals and organizations fearing that commodification has diminished the ability of seed systems to benefit the public good. At the same time, the circumstances of present-day food systems, whereby most farmers and gardeners in places like the US have become highly reliant on commercial sources of seed, cannot be ignored. This reliance illustrates a double-edged sword whereby the exchange of seed through commercial channels has become

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necessary to support food production, but in such a way that further solidifies the control of the seed industry and concurrently erodes traditional agricultural practices such as seed saving (Phillips, 2016). This situation necessitates changes to the way seed systems function, which can be achieved, at least in part, by reducing the corporate hegemony of the seed industry (IPES-Food, 2017; Howard, 2022), promoting fair access to seeds through mechanisms such as the OSSI (Montenegro de Wit, 2019), fostering opportunities for alternative seed companies (Helicke, 2015), and elevating seeds that contribute to sociocultural and environmental values such as biodiversity conservation, biocultural services, climate resiliency, and community building (Batur, Bocci and Bartha, 2021). Concurrently, the findings of this paper argue that changes within the private sector (whether that be in the seed industry or in the alternative seed economy) are not enough to facilitate sweeping transformation. While part of the solution, growers within farmer seed systems also stress the need to overhaul the power dynamics that have been deeply entrenched by processes of commodification and commercialization by both reducing grower dependency and consumer complacency on commercial sources of seed. This can be done by fostering seed saving and sharing networks which, although less prevalent in the US, are being fiercely protected and promoted by peasants and small-scale producers globally (Peschard and Randeria, 2020).

As Radin (2001) explores in her conceptualization of incomplete commodification, the ability for commodities to retain non-monetary import is essential to social wellbeing. The non-commodity values that growers expressed within this study showcase this and suggest avenues for seed systems to more properly reflect the desires and preferences of growers. These findings reflect decommodification efforts to protect seeds from enclosure by private industry and bolster seed sovereignty (Hernández Rodriguez 2023), but also demonstrate desires to make changes within the seed industry by shifting the mindsets of seed consumers (e.g., farmers and gardeners) and food consumers more generally. For instance, growers discussed the importance of provenance to the seeds that they purchase, sow, save, and exchange with other growers – a characteristic that seems obvious but has been largely disregarded by the biggest seed industry giants as they attempt to create commodities that are indistinguishable from each other and can be planted widely across a broad array of environmental contexts (Kloppenburg, 2005; Howard, 2022). By acknowledging the importance of provenance and transparency in seed procurement, alternative seed companies are contributing to increased access to seeds that are in line with the values that many growers have, including preferences for locally and regionally produced seed, heirloom, and open-pollinated varieties, and varieties that are not limited by stringent utility patents (Campbell, 2012; Helicke, 2015; Soleri, 2018; Montenegro de Wit, 2019; Isbell, Tobin and Reynolds, 2021). That said, interviewees articulated that the private sector has a lot of work to do before it can adequately reflect the values held by growers. They stressed that changes in the private sector are vital, especially considering the essential role that seed companies play in providing seed for farmers and gardeners.

Taking the viewpoint that commodities reflect the dominant values of the society that governs them (Appadurai, 1988; Kopytoff, 1986) and that transactions within the current market economy value self-interest and profit maximization (Polanyi, 1944), it is easy to see why commodities are associated with the erosion of social and environmental values. Efforts that attempt to reorient commercial systems toward other (i.e., non-instrumental goals) thus play an important role in supporting sustainability goals as well as help consumers imagine other qualities that they should appreciate in the food and inputs they consume (Goodman, DuPuis and Goodman, 2012; Rosol, 2020). This alternative food economy, marked by direct-to-consumer outlets, food co-ops, short-circuit-supply chains, and alternative seed companies, is not radical in the sense that it does not challenge the market system on which the conventional food system relies. However, these avenues do provide for social protection and create space for conversations that stimulate new cultural understandings of procurement and exchange (Matacena and Corvo, 2020). By leveraging the wide array of values that already exist within farmer seed systems, especially among individuals who sell seed for reasons beyond profit (Tobin, 2022), commercial seed exchanges can contribute to the creation of a different type of seed industry (or *industries*) that uplift goals far beyond the economic. As explored by Hinrichs (2000), marketness and embeddedness need not always conflict with one another, highlighting how community-informed commercial initiatives such as alternative seed companies can provide a different type of market relationship that serves economic, social, and environmental needs.

Reforming the seed industry is not the sole solution to solving the deeply pervasive issues that plague contemporary food systems. As Anderson et al. (2019) discuss in support of agroecology, food system transformation requires a paradigmatic shift in the way that food (and seed) is exchanged, valued, and governed – tasks that cannot and should not be left to the private sector. As growers within this study stressed repeatedly, contestation is necessary not only through purchasing more ethically but also through greater investment and education with seeds beyond buying them, putting them in the ground, and repeating that year after year. Instead, growers advocated for the 'revolutionary' (as phrased by one grower) skill of seed saving to be practiced by more farmers and gardeners. This sentiment was stressed particularly strongly by older interviewees (over 60 years old). Indeed, while interviewees generally expressed a place for both industry and non-commercial seed endeavors in farmer seed systems, older growers were often more impassioned about non-commercial efforts – perhaps due to a mixture of having more experience with seed saving and having more time to devote to farming and gardening (most of this group reported being retired) but also because they saw in their lifetimes first-hand changes in the structuring of the seed industry that they viewed as highly problematic and a threat to the existence of non-commercial seed saving and sharing networks.

Considering the dramatic decline of seed saving across the US in the last 100 years, in correlation with rising private interest and corporate control in seed systems over the same period (Mascarenhas and Busch, 2006), seed saving has indeed become less commonly practiced, and, in cases where seeds are saved from proprietary varieties, outlawed (Howard 2015). Through seed saving, as well as involvement in non-commercial seed exchanges such as seed libraries, swaps, and fairs, growers can regain agency and decrease their dependency on seed companies (Peschard and Randeria, 2020), a goal that is important for redefining power dynamics within food systems globally. Moreover, as many growers highlighted during interviews – seed saving does not have to be a daunting task. While saving seeds for some crops may require high degrees of knowledge and time (e.g., self-pollinating biennial crops that need two seasons before being harvested and seeds from fleshy fruits that

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require more cleaning), seeds from pods or dry seedheads such as legumes and many common kitchen herbs are relatively easy to save seed for and thus can be a great place for growers to start learning the basics of seed saving and become more self-sufficient.

No grower within this study suggested a one-size-fits-all solution, neither suggesting that singularly supporting alternative seed companies nor everyone saving seed for every crop they grow is the answer. Instead, a more just seed system would include participatory approaches to cultivar development, stronger partnerships between public institutions and communities, reduced restrictions on the use of seed varieties, and more support for agricultural education and knowledge exchange (Lyon, Friedmann and Wittman, 2021). Tools and networking opportunities for helping seed savers connect and share their skills with others, especially as a way to encourage innovation and the exchange of intergenerational knowledge, are also critical to protect from the loss of both varieties and knowledge that seed actors maintain. At the core of all these efforts should be an acknowledgment that neither the commercial nor non-commercial sector is strongest on its own, as exemplified by challenges in seed sourcing following the COVID-19 pandemic (Isbell et al., 2023). That said, considering the lack of historical public support for seed saving and other non-commercial forms of seed procurement, special attention should be placed on seed saving and exchange networks that help shift power away from companies, thus enabling more democratic and self-sustaining seed systems.

Undoubtedly, the US seed system as it stands, and its canonization of agri-chemical/seed companies that make up its seed industry, is problematic in its overdependence on a handful of commercial sources of seed. However, the findings of this research provide evidence that growers use and value many sources of seed (both commercial and noncommercial), underscoring the often highly nuanced and diverse preferences that growers have within farmer seed systems. The growers interviewed for this research generally expressed a strong drive to contest the current system – socially establishing the importance of non-commodification even with commercial spheres, but also by advocating for more radical change. By both embedding commodity seeds with non-commodity value and participating in forms of contestation such as seed saving and non-commercial exchange, growers within farmer seed systems exemplify a deep desire to re-link social, environmental, and economic values within seed and food systems.

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