Spring 4-17-2024

Seed Value Chain Analysis: Enhancing Culturally Meaningful Seed Access by Harmonizing Seed Companies, Seed Growers, and Farmers/Gardeners in the Northeastern United States

Claire Fischer
University of Vermont

Seed Value Chain Analysis: Enhancing Culturally Meaningful Seed Access by Harmonizing Seed Companies, Seed Growers, and Farmers/Gardeners in the Northeastern United States

Claire Fischer
University of Vermont - Food Systems MS Candidate
Advisor: Dr. Dan Tobin
Committee: Dr. Micaela Colley, Dr. Travis Reynolds, Dr. Dan Tobin
April 2024

Abstract

Seeds are often valued solely as agricultural inputs, which diminishes the other benefits they provide such as cultural connections between people and the food they consume. Because seeds are primarily valued for their ability to enhance productivity and profit, a limited supply of culturally meaningful (CM) seeds exist in the US, creating barriers for individuals and communities - and particularly ones of color - seeking to connect to their traditional foodways. The Ujamaa Cooperative Farming Alliance (UCFA), a collective of BIPOC (Black, Indigenous, and People of Color) seed growers and distributors, is working to construct seed value chains (SVC) which proliferate the accessibility of CM seeds for communities of color and promotes seed sovereignty. In this project, we conducted a SVC analysis, which accounts for all the activities required to take seeds from production to consumption, to better understand how the Northeastern United States' SVC functions, what the priorities of different stakeholders are, and where bottlenecks and opportunities exist to develop market opportunities for CM seeds. Based on data from three focus groups (Ujamaa seed growers, other farmers/gardeners, seed companies; n = 14), and survey responses (n =1753), this study elucidates several areas in which developing market opportunities for CM seed will require harmonizing diverse priorities and objectives along the SVC. For example, farmers/gardeners note CM seeds as a limiting factor for providing CM produce to their customers, seed growers express an interest in accessing market opportunities for their seeds, but seed companies expressed concern about culturally appropriate marketing of CM seeds. Further, farmers expressed the desire to work with CM seeds, but the agroecological constraints to locally grow those crops in a Northeastern climate creates a tension between local and CM seeds, highlighting potential market constraints for regionally adapted CM seeds. Lastly, all stakeholder groups agreed that CM seeds should be treated differently than typical market goods, emphasizing the need to embed values, such as fair labor practices, seed sovereignty, and ecological sustainability, into the CM SVC, rather than only considering supply and demand analyses. By examining stakeholders in relation to one another, this value chain analysis will inform strategies to better link different actors along the Northeastern US SVC, supporting seed growers to better access markets to make CM seeds – and the foods they produce –more widely accessible, enhancing both seed and food security.

Glossary of Terms

Term	Definition
CM	Culturally Meaningful
PAR	Participatory Action Research
SVC	Seed Value Chain
UCFA	Ujamaa Cooperative Farming Alliance
VCA	Value Chain Analysis
VCD	Value Chain Development

Acknowledgments

I'd like to extend my gratitude to my committee, Dr. Travis Reynolds, Dr. Micaela Colley, and Dr. Dan Tobin for your expertise and willingness to contribute to this project. I have greatly enjoyed working with you all and hope to continue our collaborations in the future.

Dan, thank you for your continued encouragement and support these past two years. I am deeply grateful for both the professional and academic development I have gained because of joining your research team, along with Sally, Carina, and the entire Ujamaa team. I am confident that the quality of this project is greatly enhanced due to your attention to detail, proactive thinking, and constructive guidance.

I would also like to thank the rest of my Food Systems MS cohort for being the most supportive, intelligent, and thoughtful group of people I could imagine doing this with. Entering this program two years ago, I had no idea I would be leaving with such a special community, but I incredibly appreciative of that outcome.

Lastly, I'd like to thank my family for their continued support as I navigate my path in life – I couldn't do it without you! I'd especially like to thank my boyfriend, Marty, for keeping me caffeinated, and my cats, Ben and Fish Fry, for keeping me company during long hours of writing and encouraging me to take breaks for playtime every once in a while.

Introduction

Value chain development (VCD) is an important strategy to enhance small-scale farmers' access to markets and improve productivity and efficiency, which can result in positive effects on livelihoods, food security, climate resilience, and gender equality (Ros-Tonen et al., 2019). A value chain describes the full range of activities involved in the production to consumption or disposal of a product (Kaplinsky, 2000). VCD utilizes the framework of value chains to increase the capacity of small-scale farmers to take advantage of market opportunities (Donovan et al., 2021). Pro-poor VCD further emphasizes increasing opportunities for stakeholders who have been historically excluded from value chains based on social or economic status (Tobin et al., 2016).

Value chain analysis (VCA) considers the range of stakeholders involved in the value chain and their successive value-adding activities. VCA seeks to link the preferences and needs of different stakeholders and build capacity for these needs to be met along the value chain (Donovan et al., 2021). Informed by value chain analysis, VCD seeks to "integrate smallholder farmers into competitive markets to promote economic and social development" (Tobin & Glenna, 2019, p. 1). These VCD efforts generally involve a combination of government entities, nongovernmental organizations, and agrifood firms to establish pro-poor markets, or strategies to "make markets work for the poor" (Hellin et al., 2007; Tobin & Glenna, 2019. More specifically, pro-poor VCD seeks to increase transparency and diffuse power structures across the value chain to increase participation of small-scale participants in the market chain (Tobin et al., 2016).

Despite the goals of inclusion embedded in the rhetoric of VCD, and especially pro-poor VCD, research suggests that equity and poverty reduction are not always achieved through VCD (Minh & Osei-Amponsah, 2021). Existing institutional and societal constraints, such as class, gender, or race dynamics, can contribute to unequal access to opportunities despite value chain intervention (Kilelu et al., 2017). It has been found that market actors with more natural, financial, human, and social assets are positioned the best to participate in value chains (Tobin et al., 2016). In a review of value chain literature, Ros-Tonen et al. (2019) found value chains may aggravate existing inequalities and exclude people with less access to land and capital, as well as reproduce existing power imbalances among actors across the value chain. As such, there exists a need to further explore the exclusionary forces present in value chain development and how

value chains can become more inclusive and be used as a tool to shift power into the hands of those who hold less power.

Seed value chains (SVC) in particular have been identified as an important area for the application of VCD (Donovan et al., 2021). VCD allows for investigation of all stakeholders in a SVC at once, enabling the identification of bottlenecks and opportunities for the strengthening the value chain (Donovan et al., 2021). While Donovan et al. (2021) focus on the Global South, the potential relevance of the VCD concept extends to the Global North as well. In the United States, seed systems that are alternative to dominant commercial systems have emerged as a strategy pursued mostly by small-scale farmers, nonprofits, and other grassroots initiatives to increase access to seed types like heirloom, organic, and open-pollinated (Helicke, 2015). Additionally, there has been a movement to preserve and increase access of culturally meaningful (CM) seed varieties with a focus on seed sovereignty and regional adaptation (Helicke, 2015). There has been a recent emergence in the US of small seed companies, seed libraries, nonprofit organizations, and public breeding initiatives that focus on these goals (Helicke, 2015). Some of these emerging alternative seed systems are focused on providing culturally significant seeds to historically marginalized communities as a step toward food sovereignty (Soleri, 2017). As pro-poor VCD shares a similar goal of enhancing inclusivity for groups that have previously not been included in a value chain, it is one strategy to make seed value chains more inclusive and representative of a wider range of people.

Despite this rise in seed activism, globally, the dominant seed system is marked by consolidation and homogenization, with just 4 companies accounting for 53.2% of seed sales globally (Howard, 2021), and only 9 plant species accounting for 67% of global crop production (FAO, 2019). This homogenization of crop production with an emphasis on commercially profitable crops and varieties has disconnected communities from their culturally important foods and seeds, threatening seed sovereignty and undermining food security (McGuire & Sperling, 2011). McGuire and Sperling (2011) find the lack of purchasing power, limited social capital, and poorly functioning markets to have strong effects on the accessibility of seeds and foods for small farmers. As the first step in cultivating foods, a diverse and resilient seed system is the basis of a diverse and resilient food system (Soleri, 2017).

As such, there is a need to strengthen the capacity for alternative seed systems to maintain and distribute CM seed varieties. Pro-poor VCD can strengthen CM seed access

because of its aim to recognize those who have historically been excluded from value chains based on race, class, or gender. Much of the previous scholarship in this area has been situated in the Global South, where pro-poor VCD has shown some successes in enhancing small farmers' livelihoods (Devaux et al., 2009). Informed by work done in the Global South, this study hopes to apply pro-poor VCD to the CM seed value chain (SVC) in the Northeastern US.

The Northeastern United States is a region with a robust community of seed growers who maintain CM seeds, but remain disconnected from market opportunities (Isbell et al., 2021). Decades of discrimination from the USDA have disenfranchised BIPOC growers, the primary keepers of CM seeds, from accessing land, capital, and other supports, systematically disconnecting them from market opportunities (Bustillo, 2023). In concentrated industries, such as the seed industry, understanding the factors that influence the ease with which new market participants can enter the value chain is key to understanding who and what products can successfully take hold in the value chain (Kaplinsky, 2000). Further, Donovan et al. (2021) suggests a clear understanding of consumer demand should be the starting point for seed VCD. In the context of CM seeds, evaluating the nature of the seed industry and the relationship between seed companies, CM seed growers, and farmers/gardeners growing CM crops as well as the supply of demand for CM seeds and crops will elucidate how CM seeds can successfully proliferate in the market.

Within the US, community-based organizations have faced substantial barriers are working to enhance access to CM seeds where the dominant seed industry. Ujamaa Cooperative Farming Alliance (UCFA) is a collective of BIPOC (Black Indigenous, People of Color) farmers and gardeners in the United States working to leverage existing market opportunities to proliferate access to CM seeds through their seed company, Ujamaa Seeds. Ujamaa Seeds was founded in 2021 and currently sells a selection of seeds from their member growers but hopes to expand their offerings and support more BIPOC seed growers cultivating CM seeds. Guided by value chain analysis, this study seeks to illuminate where interventions could take place to lessen barriers creating a SVC that is more inclusive and equitable, particularly for historically marginalized growers and communities.

For Ujamaa to effectively support more growers and provide more market opportunities to their existing growers, it is necessary to further understand the CM SVC. By examining multiple stakeholder perspectives at once, a value chain framework is useful to explore where

these opportunities exist and can be strengthened, connecting small-scale CM seed producers to end-users and markets.

The purpose of this study is to explore the market potential for CM seeds in the Northeastern United States through though a CM seed value chain analysis in collaboration with Ujamaa. Value chain analysis is the guiding framework of this study. The specific research questions are as follows:

I. What factors influence the demand for CM seeds by farmers/gardeners and seed companies?
II. What factors influence the supply of CM seeds from seed growers?
III. What tensions exist among seed companies, farmers/gardeners, and seed growers that are barriers to harmonizing supply and demand of CM seeds?
IV. What commonalities exist among seed companies, farmers/gardeners, and seed growers to harmonize supply and demand of CM seeds?

Literature Review

Inclusion and Exclusion Within Value Chains

To achieve the intended inclusivity and diffusion of power for all stakeholders in VCD, it is important to consider the distinction between market availability and accessibility. Drawing on the definition of food security, in the context of seeds, availability refers to the quantity of seed within reasonable proximity to people, whereas accessibility means that people have adequate resources to obtain seeds, despite their availability (McGuire and Sperling, 2011). A third factor is 'utilization', which refers to the extent to which seeds are of acceptable quality (germination, cleanliness, etc.) to a farmer and meets their specific needs (culturally relevant, regionally adapted, etc.) (McGuire and Sperling, 2011). For a seed value chain (SVC) to be inclusive and meet the goals of seed security, it must make seeds available, accessible, and usable for all stakeholders. Because value chain development can, at times, reproduce existing power imbalances or exacerbate social inequality, groups that have less societal power are at risk of being excluded from the opportunities generated by value chain development (Ros-Tonen et al., 2019).

Societal factors such as land access, wealth, gender, and race/ethnicity can act as strong inclusionary or exclusionary factors in value chain development (Kilelu et al., 2017). In addition to societal factors, some small-scale farmers actively choose not to participate in value chains (Tobin et al., 2016). In response to gender inequalities in value chain development, much attention has been paid to increasing women's opportunities to take advantage of value chains (Devaux et al., 2018; Minh & Osei-Amponsah, 2021). Research has shown that women participate in value chains and affected by VCD differently than men, necessitating the application of a gender lens for inclusive VCD (Devaux et al., 2018). Drawing on lessons from previous efforts at gender-inclusive VCD (Mulema et al., 2016; Stoien et al., 2018) it is possible that similar strategies could be utilized to create value chains that are more inclusive for BIPOC seed producers.

To create inclusive value chains, it is necessary to address the social constraints influencing the structure and function of value chains. Strategies to strengthen value chain inclusivity include multi-stakeholder partnerships (such as between producers and purchasers), social upgrading (improving producers' rights and working conditions), small-scale farmer empowerment (recognizing power imbalances and trying to diffuse them across the value chain), livelihood integration (diversifying livelihood activities), and gender sensitivity (recognizing differences in gendered realities and leveling the playing field) (Ros-Tonen et al., 2019, Thiele et al., 2011). However, previous research cautions against using these strategies without paying particular attention to the power dynamics at play in value chains that can supersede efforts to create inclusivity (Jones at al., 2017, Nelson & Tallontire, 2014). Generally, inclusive value chain literature emphasizes the need for nuanced conceptualizations of value chains that pay particular attention to the range of factors, both sociocultural and material, influencing stakeholders' participation in value chains (Devaux et al., 2018; Ros-Tonen et al., 2019).

One strategy for enhancing the efficacy of inclusive VCD is the removal of barriers to entry at various nodes of value chain, such as power imbalances, access to land, and marginalization due to race or ethnicity (Pastakia, 2012). Barriers to entry refer to the obstacles that make it prohibitive for a new stakeholder to enter a market – the underlying factors that render a value chain inclusive or exclusive to new stakeholders who wish to integrate into the value chain (Porter, 1989). Existing power imbalances, access to knowledge, social capital, and values can also act as barriers to value entry for small-scale farmers who lack these non-material

resources (Minh & Osei-Amponsah, 2021; Tobin et al., 2016). Further, previous research has shown that social and resource networks are especially important for connecting small and minority-owned farms to market opportunities (Khanal et al., 2020). In the context of a particular industry and its value chains, it is necessary to examine what influences the ability of new individuals and businesses to participate in the industry's value chain. When inclusive value chains are achieved and power is diffused, research has shown benefits to small famers' livelihoods (Reardon, 2009).

Dominant Seed System

The global seed market is highly concentrated, with just four companies (Bayer, Corteva, ChemChina/Syngenta, and Vilmorin/Groupe Limagrain) controlling 53.2% of the market share for commercial seeds (Howard, 2021). The commodity crop seed market (e.g., corn, soy, and cotton) has experienced greater concentration than the specialty crop seed market, e.g., fruits and vegetables grown on smaller acreage, but consolidations have recently increased among specialty seed markets as well with the Bayer - Monsanto merger resulting in a 94% control of the carrot seed market and 90% for cucumbers (Jenney, 2023).

Whereas seeds were once a resource of the commons, cultivated, preserved, and shared freely by farmers, farmer sovereignty over seed has since been eroded as a result of various technological, policy, and social changes (Helicke, 2015; Kloppenburg, 2014). The result of these changes in the seed system has been to place farmers and seeds in the free market every growing season, creating a booming seed industry, and corresponding farmer reliance on a market that did not exist only a few decades ago (Kloppenburg, 2014).

This concentration, and the lack of crop diversity in the seed system resulting from it, has had severe ecological and social consequences. The FAO has declared the decline in global plant diversity as one of the most serious issues currently facing the planet (Campbell, 2012). The decline of genetic diversity within the food system leaves it vulnerable to disruptions, such as disease or natural disaster. Because of the role agrobiodiversity plays in enabling crops to adapt to changing environments, it is a crucial prerequisite of a sustainable agricultural system (Lover & Spaner, 2007). Further, crop diversity and seed security have been established as critical to ensuring food security for communities in both the Global South and North (McGuire & Sperling, 2011; Thrupp, 2000). Increasing homogeneity of the global food system has resulted

in a disconnect between many communities and their traditional, culturally important foods, undermining food security on the local scale (Khoury et al., 2014).

In the context of seeds, intellectual property rights (IPR) represent restrictive barriers of entry, as farmers are not permitted to save or breed seeds that are under utility patents (Kaplinsky, 2000). Concentration in the seed system and IPR regulations have prohibited growers from engaging in the seed value chain in a way they once were able to (Helicke, 2015). Based on this homogenization and privatization of seeds, it is evident that the dominant food system falls short of providing access to CM seeds and foods, disrupting both physical access to seeds and the cultural importance that is carried with them. As such, seed systems outside of this dominant system have responded to this lack of availability, accessibility, and utilization in the market.

Alternative Seed Systems in the United States

In response to this consolidation and concentration of power in the dominant seed system, seedkeepers across the United States have worked to increase seed sovereignty and reclaim power in the seed value chain, utilizing both market- and non-market-based approaches. Independent seed companies, small scale seed growers, community seed banks, seed libraries, and participatory plant breeding contribute to an alternative seed system that integrates values beyond the scope of financial gain as in the dominant seed system (Helicke, 2015; Soleri, 2017). Many alternative systems specifically emphasize the importance of preserving CM seed varieties (Carolan, 2017; Soleri, 2017). For example, Truelove Seeds, a small seed company in Philadelphia, offers African Diaspora, East Asian, and Italian Collections of seeds (Appendix A). Alternative seed systems often emphasize regionally adapted seeds, which are bred to be best suited for growers' particular climates and are increasingly important as climate change alters growing conditions (Helicke, 2015).

Alternative seed systems are not a monolith and exist on a scale between informal seed systems (diffused power, direct farmer-to-farmer exchange) and formal seed systems (specialized, market-oriented) through which many 'semi-formal' seed systems emerge (Soleri, 2017). Semi-formal seed systems can perform multiple different seed system functions, such as conservation, improvement, or multiplication, but all are centered around distribution (Soleri, 2017). At the core of many alternative seed systems, particularly those that exist outside of the

market, such as seed libraries and exchanges, is the idea of seed sovereignty. A movement emerging from farmers, peasants, and activists in the Global South, seed sovereignty includes the right to save and replant seed, the right to share seed, the right to use seed to breed new varieties, and the right to participate in shaping policies for seed (Kloppenburg, 2014). Efforts to regain seed sovereignty vary widely in approach, but include legal action to protect rights to seed, such as the Open-Source Seed Initiative (OSSI) and farmer and peasant movements, such as La Vía Compesina and Navdanya (Kloppenburg, 2014). Further, seed sovereignty is particularly important as it is a necessary prerequisite for food sovereignty, which refers to the self-governing of people over their food system (Swiderska & Argumedo, 2022). Major barriers to seed sovereignty include IPR, centralized plant breeding, and monopoly power in the dominant seed system, and the disconnection of farmers from their seeds – all of which alternative seed systems work against (Helicke, 2015; Hubbard et al., 2022; Kloppenburg, 2014).

Despite the rise of both market- and non-market-based strategies working against seed system consolidation, cultivating CM seeds, and promoting seed sovereignty, there remains a disconnect between these seedkeepers and access to channels through which to proliferate CM seeds more widely. It remains to be understood what barriers exist that prevent seedkeepers from accessing market opportunities for CM seeds. Identifying and understanding these barriers is particularly important for CM seeds because of their lack of representation in the dominant seed system and role in enabling a CM diet for historically marginalized communities.

Cultural Meaning of Seeds

For many, seeds represent more than a biological organism, also containing the sociocultural components that have coevolved with a community over time (Carolan, 2007). Alternative seed systems that recognize the cultural value of seeds also foster the exchange of seeds, history, knowledge, and stories along with the exchange of the material seed (Campbell, 2012). As such, the erosion of these seed varieties not only represents a loss of economic and environmental value, but also cultural in the form of the biocultural heritage carried by the seeds (Swiderska & Argumedo, 2022). Biocultural heritage refers to the "knowledge, innovations and practices of Indigenous peoples and local communities that are collectively held and inextricably linked to traditional resources and territories, local economies, the diversity of genes, species and ecosystems, cultural and spiritual values, and customary laws, shaped within the socio-ecological

context of communities" (Swiderska & Argumedo, 2022). Andean potatoes and Mesoamerican maize are two prominent examples of crops that are tightly intertwined with cultures both past and present (Curry, 2022; Swiderska & Argumedo, 2022).

Seedkeepers are motivated to maintain genetic diversity by a combination of economic, cultural, environmental, community, personal, and political reasons (Isbell et al., 2021). Motivations for seedkeepers to get involved with seed work include preserving family heritage, sharing knowledge with other seedkeepers, and preserving traditional agricultural practices (Baxley et al., 2020; Campbell, 2012). Moreover, in a study of Vermont seedkeepers, Isbell et al. (2021) found cultural motives to be associated with the greatest increase in crop diversity above both economic and personal motives, pointing to a potential relationship between CM crops and high biodiversity. Preserving CM varieties is particularly relevant to communities who have been disconnected from their seed systems and foodways through the privatization and biopiracy of seeds (Curry, 2022; Guo et al., 2021). As such, the ability for individuals and communities to access the seeds that are important to them is crucial for maintaining cultural heritage and culturally relevant diets.

Culturally Meaningful Seed Value Chain in the Northeastern US

To further understand the inclusionary and exclusionary forces for CM seed growers and distributors within the seed value chain (SVC), this study presents a case study of the CM SVC in the Northeastern United States. Because growers of CM seed, many of whom are from historically marginalized communities, and the seeds themselves have been excluded from market opportunities, an inclusive VCD framework informed by work in the Global South is particularly relevant. In the Global South, inclusive VCD has been shown to lead to positive outcomes for small-scale farmers when the heterogeneity in gender, class, knowledge, etc. of stakeholders and their access to value chains is understood and considered in VCD strategies (Ros-Tonen et al., 2019). Growers in the Northeast maintain a high level of crop diversity but are often disconnected from market opportunities for their seeds, despite the established role of commercialization in the United States seed system (Isbell et al., 2021). A survey of organic seed growers in the Northeast highlighted both economic and sociocultural barriers to accessing the seed market (Mulugeta et al., 2021). For example, access to tools and equipment for seed work, financial capital, and legal regulations around seeds were highlighted as economic challenges.

Further, inclusivity of historically marginalized groups, lack of connectivity to other stakeholders in the seed system, and information about cultivation of and business opportunities for seeds were also noted as challenges. About 50% of growers surveyed indicated that they felt they did not have the power to engage in profitable business opportunities related to seeds, highlighting the opportunity to strengthen that power to leverage market opportunities (Mulugeta et al., 2021). As such, it seems that seed growers in the Northeast who desire access to market opportunities may face similar challenges to those in Global South.

Previous research has shown cultural importance to be a major motivation for growers in the Northeast who maintain plant genetic diversity (Isbell et al., 2021). The Northeastern US is a highly diverse region, with 17.1% of the population being born outside the United States and later immigrating to the Northeast (Census, 2022). Access to CM seeds in the Northeast has been highlighted as one strategy to reconnect diverse individuals and communities to their foodways through the ability to cultivate and consume CM foods (Guo et al. 2021; Lyon et al., 2021). Access to culturally acceptable food, beyond just access food broadly, is an important aspect of food security, which is often overlooked in efforts to enhance food security (Hammelman & Hayes-Conroy, 2015). As such, access to CM seeds should be considered as an important approach to increase food security for historically marginalized communities. There is an opportunity to connect value chain actors and identify where barriers to entry for seed growers and seed companies maintaining this diversity exist within the current SVC to promote both seed and food sovereignty.

Methods

Research design

The design of this study was guided by participatory action research (PAR) protocols, which emphasize the involvement of stakeholders and community partners throughout the entirety of the research process. PAR involves a great degree of engagement with stakeholders and concentrates on reflection, iteration, power relations, and multiple cycles of co-learning throughout the research process. As a research method that is particularly focused on generating actionable knowledge that directly benefits the community and stakeholders with whom the researchers are collaborating, PAR is particularly suited for research oriented around the Sustainable Development Goals of the UN (Méndez et al., 2017; Snapp et al., 2023). Further,

partnerships at every level of design of a value chain intervention has been shown to promote inclusion in VCD, making PAR a fitting research design for evaluating where there are opportunities to increase value chain participation through VCD (Devaux et al., 2018). When considering the dynamics of an existing value chain, utilizing a PAR design better ensures a value chain analysis guided by value chain stakeholders themselves every step of the way. This is not a novel approach, as participatory models of value chain analysis have been previously developed, such as the Participatory Market Chain Approach (PMCA), which emphasizes smallholder participation in VCD (Devaux et al., 2017). Specifically, PMCA incorporates social learning, social capital formation, and joint research and development activities in its approach (Horton et al., 2020). Nevertheless, the integration of PAR and VCD methods allowed for the co-creation of all research activities and the development of the value chain with community partners and stakeholders.

This project was carried out through the continuous collaboration of a University of Vermont (UVM) research team and several Ujamaa researchers, leaders, and members. Specifically, Ujamaa researchers provided community expertise and participated in proposal writing, research design, instrument development, data collection, and dissemination of findings. Because Ujamaa members were both researchers and participants in this study, we controlled for potential bias by ensuring members were exclusive in their roles either as researchers or participants. The UVM research team led Institutional Review Board (IRB) approval, instrument design, and data collection protocol, while training Ujamaa researchers on those topics along the way.

The study followed a mixed methods design in which both qualitative and quantitative data were utilized and combined to answer the research questions. Researchers use mixed methods designs for a number of reasons, including to enhance study validity by using different data types to measure the same phenomenon, gain a wider and deeper understanding of research questions, or examine the effectiveness of an intervention with contextual understanding (Creamer, 2018). In this study, I use a mixed methods design primarily for the richness of data it can provide to answer my research questions.

A combination of convergent parallel (qualitative and quantitative data collection and analysis completed at the same time and then combined) and exploratory sequential (qualitative data collection and analysis completed prior to quantitative to inform instrument development)

designs was used to answer all research questions (Creswell and Plano Clark, 2017) (Figure 1). The results from both the qualitative and quantitative portions of the study were combined to complement one another to interpret the findings for all research questions. In this study, the purposes of a mixed methods approach were data triangulation, enhancement/complementary data, and instrument development (Creamer, 2018). As such, using mixed methods enhanced the validity by using different types of data, provided more nuanced and contextualized data, and provided information to develop a quantitative instrument.

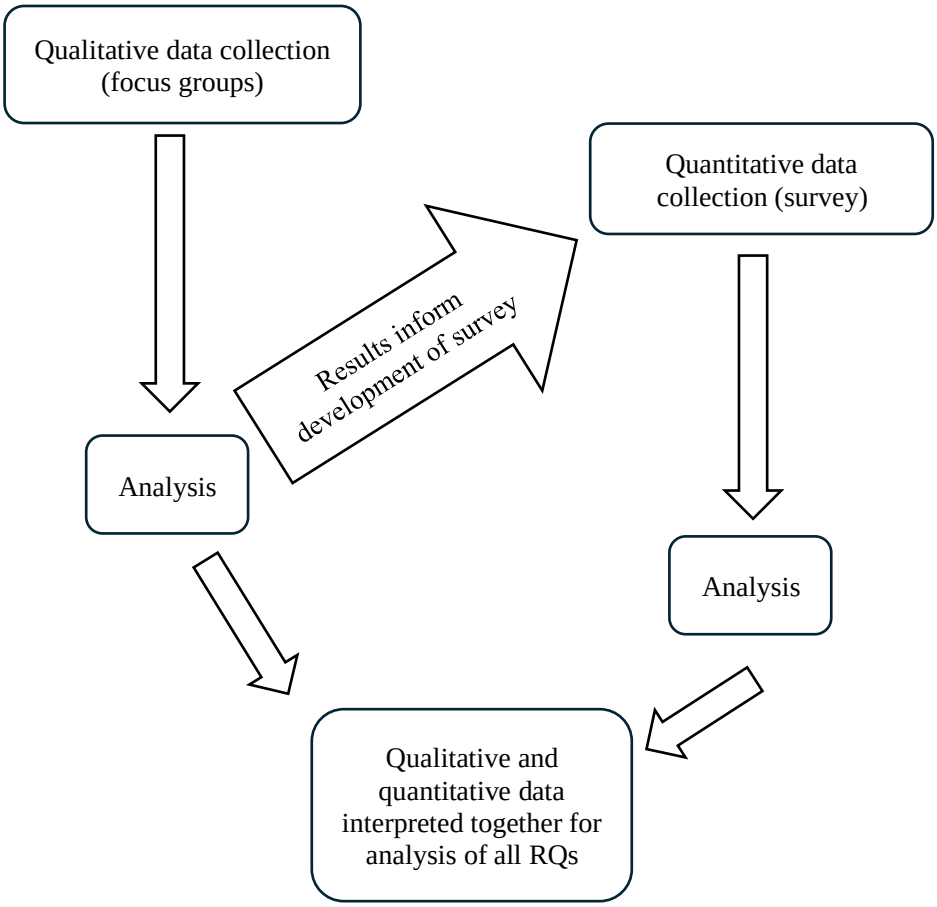


Figure 1. Mixed methods research design. The staggering indicates the relative time each task was completed.

Population and sampling

Qualitative. The population for the qualitative portion of this study represented different nodes of the Northeastern seed value chain and included six different perspectives: Ujamaa-affiliated growers, non-Ujamaa-affiliated farmers and gardeners, seed companies, produce wholesalers and distributors, chefs and restaurants, and specialty grocers. We chose these stakeholder groups to account for the movement of seeds from production (seed growers) to consumption (chefs and restaurants, specialty grocers), encapsulating the whole value chain. Focus groups participants were identified using purposive convenience sampling, taking advantage of existing networks and collaborations. We began by compiling a list of potential participants who fit one of the six stakeholder group identities and were working in the Northeastern US. Because the study is focused on diverse culturally meaningful seeds and importance of incorporating diverse perspectives, participants were then selected with a preference for representation of diverse races/ethnicities using purposive sampling (Campbell et al., 2020). Of the three focus groups used in this study, the farmers/gardeners and Ujamaa growers were both representative of diverse racial/ethnic groups, but the seed companies focus group was majority white participants. Most participants in all focus groups were middle-aged (25-45).

Quantitative. The population for the quantitative portion of the study include the same set of market actors as the qualitative portion, but with a wider geographic reach to increase sample size, such that we recruited both in the Northeastern US and nationally. Because some quantitative analyses require a threshold of responses, we hoped to reach the largest audience by widening the geographic scope. Because no sampling frame for value chain actors in the culturally meaningful seed value chain already existed, the strategy for recruitment was to spread as widely as possible to generate the greatest number of responses from relevant groups. We used purposive convenience sampling to ensure racial/ethnic diversity in the sample given the focus on diverse cultural identities of the study (Campbell et al., 2020).

Several methods were used to identify the survey sample. The survey was shared online via several listservs and newsletters and in-person at relevant conferences and convenings, which accounted for the majority of survey respondents. We also compiled an email distribution list, taking advantage of various networks and online platforms. Lastly, we identified participants via an initial round of recruitment in which a preliminary Qualtrics survey to indicate interest in

being a participant was shared with existing online networks the research team is a part of. That interest form generated 80 respondents who then received the link to the final survey during distribution.

Ujamaa growers were identified through established networks with the Ujamaa Cooperative Farming Alliance (UCFA). The 'chefs and restaurants' sampling category included BIPOC chefs and restaurants that serve ethnic cuisines, which we primarily identified via Google Maps searches of major metropolitan areas in which searches such as "Ethiopian restaurant" or "BIPOC-owned Restaurants" served as a starting point to compile contact information from restaurant websites and preexisting website directories such as eatokra.com. Produce wholesalers and distributors were identified largely through the website foodcodirectory.com, which provides a list of wholesalers by state, as well as the USDA food hub directory. The 'specialty grocers' category included both ethnic grocers and grocers with an emphasis on providing local produce, which were mainly found via Google Maps searches, such as "West African grocer" or "Co-op grocery" in a variety of cities and towns in the Northeastern US, like Philadelphia, Albany, and Baltimore. Farmers and gardeners for this contact list were identified primarily from directories on agricultural organizations', such as organic farmer associations (e.g., branches of the Northeast Organic Farming Association) websites. We relied heavily on the Organic Seed Alliance directory to compile contact information for seed companies, as well as internet searches for companies not included in the directory. Additionally, we had access to a list of 300 seed companies from a previous graduate student at UVM. These internet searches generated a list of 4,355 total contacts who received the survey via email. In addition to these contacts, we also recruited via organizations, such as Northeast Organic Farming Associations and Master Gardeners, who agreed to share the survey recruitment information with their networks.

Given grant objectives, participants were initially restricted to the Northeastern United States, which includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, Washington D.C., and West Virginia as defined by the Northeast Sustainable Agriculture and Education (SARE). However, once there was adequate representation from the Northeast, we expanded recruitment nationally in the interest of saturating the distribution list.

Instrumentation

Qualitative. Qualitative data were collected via focus groups. The focus group protocol was informed by the 2022 Juneteenth convening hosted by Ujamaa and insight from Ujamaa researchers. The convening provided a starting point for identifying the types of questions we wanted to ask and what insights into the market would be helpful for Ujamaa to gain by having group discussions with UVM and Ujamaa researchers led by Ujamaa. The protocol for the focus groups was developed and field tested prior to beginning data collection. The final version sought to gain perspectives on the marketability of culturally meaningful seed, as well as perceived barriers or opportunities in the value chain across the different stakeholder groups. Each focus group utilized the same protocol to ensure comparability across groups (Appendix A). We structured focus group questions to elicit responses related to the cultural importance of seeds or foods, accessibility of those seeds or foods, and the role that different stakeholders play in enhancing or hindering accessibility.

Quantitative. To obtain quantitative data for the study, we developed a survey in Qualtrics. The survey consisted of one section that all stakeholders completed followed by sections that filtered participants based on their self-selection into one of ten positions in the seed value chain (gardener, urban farmer, rural farmer, seed company representative, seed retail representative, food distributor representative, value-added food business representative, grocer representative, professional chef, or restaurant representative) which were consolidated into four stakeholder group question blocks (seed companies, farmers/gardeners, Ujamaa growers, and downstream value chain stakeholders). Participants also completed demographic information.

The UVM research team and an Ujamaa researcher developed the survey questions based on the qualitative focus groups in this study, previously deployed seed producer surveys, and academic and industry knowledge. Prominent themes included CM seed access, demand for CM seeds and foods, and connectivity to other value chain stakeholders. Questions consisted of both open- and close-ended format, predominantly multiple choice and Likert-type (full survey instrument provided in Appendix B).

To ensure validity of key survey questions, multiple rounds of internal and external testing and editing were completed prior to survey deployment. There was an initial round of field testing in which at least one representative from every stakeholder group (n = 9) completed the applicable section of their survey and provided feedback on every question. Everyone that conducted this field testing received a $50 gift card as compensation for their time. After that

initial round of testing, the survey was shared internally amongst research collaborators at UVM for another round of field testing focusing on face validity. After each round of testing, we discussed the feedback with an Ujamaa researcher and applied necessary changes until we reached the final version of the survey.

Data collection

Qualitative. We received Institutional Review Board (IRB) approval July 11, 2022, prior to completing any data collection with participants. We conducted a series of six focus groups consisting of different stakeholder groups between August 30th and October 11th, 2022, each with 3-9 participants: Ujamaa growers, farmers and gardeners, seed companies, chefs and restaurants, specialty grocers, and produce wholesalers and distributors. Focus group participants were identified using purposive convenience sampling, taking advantage of existing networks and collaborations. For each stakeholder group, we compiled a list of potential participants, who were contacted with the same recruitment email message, no more than three times each until each group was saturated with at least eight participants. However, some groups experienced attrition after recruitment and so were conducted with fewer than the expected six participants.

The focus groups were conducted via Zoom and each lasted 60-90 minutes. For consistency, the same Ujamaa researcher acted as the facilitator for each group and there was UVM researcher serving as technology troubleshooter and an Ujamaa researcher taking notes. Each group received the same interview protocol (Appendix C), but conversations varied somewhat depending on how the group responded. As compensation for their time, each participant received a $50 gift card. Each focus group was recorded and subsequently transcribed via speechpad and anonymized prior to analysis.

Quantitative. Once Institutional Review Board (IRB) approval was obtained for the study, we were able to begin data collection with participants. All recruitment was made with an identical recruitment message informing potential participants of the aim of the study and requesting their participation. Recruitment efforts began while we were developing the survey; compiling a distribution list of emails to share the survey with (as described above) and beginning to ask different organizations to share the survey when it was published. After the survey development was complete, recruitment efforts continued with two main strategies: distribution via existing networks' newsletters and listservs and email distribution via our

research email. The survey was deployed via email with an open anonymous Qualtrics link in October 2023 and responses were collected through January 2024. Survey distribution groups included Ujamaa growers (n =19), other farmers and gardeners (n =787), chefs/restaurants (n =2055), produce wholesalers/distributors (n =680), seed companies (n =359), and specialty grocers (n =455) (Table 1). At our request, and to gain as many perspectives as possible, the survey was shared via Northeast Organic Farmer Associations (NOFA) and Master Gardeners networks, Black farmer organizations, Organic Seed Alliance, and other seed and farming organizations with first a Northeastern – and then a national - focus. Sharing the survey via these networks generated the majority of responses. Contacts on our email distribution list received a reminder email and link to the survey every week for four consecutive weeks before being removed from the email list. As compensation for their time, each participant could opt into a drawing for one of sixty $50 gift cards. The survey received a total of 2,177 responses in the four months it was open. Of those, 1,753 survey responses were fully completed and could be used for analyses.

Table 1.

Stakeholder groups, recruitment strategies, and responses to the survey.

Stakeholder group	Brief recruitment strategy	Recruited via email	Responses to survey
Ujamaa Growers	Ujamaa research partners	19	47
Farmers/Gardeners	Email distribution lists; listservs and newsletters such as NOFA, Master Gardeners, and National Black Food & Justice Alliance	787	1538
Seed Companies	Organic Seed Alliance directory and newsletter; personal contacts	359	82
Chefs/Restaurants	Web searches; web directories (eatokra.com); Google Map searches	2055	26
Specialty Grocers	Google Maps; web directories (National co-op Grocers)	455	27
Wholesalers/Distributors	Web directories (foodcodirectory.com and USDA food hub directory)	680	33

Note. This table accounts for just one of three sampling strategies, since the exact number of potential respondents reached by the other strategies is not known.

Data analysis

Qualitative. Each focus group was coded using approaches described by Creswell (1998), including open, axial, and selective coding. This approach consists of developing categories of information (open coding), interconnecting the categories (axial coding), building a 'story' that connects the categories (selective coding), and ending with a set of theoretical propositions informed by the coding (Creswell, 1998).

I engaged in the coding process with my research questions in mind, and so the analysis and emerging themes were guided by themes of market dynamics, barriers, opportunities, and

demand for CM seeds. Through open coding in NVivo, I developed a single codebook for the three relevant focus groups (Ujamaa growers, farmers/gardeners, seed companies) to best allow for cross case comparison (Appendix D). I then developed emerging themes from each focus group individually (within case analysis) by engaging in axial and selective coding as described by Creswell (1998). After completing within case analysis for each focus group, I compared where the focus groups converged and diverged in a cross-case analysis that considered all three focus groups together.

Quantitative. All quantitative analyses were conducted using Microsoft Excel and the Statistical Package for Social Sciences (SPSS). Data were cleaned, labeled, and organized to allow for descriptive statistics (Table 2) and preliminary analyses in excel before being uploaded to SPSS, where we analyzed the data guided by the research questions of this study.

Some variables were transformed for the purposes of this study. Although some nuance is lost in the data by aggregating, combing the data in these ways allowed for comparison of groups of respondents with more statistical robustness. This is because the differences in sample sizes between categories, 'white' and 'Asian', for example, were large enough that only descriptive statistics could be performed prior to aggregating. Race was aggregated into 'white' and 'BIPOC', which encapsulated "Asian", "Black/African American", "Native Hawaiian or Pacific Islander", and "Hispanic/Latine". Gender was similarly aggregated into 'male' and 'not male', which included "female", "non-binary", and "genderqueer". Lastly, employment was aggregated into 'full-time employed', including "full-time employment for another person/organization" and "full-time self-employed/contractor/freelance", 'part-time employed', encapsulating "part-time employment for another person/organization" and "part-time self-employed/contractor/ freelance", and 'not working", containing "not able to work", "unemployed", and "retired".

Additionally, several Likert-type questions were aggregated into overall measures of the concept. These transformations allowed nominal data to be aggerated into scalar data, making the data more robust for analyses. For example, farmers/gardeners were asked about how connected they felt to other stakeholder groups in the SVC. We found their responses to each question about connectivity to achieve reliability (alpha = .865), so created a new single measure from the 11 original items that measured farmer/gardeners' overall connectedness to other SVC stakeholders on a 5 point Likert-type scale. The same process was completed with seed companies' responses to 11 items about their connectedness with other SVC stakeholders (alpha

= .756). Likewise, aggregate measures of 11 items asking about challenges on a 5 point Likert-type scale (alpha = .909) and 8 items asking about resource access on a 4 point Likert-type scale (alpha = .848) for seed growers were created. Lastly, a measure of the overall barriers faced by farmers/gardeners was created from 13 items asking about the severity of various barriers on a 4 point Likert-type scale (alpha = .896).

Once all variables were transformed to allow for streamlined analyses, we conducted a series of bivariate and multivariate analyses, including chi-square tests, independent-samples t-tests, and binary logistic regressions. For all tests, the threshold of significance was 0.1 due to the exploratory nature of this study. For the regressions, the demographic variables of race, gender, employment, income, and age were held constant, and only one test variable was included in the model at a time.

Table 2.
Demographic variables for survey participants. Downstream value chain actors are produce wholesalers/distributors, chefs/restaurants, and specialty grocers.

Variable	Frequency	Percent
Race		
White	1158	70
Black, Indigenous, Person of Color (BIPOC)	280	23
Gender		
Male	418	27
Female	948	61
Nonbinary or Queer	87	6
Age		
18-29	47	4
30-39	180	14
40-49	243	20
50-59	198	16
60-69	322	26
70-79	214	17
80+	38	3
Position in Value Chain		
Farmer/gardener	1538	87
Seed company representative	82	5
Ujamaa seed grower	47	3
Downstream value chain actors	86	5

Note. Several of these categories were 'select all that apply' and/or included 'prefer not to answer' and 'other' options, which explain total percentages that are above or below 100%.

Findings

Focus groups and survey questions about the nature of the supply and demand for CM seeds, and the tensions and commonalities that are present among seed companies, farmers/gardeners, and seed growers in the CM SVC, revealed three key themes that were present at all nodes of the value chain considered: (1) the importance of non-economic values, (2) scale, and (3) value chain participation and collaboration (see Table 1). Each of these themes emerged as areas where there are bottlenecks to or possibilities for the creation and coordination of the CM SVC. Within each of these themes, findings from both qualitative and quantitative

data point to places where stakeholders' views converge and diverge, elucidating where harmonization of perspectives already exists and where it can be strengthened to bolster the availability of CM seeds.

Qualitative results suggest there is desire and readiness among many seed system stakeholders in the Northeast for CM value chains to be strengthened. One Ujamaa seed grower expressed their desire for the establishment of a formal CM seed market saying, "I feel we're sort of at a tipping point where there's enough people who are interested in growing some of this stuff, but there's not a real market set up yet. You know, it's kind of like everybody's sort of just waiting." The qualitative and quantitative findings attempt to directly respond to this need, showcasing where along the value chain steps can be taken to establish the CM seed market.

Table 1.

Summary of barriers and opportunities for CM seeds in the SVC.

Characteristic	Seed Growers	Farmers/Gardeners	Seed Companies
Non-economic values	**Opportunity:** Want to grow seeds that hold personal meaning to them **Opportunity:** Build connectivity with seed companies to ensure CM seeds are being sold in a culturally appropriate way	**Opportunity:** Want to buy seeds and grow crops that hold meaning to them	**Barrier:** Concerned about marketing seeds that are not from their culture for fear of exploitative practices or cultural appropriation **Opportunity:** Should keep CM stories and meaning attached to seeds as they are being marketed and sold to a wide audience
Scale	**Barrier:** Are often growing seed on small plots, so cannot offer large amounts of seed, can be difficult to integrate a seed crop with vegetable crops **Opportunity:** Trainings on how to grow seed on small scale	**Barrier:** Want seeds that produce well when grown on a small scale **Barrier:** CM seed access is key for CM crop market development	**Barrier:** Desire to pay seed growers a fair price, but only are buying a small amount of seed from growers **Opportunity:** Implement ways to support growers better financially (e.g. profit sharing, guaranteed minimum price, etc.)
Value chain participation and collaboration	**Barrier:** BIPOC seed growers have less access to resources and experience more challenges to seed growing than white growers **Opportunity:** Seed growers that are better connected to the SVC are more likely to grow CM seeds	**Barrier:** Farmers who experience greater barriers to their agricultural activities are more likely to be growing CM crops	**Opportunity:** Support BIPOC seed growers by buying their seeds and highlighting their importance

Non-Economic Values

The qualitative and quantitative results suggest that people engaged with CM seeds value those seeds, and the resulting crops, for more than just their economic value or returns. While in any exchange of goods, there is bound to be some economic consideration, it is important to note that the primary conversations around seeds' and foods' importance in the focus groups were not related to their economic value and instead highlighted non-economic ways they were meaningful. This is evident throughout the value chain, with seed companies emphasizing the need to incorporate values, such as culture, community, and ecological responsibility, into marketing, farmers and gardeners describing the importance of how seed is grown and how the growers are treated in the exchange, and seed growers explaining how they choose the varieties of seeds they grow out. As such, to understand the supply and demand of CM seeds and how to leverage the SVC to increase their availability, it is necessary to evaluate why different stakeholders, grow, purchase, and market CM seeds, rather than just assume it is entirely based in the economic value of CM seeds.

Focus groups and survey data show that, for some, seeds carry meaning that is far beyond their material components – seeds are more than just the first stage of the foods that result from them. Focus group participants indicated that seeds are vessels of cultural heritage, facilitators of community, and drivers of systems change. This is consistent with survey findings, with 62% of respondents noting that seeds are important for their connection to family traditions (n=1731), 76% for their connection to where they live (n=1737), 44% for connection to a food movement (n=1750), and 38% for connection to their ethnicity, race, or culture (n=1737). Interestingly, in an independent samples t test, seeds' importance for connecting to ethnicity, race, or culture is significantly higher for BIPOC respondents (M = 3.31, SD = 1.12) compared to white respondents (M = 3.05, SD = 1.22) ($t(1099) = -2.66$, $p = .004$) on a 5-point Likert-type scale where 1 = very unimportant and 5 = very important. The same is true is for connection to a food movement, which is more important to BIPOC (M = 3.46, SD = 1.16) than white (M = 3.14, SD = 1.22) respondents ($t(1104) = -3.19$, $p < .001$). These findings were both confirmed with a Mann-Whitney robustness check for ordinal data ($U = 89251$, $p = .015$; $U = 93379$, $p = .002$,

respectively). Based on the findings, it appears that there may be higher potential to stimulate consumer demand among BIPOC populations. These quantitative findings are complemented by focus group discussions about the embedded cultural meaning of seeds. One seed company representative expressed the connection between seeds and people saying:

> I feel like a lot of seeds have been tended so closely and are so closely related to the group of people who has been in relationship with them that, at a certain point, it's impossible to separate out. And when anybody plants and grows those seeds, they're sort of in relationship with those people as well as the seed.

To the same question about the embedded cultural meaning of seeds, a farmer noted the capacity of seeds to bring communities together:

> …in Philly where I'm based, there's been a lot of Black and Asian solidarity work around seeds and building out seed libraries, and it feels like a really beautiful, like, building out of the culture in Philly around, like, local food and solidarities between people, and, like, bridging a lot of shared histories as well.

These results show how the significance of some seed varieties is related to familial, community, and cultural ties, so to fully understand their market potential, these non-economic values must also be considered, such as community-building, culture, and social justice, as well as traditional economic values, like cost and demand.

Consistent with the importance of non-economic values for seeds, the qualitative and quantitative findings show that purchasers of CM seeds are not purchasing solely on use value of seeds, but also for cultural and ethical reasons. When focus groups were asked about what they value in the food crops they buy, one farmer responded with his considerations, saying:

> … are we growing these food items in a manner that allows us to continue growing at the same production level and quality of product and perpetuity? Are we are leaching the nutrients from the soil and to the point where we won't be able to turn the high quality of product, you know, in 10, 15, 20 years? Are we limiting our descendants the ability to do what we are able to do now?... And then how it's distributed. …Does it get to my table and at least further some process to the environment? Are we using the smartest most thought-forward-thinking methods to distribute the food item so I can receive it? And a lot of that means ultimately growing a lot of small batch things on small plots of land very close to

where it would be consumed. But that's what that means, I'd say, responsible in nutshell.

This quote, which is consistent with other focus group participants, suggest that consumers of CM seeds and foods are considering more than just price, convenience, and desire when purchasing seeds and foods. They are considering the ethics and values embedded within the products, such as how the workers were treated and what the agricultural practices used to grow the food were. Figure 1 shows the importance of different farm characteristics to consumers across the value chain. Consistent with focus group results, characteristics such as labor standards, sustainable agricultural practices, and locally grown are important to consumers. Survey responses suggest that farms maintaining CM varieties is the least important characteristic across all items measured. However. In an independent samples t-test, findings show that it is more important to BIPOC stakeholders that the foods they consume are produced on a farm that maintains culturally significant varieties (M = 3.83) than it is to white stakeholders (M = 3.66) (t(*1101*) = -1.77, p = .038) on a 5 point Likert-type scale from 1 = very unimportant to 5 = very important. This finding was confirmed with a Mann-Whitney robustness check for ordinal data (U = 88273.5, p = .056).

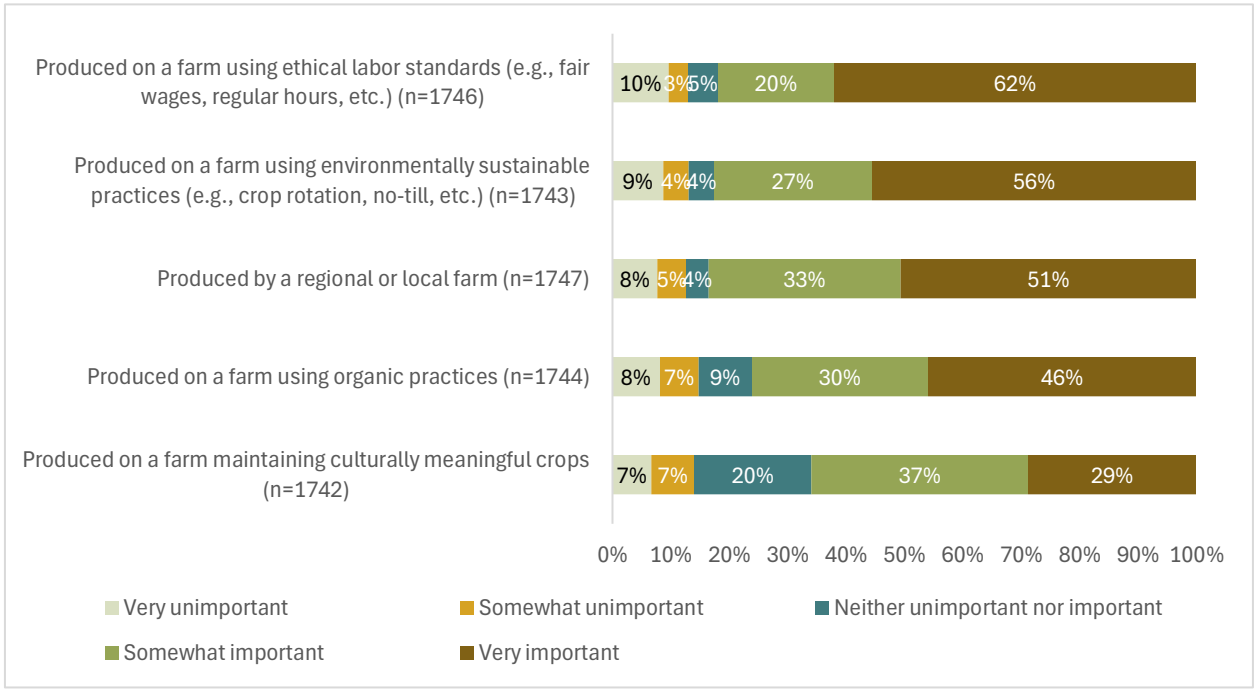


Figure 1. **How important are the following farm characteristics** to the foods you prefer to consume?
Note. Bar graph shows the percentage of respondents selecting each response on the given scale of 1-5 where 1= Very unimportant, 2= Somewhat unimportant, 3= Neither unimportant nor important, 4= Somewhat important, and 5= Very important.

In addition to responsibly grown and distributed, farmers/gardeners and Ujamaa seed growers in focus groups expressed a strong desire for seeds that have meaning to their culture. The qualitative results show that consumers of CM seed are looking for foods that align with their cultures' culinary traditions. One farmer talked about the desired characteristics for crops he sees in his community saying:

> I'd say the most valued trait for folks in our area is the quality, meaning, in addition to it being fresh and healthy, that it has culturally significant...that the varieties that are being produced match a food tradition or expectation. And that really, like a lot of "American varieties" aren't...they don't taste the same, they don't cook the same, often they don't even look the same.

When discussing crops that are important for them to grow, one Ujamaa seed grower said, "I'm looking for crops that I can grow that are meaningful to my family's diet, my community's diet, and are manageable for me."

Further, the farmer and gardener survey results show that growers are engaging in agriculture for reasons beyond economic gain, with only 25% of farmers and gardeners surveyed noting profitability as being an important reason they farm or garden. Rather, respondents noted connecting to family traditions (59%), enhancing their access to CM foods (55%), and connecting to where they live (74%) as important motivators for farming or gardening. In a series of independent samples t-tests, there were no significant differences between how important white and BIPOC growers found each of the previous items. This suggests that BIPOC and white growers are engaging in agriculture and food production for similar reasons. Seed companies generally agreed with this significance of seeds with 52% of seed company survey respondents (n=71) noting the cultural meaning of seeds as somewhat or very important to their seed company when making purchasing decisions.

Although seed companies recognize the need for making CM seeds more available, as is shown in the seed company focus group data, they are hesitant to be the ones to bring certain CM seeds to a formal market. Because CM seeds carry meaning that is deeper than their biological components or economic value, seed company focus group and survey data suggest that seed companies are unsure how to best engage with and market CM seeds. Seed companies expressed concern in marketing and selling seeds that are culturally important for cultures external to their

company for fear of cultural appropriation. The focus group data suggest that this concern is preventing seed companies from carrying some CM seed varieties. One seed company representative expressed this saying:

> And there's some varieties that I don't think have ever been sold in a big seed company way, at least. And I definitely don't want [my seed company] to be the ones always bringing new varieties. Like, that to a market, feels exploitative and, yeah, not our place. But it's tricky. It's tricky to figure out with, like, we do sell some old Abenaki varieties of corn and stuff, and it's just tricky constantly.

This concern was echoed by others in both the qualitative and quantitative data. When asked about the challenges to marketing CM seeds, 58% and 61% of seed company representatives (n=61) noted that culturally appropriate advertising and of CM seeds and selling CM seeds in a culturally appropriate way were moderately or very challenging, respectively (Figure 2). Some seed companies did see an opportunity to leverage their power to provide access to CM seeds and give back to the communities the seeds belong to. One seed company representative expressed this noting:

> And there's lots of people in the world who are eager to make a cultural connection with their own cultural group many times. And for whatever their circumstances, the root of purchasing a product that speaks to them and is from their cultural group, and is closing the loop, where the revenue is also continuing into their community. I've seen it happen that it's, for some people, a very positive experience on both the purchasing side and on the supply side. So, it's very tricky, of course, because commerce has that double-edge sword. So, it can sour. But I think there is the possibility in carefully structured commerce to actually elevate people's experiences and connect people with historically significant or culturally significant seeds from communities that they're even a part of in a way that does feel ethical and good. I think the possibility exists. It's just that it's a tricky path to navigate, for sure. These findings suggest there is a tension between seed companies' desire to make CM seeds available and concerns for exploiting BIPOC communities who have been stewarding the seeds for centuries in the process. However, the availability of the CM seeds through formal channels relies on seed companies agreeing to carry these seeds and form relationships with CM seed growers that are not rooted in extractive relationships. To expand their offering of CM seeds, 82% and 72% of seed company respondents (n=56) indicated opportunities to interact with

CM seed growers and training on how to develop relationships with growers of CM seed would be helpful, respectively. Further, over 70% of respondents responded that each of the presented options would be helpful to expand their CM seed offerings (see Figure 2), pointing to an opportunity to intervene in the SVC to enhance CM seed access.

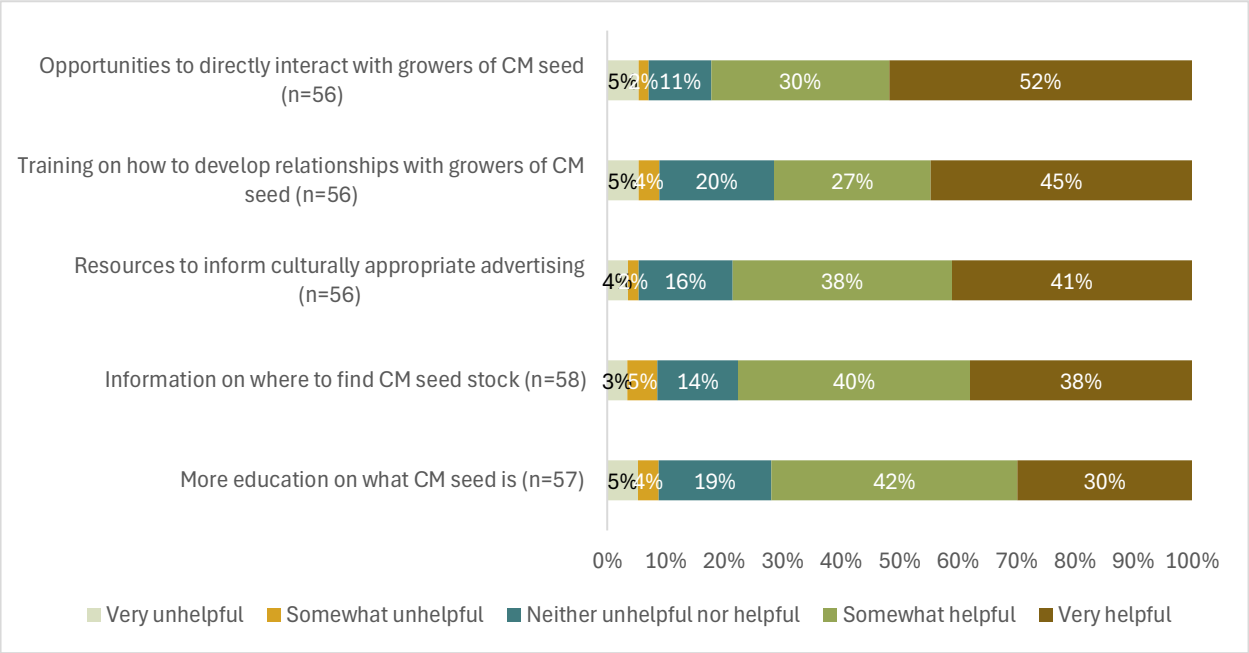


Figure 2. To what extent would each of the following be helpful to the company/retailer you work for or represent in expanding its offerings of CM seed?
Note. Bar graph shows the percentage of respondents selecting each response on the given scale of 1-5 where 1= Very unhelpful, 2= Somewhat unhelpful, 3= Neither unhelpful nor helpful, 4= Somewhat helpful, and 5= Very helpful.

Another bottleneck in creating the CM SVC that emerged from the qualitative and quantitative data is establishing best practices for marketing and selling CM seeds. To overcome the unfamiliarity with CM seeds and crops highlighted as a barrier and maintain cultural sensitivity in marketing, seed companies, farmers/gardeners, and seed growers all mentioned education of consumers and maintaining the linkages between seeds and cultures as marketing strategies. When discussing how to increase the market potential for CM seeds, one seed company representative suggested, connecting the seed packets to the seed growers to enhance marketability, saying:

> …more short-term storytelling, like, who grew the seeds? Who had been stewarding the seeds, just putting faces and people, you know, behind just the seed packet or something like that, I think could be really cool. So, it's not just something generic, but something that's really linked to people. And, yeah, just makes it more exciting.

Offering a similar suggestion to enhance the marketability of CM seeds, another seed company representative said:

> And we try to address [unfamiliarity] by doing a good job, providing cultural information, and the story behind the thing. And in addition to just being helpful for the user, I find that's a really, just a beautiful way to provide information about the vegetable or the product.

Seed company representatives were generally focused on educating their current, mostly white, customers on CM crops. Farmer/gardener survey results support the importance of education, with 25% of farmers and gardeners (n=1428) indicating they were not sure if they were growing CM crops. A chi-square test showed that there is no significant difference in knowledge of whether they are growing CM crops between white and BIPOC growers ($p = .124$), suggesting the need for education campaigns that reach multiple audiences.

In contrast to other focus group participants who mostly mentioned the need to educate consumers of seed about CM seeds, an Ujamaa seed grower noted the importance of involving the whole value chain, from seed growers to chefs and grocers, in bolstering the market for CM seeds saying:

> I think it's useful if we as growers are moving through that process [of moving toward a culturally meaningful diet] ourselves constantly, then we remind ourselves that it is this process, and that we can help the people around us, the chefs, the grocers, you know, the consumers to be able to move through that process too… And so just, you know, introducing people to these new [seeds and foods] and then helping them to figure out. Okay, 'how do you actually use this thing?' And then beyond that, like, not just how do you use it, but how do you then integrate it in a meaningful way into the cooking that you do, the hosting that you do, right?

Regionally adapted seeds were also found to be highly desired by growers, but the lack of regionally adapted CM seeds presents a barrier for farmers and gardeners who want to grow CM crops that originate in a different growing zone. The lack of regionally adapted CM seeds also prevents access to locally grown CM foods for those that desire them. About this lack of

regionally adapted CM seeds, one farmer noted, “So folks are interested in say, moringa. That is a great example of a crop that there’s a lot of interest in. Some folks have been successful in sourcing seeds, but not all of them grow well in our climate.” One farmer lamented on the loss of a BIPOC-owned seed company that was providing regionally adapted CM seeds, saying:

> I think for me … having them be regionally adapted feels really important, like, for example, there’s Kitazawa Seeds, who’s just incorporated long-time Japanese-owned seed company that has just been incorporated into a white-owned company. So, like, that’s a major loss. And they’re all California-based and adapted seeds. So, like, having more East Coast, where I am, adapted seeds available where they’re, yeah, just adapted to this climate.

These conversations point to a tension between the availability of and desire for local and CM foods, where the availability is not meeting demand. Moreover, there is barrier for farmers to provide local culturally significant crops if they are not regionally adapted, resulting in consumers who want these foods having to resort to either purchasing them from distant sources (e.g., from online or shipped internationally) or going without. Further, 57% of farmer and gardener survey respondents who grow CM crops (n=964) noted the availability of CM crops varieties to their region as a moderate or major barrier. A one-way ANOVA shows no difference in the severity of this barrier based on region in the US, suggesting a need to focus on regional adaptability nationwide.

When asked about their company’s priorities, 51% of seed companies responded that increasing the number of regionally adapted varieties offered (n=74) was of ‘high priority’ to them, but only 22% indicated increasing the number of CM crop varieties offered as ‘high priority.’ Additionally, when asked about the importance of different seed qualities when purchasing for their business, cultural meaning was the least important item, with 52% of seed company representatives (n=79) said the cultural meaning of seeds was important, while 76% (n=78) rated regionally adapted to be important. These results suggest seed companies may prioritize sourcing regionally adapted seeds, as well as other qualities, such as non-GMO and heirloom, over those that are both regionally adapted and CM.

On the marketing and distribution side of the value chain, the qualitative data suggest there is an opportunity to enhance CM seeds’ market potential by embedding the values that align with those that farmer/gardeners and seed growers highlight, such as cultural stories, social

responsibility, ecological sustainability, and regional significance. One seed company representative emphasized this values-based commerce saying:

> …I think probably many of the folks that the seed companies on this call are marketing to tend to purchase based on values. At least a lot of [my seed company's] customers do, are sort of voting with their dollars when they buy from us. … And if a customer can see that an amount of their money is going directly back into a project, that they are perceiving that they are supporting when they're buying culturally meaningful seeds could go a long way.

Another seed company representative further posited that it is the responsibility of individuals and entities in the SVC to incorporate values into their work, saying, "whether we see it or not, seed companies and everyone engaged with seed, which is us all, we have a massive responsibility to be lifting up legacies of genocide, and colonization, and appropriation…" There seems to be understanding from seed companies that CM seeds should be treated, in some ways, different than non-CM seeds. This may include seed companies reinvesting some of the profits from seed sales into the community to whom the seeds are meaningful, sourcing CM seeds from growers who are honoring the cultural importance of the seeds, or ensuring open access of genetic material to groups who identify with the seeds and may want to use them in community breeding projects. This view is generally cohesive with the perspectives of seed growers and farmers/gardeners who also note the importance of the social responsibility of seed companies and importance of socially responsible seed work in general in the qualitative data.

Scale

Scale emerged as a key theme impacting CM seed supply, demand, and thus the potential to harmonize the CM SVC. The quantities of CM seed that companies are purchasing from growers tend to be small and the farmers and gardeners that typically purchase these varieties from seed companies are typically small-scale growers. These factors of the CM SVC work together to shape the market potential for CM seeds from both the supply and demand sides.

The qualitative findings suggest that individuals who are growing on a small-scale have priorities in crops that are reflective of their scale, such as high productivity on small acreage, ability to be interplanted with other crops, and low requirements for processing. Regarding the demand he sees for CM seeds, one farmer noted, "…the scale of a lot of growers who are interested in these crops is anywhere from like a quarter acre to up to two acres. And they're

managed very intensively…" Another farmer elaborated on farmer preferences related to scale saying, "Production numbers are important for folks because they're growing in such small, intensive plots that if your pumpkin for vines produces too many vines and not enough fruit, you're missing out on a double crop there." Seed companies also perceived that many of their consumers were growing a small scale, which leads to desires for crop attributes that are reflective of their scale. One seed company representative explained their consumers' preferences:

> … crops that are particularly good, fresh as opposed to things that you buy at the farmer's market or at the grocery store. Like when you talk from a home garden perspective, most of our customers are home gardeners. And I think that many when they decide in their limited space, what they're going to grow, they're choosing things that are, especially good, fresh, and eaten straight off the plant. And so things like fresh herbs, tomato varieties that don't travel well, things like that. I think that's a criterion for folks who have limited space for what they plant.

Based on the qualitative findings, there is an opportunity for seed companies to reach more growers interested in CM crops by focusing on seeds that are well-suited to small-scale growing**.** Seed company and farmer/gardener focus group data suggest there is common understanding between seed companies and farmers/gardeners about what crop characteristics are preferred for CM seeds, such as crops that do not require a lot of processing after harvest and that can thrive when planted in high density. However, the seed company and farmer/gardener survey data suggest there may not be a correlation between scale and cultivation of CM crops. A chi-square test indicates there is no significant difference between farmer/gardener size – home or urban growers (<5 acres), small scale (5.1-50 acres), medium scale (50.1-150 acres), or large scale (>150 acres) – and if they do or do not grow CM crops. Of the seed companies in the survey, 66% noted they are selling primarily to home gardeners, community gardeners, and/or urban growers (< 5 acres). The disconnect between the qualitative and quantitative findings on scale and interest in growing CM seeds suggests that large-scale growers may be as interested as small-scale growers in CM seeds, so the market potential for CM seeds may be larger than CM SVC stakeholders perceive it to be.

In addition to scale as a contributing factor to demand of CM seeds, the data also indicate that scale is a source of misalignment between seed companies and seed growers. The

seed company and famer/gardener focus group data suggest that because the market for CM seeds is not as large as it is for more mainstream crops, seed companies are typically not looking to purchase large quantities of seeds from seed growers, resulting in seed growers growing CM seeds on a small scale that is hard to make a profit on. However, as noted above, responses from farmers/gardeners to the survey suggest large-scale growers are not less likely to cultivate CM crops, so there may be a greater market for CM seeds than is currently perceived. From the seed company perspective of this tension, one representative noted:

> And one [challenge] is just trying to figure out how to make growing a small quantity of seed worthwhile for a grower, I find really hard. I mean, [my seed company] sells a wide variety of quantities for what we need for inventory for a year. But some things are really small in ounces. And people who are growing them for us are doing a lot of work, even if it's a small amount of row feet and they're making less than $100, which is truly like a, it's not a source of income. So, that's a challenge.

Quantitative findings further support this desire, with 63% of seed companies (n = 73) noting that increasing the amount of money paid to their seed growers was of medium or high priority for the company.

Farmers and gardeners perceived related yet distinct difficulties in growing seed for companies. For example, one seed grower commented:

> … seed is very challenging to work into a vegetable or grain farm situation at times, because you're already waiting a couple of months for a vegetable crop to mature. But waiting a better part of a year to get paid for a seed crop can be challenging as a small-scale grower. And I think that to recruit more growers or to encourage new seed growers that some type of seed, more like a CSA system where there's some type of down payment or upfront payment would help to encourage a lot of producers to scale up seed growing. Just to know that there's something that's gonna support them for a few months or that they can use to defray their input costs till the seed matures."

Results suggest that seed companies are hesitant to onboard CM seeds because they are concerned that they cannot offer financially viable prices to seed growers when buying in small quantities, creating a bottleneck in the market. Seed growers echo the concerns about economic constraints and offer a suggestion of a CSA-like system to ease the burden. Further, as previously noted, consumers of CM seed want to know seed growers are being fairly

compensated by seed companies, so this tension represents a bottleneck for developing a functioning CM SVC.

Further, results indicate there is unmet demand for CM seeds, which is leading to unmet demand for CM foods. When asked about barriers to accessing CM seeds, 46% of farmers and gardeners (n = 965) indicated that access to sufficient qualities of CM seed was a moderate or major barrier. Findings from the farmer/gardener focus group indicate that this lack of access to CM seeds has downstream impacts on the availability of CM foods grown from those seeds and the farmers who market those crops. On the impact a lack of CM seed access has on the market potential for farmers selling CM foods, one farmer said:

> …there's potential for a lot of new growers and growers who want to expand for many different regions and in many different markets. The question is, how do we make those varieties that there's a market for accessible seed-wise?...And from our experience here, seed access is key, that a lot of times, it takes being able to access seeds in a larger amount or consistently to get someone off the ground to help them to either meet a growing contract or meet a need for a local market. … there's lots of potential for folks to work towards a livable wage growing culturally significant varieties, but I think the seed access is definitely central…

Despite farmers and gardeners suggesting unmet demand for CM seeds, seed companies perceive the lack of consumer demand to be a barrier to carrying more CM seeds, with 48% of seed companies (n=61) saying consumer demand for CM seeds is moderately or very challenging for their seed company. This barrier is noted as the third most challenging barrier behind the challenges related to selling CM seeds in a culturally appropriate way. If seed companies carried more CM seeds, providing a steady and reliable source, growers that want to cultivate CM crops may not be limited by seed supply and traditional varieties would continue to be in circulation.

To make CM seeds more available, it is key to understand the factors currently impeding their accessibility. One farmer explained how small-scale growers often have less time to devote solely to cultivating and preserving CM seeds, which may lead to their lack of presence on the market. He explains how the scale of growers, many of whom have off-farm employment, impacts what varieties of seeds are proliferated, saying:

> …the characteristics of varieties that have cultural significance have been very difficult for growers to manage themselves, because most of these folks are working full-time

> jobs, they have families, and they do the farming the rest of the time. So it's very hard to also save seed and be a plant breeder and a seed producer on top of that. So, I think where a lot of hybrids can displace traditional varieties, just sometimes because folks are stretched thin, and that's not a specific characteristic in and of itself, but more how traditional growers are interacting with seeds, in our experience here.

This assertion that growers are already stretched thin is echoed in farmer/gardener survey results, with 58% of farmers and gardeners (n=1488) answering that their lack of time was a moderate or major barrier to growing in the way they desire to. A one-way ANOVA showed no significant difference between the severity of this barrier based on employment (full-time, part-time, or not employed) ($p = .319$, $F = 1.144$), suggesting that all growers, regardless of employment, may experience this barrier. Because growers already have limited time to spare, these results highlight the opportunity for CM seeds to be supported by the formal seed system as well as the informal. If growers could reliably source the seeds they desire, they would not need to devote as much time to seed saving activities if they do not wish to, leaving more time for growing food. However, regionally diverse cultivation of seed varieties is still important to ensure seeds are adapted to grow in a variety of regions.

Farmer/gardener survey responses show that 33% of farmers or gardeners surveyed (n = 1136) were interested in growing seeds for Ujamaa Seeds, a CM seed company, further suggesting there is interest in engaging with the formal seed system. A series of chi-square tests showed no significance differences in the likelihood to want to grow CM seeds with Ujamaa on the basis of gender, race, education, or region. However, an independent samples t-test revealed that seed growers who wanted to grow for Ujamaa were on average younger ($M = 54.79$, $SD = 14.65$) than those who did not ($M = 58.64$, $SD = 14.28$) ($t(789) = -3.484$, $p < .001$). This suggests that younger seed growers may be more interested in market opportunities for their seeds than older growers. Currently many farmers and gardeners are stewarding CM seeds on top of their other work and may not have the time or be interested in entering their seeds into more formal market channels, leading to lack of consistent supply or complete loss of varieties in some cases. There is an opportunity for the formal seed market to ensure CM seed varieties are maintained with the partnerships of CM seed growers who want to engage with the formal market.

While there is, of course, nothing inherently negative about small-scale growers or businesses, scale does seem to create a tension that will need to be smoothed to enhance the

market potential of CM seeds. Farmers/gardeners want to grow CM food but are limited by seed supply and have to rely on growers who are already stretched thin to uphold the CM seed market. Seed companies struggle to make growing a seed crop economically viable for growers to ensure a steady supply when they are purchasing only a small amount of seed. For seed growers, devoting a portion of their field to a seed crop that has an up-front investment with potentially small returns creates a large barrier to beginner or small-scale growers. Findings from the seed company, farmer/gardener, and seed grower focus group data suggest that seed companies hold the power to prop up the market for CM seeds, financial support CM seed growers, and provide a consistent supply of CM seeds for farmers to be able to meet demand for their crops.

Value Chain Participation and Collaboration

Along all nodes of the value chain included in this study, participants noted the need to increase connectivity and collaboration along the value chain. This would allow for different stakeholders to better understand the needs and desires along the SVC and how to better meet those needs. Only 12% of farmers and gardeners (n=1386) said they felt very connected to seed companies. Qualitative findings stressed the importance of connectivity with different stakeholders in the SVC. One seed company representative highlighted the importance of collaboration with CM seed growers when marketing CM seeds, saying, "…one thought is we could help to make things available and well known if, you know, the people who have that cultural importance with the seed were on board and partners, I think would be important, not just agreeing but partners." Further highlighting the importance of supply chain collaboration, when asked how to enhance the marketability of CM seeds, one farmer said:

> I think we need more producers. And we need more producers closer to their customers. And we need to make that connection between the producer, the small producers, and in the market. And it needs to be some type of clearinghouse or some type of application that exists that allows that producer to, in real-time, present the product quantity and quality of their product and be able to connect with the buyers on the other end.

This quote speaks not only to the issue of connectivity, but also scale, highlighting the importance of increasing the ability for seed growers to enter into and participate in the CM SVC.

Another concern among seed companies when marketing CM seeds is the consumer's familiarity with CM seeds and foods and the ability for a wide range of consumers to participate in the SVC. They worry consumer knowledge of how to cultivate, harvest, and cook with certain crops may restrict the market potential of CM seeds. One seed company representative expressed this concern saying, "The things that I work with the most at [my seed company], approachability I would say is important, you know, both from a food consumer kitchen perspective and from a grower perspective. So, if something takes some special care, there's a bit of a barrier there." Echoing similar concerns, another seed company representative remarked:

> But sometimes just unfamiliarity of something that comes from a particular, like, minority cultural group might be a barrier to getting our customer base to buy it. You know, we don't have super detailed demographics on our customer base, but as best we can tell it's basically the biggest chunk is probably older, middle-class, white ladies, basically is probably the biggest single demographic we're marketing to.

Results highlight the lack of diversity in the customer base of seed companies as a barrier to strengthening the CM SVC. The current limited demographic reach, which seems to be older, white small-scale farmers/gardeners is not reaching the demographic who would benefit most from access to CM seeds, BIPOC growers. The results indicate an unmet demand for CM seeds, but 48% of seed companies surveyed (n=61) perceive consumer demand for CM seeds to be moderately or very challenging, pointing to a disconnect between those that demand CM seeds and seed companies (Figure 3).

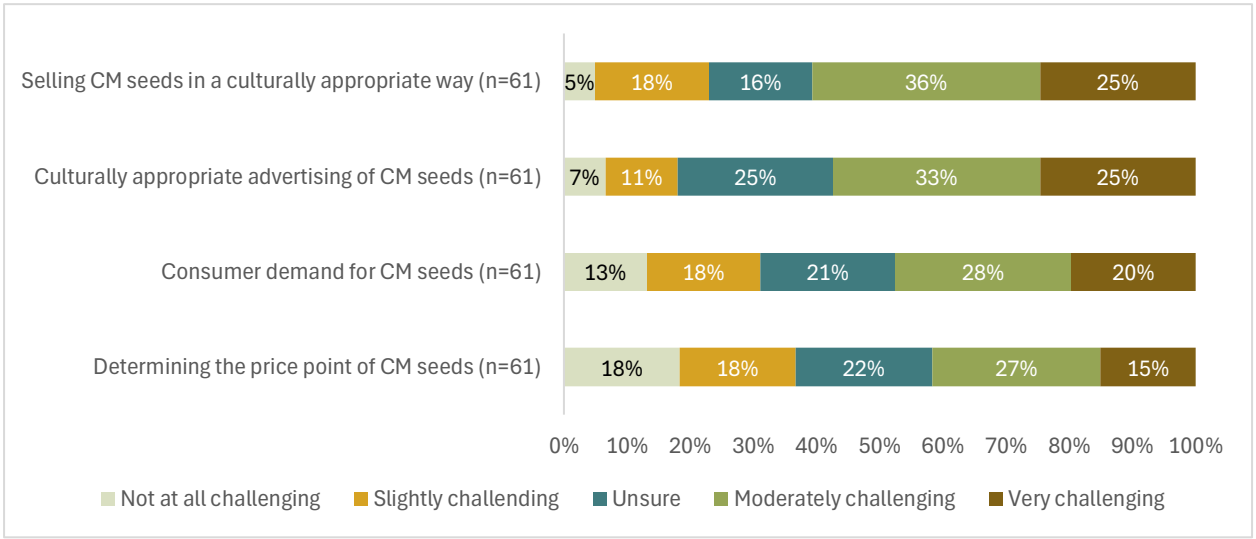


Figure 3. When thinking about marketing CM seeds, how challenging would you rate each of the following for the company/retailer you work for or represent?
Note. Bar graph shows the percentage of respondents selecting each response on the given scale of 1-5 where 1= Not at all challenging, 2= Slightly challenging, 3= Unsure, 4= Moderately challenging, and 5= Very challenging.

Lastly, qualitative and quantitative analysis suggests that the ability or desire to participate in the SVC is not equally distributed for seed growers and farmers/gardeners due to unequal access of resources, connectivity with the rest of the SVC, and experience of barriers in the agricultural activities. The seed grower survey data further suggest that racial inequalities underpin these factors. An independent samples t-test shows that BIPOC seed growers experience significantly greater challenges to their seed growing operation (M = 39.90, SD = 8.03) compared to white seed growers (M = 27.86, SD = 7.62) on a scale of 0 = not at all challenging to 44 = very challenging ($p = .007$, $t(94) = -2.495$). An independent samples t-test also showed that BIPOC seed growers indicated various resources related to their production of seed crops (e.g. sufficient land, tools/equipment for seed production, etc.) as less accessible (M = 26.78, SD = 7.27) than white seed growers (M = 30.34, SD = 6.58) on a scale of 0 = very inaccessible to 40 = very accessible ($p < .001$, $t(266) = 4.011$). However, holding demographic variables constant in a binary logistical regression, access to these resources and does not significantly impact whether seed growers grow CM seeds ($p > .1$) (Table 3, Model 1). This indicates that BIPOC seed growers may still be choosing to grow CM seeds despite resource constraints. Further supporting this finding, when demographic variables were held constant in binary logistical regressions, for each additional unit on the barriers scale (0 = no barriers to agricultural activities experienced to 56 = all barriers greatly experienced), farmers/gardeners and seed growers were 4.6 and 7.9 percentage points more likely to grow CM crops and CM seeds, respectively (Table 2, Model 2; Table 3, Model 2). This indicates that growers who are engaged with CM crops or seeds either experience greater barriers as a result of growing these crops/seeds or growers who are already experiencing greater barriers are still growing CM crops/seeds despite these barriers. Either way, these findings suggest that growers in the CM SVC likely experience greater barriers than growers who are not engaged with CM crops or seeds. In the farmer/gardener focus group, one farmer spoke to the impact of racial legacies on agriculture in America, saying:

> The stigma In certain populations in America where they have a historical legacy of being the primary population that provides the country with their food products. … So stigma associated with being a farmer, if you will, to put it plainly, I think, is a huge hurdle for some

> populations to consider it as a career or so that they can contribute to society. And as a stigma, it's gonna be very difficult to kind of rectify in some populations, in my opinion.

Because there is currently a lack of diversity of growers and other participants in the SVC, there is a corresponding opportunity to enhance that diversity by reducing the barriers to value chain participation. An independent samples t-test suggests that BIPOC farmers are better connected (M = 29.25, SD = 9.26) to other SVC stakeholders compared to white farmers (M = 27.76, SD = 8.88) on a scale of 0 = very disconnected to 55 = very connected (t(*919*) = -1.947, p = .026), which suggests an opportunity for BIPOC farmers to leverage these connections. Further, two logistical binary regressions showed that for each additional unit on the connectedness scale (0 = very disconnected from other SVC stakeholders to 55 = very connected), farmers/gardeners and seed growers were 3.3 and 1.8 percentage points more likely to grow CM crops or CM seeds, respectively (Table 2, Model 1; Table 3, Model 3). This, along with the finding that BIPOC farmers are better connected than white farmers, suggests that BIPOC growers may be better positioned to take advantage of opportunities in the CM SVC. One seed company representative commented on their company's efforts to uplift BIPOC seed growers, saying, "To be perfectly frank, when we meet an African American or a Latin American grower [we are] trying to uplift the seeds that they grow, just because there are not that many people of color who are in the little seed world." Findings show that, along with market creation for CM seeds, BIPOC growers of those CM seeds and crops need to be supported and the barriers for them to participate in the emerging market must be lessened to level the playing field.

Table 2

Binary logistic regression for growing CM crops as a function of connectedness to SVC stakeholders (Model 1) and experiences of barriers in farming (Model 2)

Y: Grows culturally meaningful crops = 1	Model 1: Connectedness Exp(B)	Model 2: Barriers Exp(B)
Gender (non-male = 1)	1.141	.970
Race (white = 1)	1.209	.530*
Income		
<$25,000	---	---
$25,000-$49,000	.960	1.2
$50,000-$74,999	.839	.894
$75,000-$99,000	.736	.662
$100,000-$149,999	.878	1.394
>$150,000	1.113	1.142
Education		
Some/all HS or GED	---	---
Technical training or cert.	1.110	.434
Associate's	.812	.385
Bachelor's	1	.678
Post-grad	.871	.499
Employment		
Not employed	---	---
Part time employed	.870	.660
Full time employed	1.033	.729
Age	.994	.976**
Connectedness	1.033***	
Barriers		1.046***
Constant	.692	4.249
R^2	.044	.108

Note. *significance at the .1 level, **significance at the .05 level, ***significance at the .001 level. The different models are indicative of tests for different predictor variables.

Table 3

Binary logistic regression for growing CM seeds as a function of access to seed growing resources (Model 1), experiences of barriers in farming (Model 2), level of connectedness to SVC stakeholders (Model 3)

Y: Grows culturally meaningful seeds = 1	Model 1: Resources	Model 2: Barriers	Model 3: Connectedness
Gender (non-male = 1)	1.892	.991	1.182
Race (BIPOC = 1)	.848	1.035	.782
Income			
<$25,000	---	---	---
$25,000-$49,000	.374*	.481	.481**
$50,000-$74,999	1.690	1.291	.999
$75,000-$99,000	.373	.641	.706
$100,000-$149,000	1.167	.760	.894
>$150,000	.902	.5	.677
Education			
Some/all HS or GED	---	---	---
Technical training or cert.	6.177*	1.909	1.287
Associate's	2.170	.880	.726
Bachelor's	1.337	2.176	.783
Post-grad	1.910	2.177	.854
Employment			
Not employed	---	---	---
Part time employed	1.830	.750	.796
Full time employed	3.032*	.995	1.091
Age	.997	.989	.980**
Resource access	.983		
Barriers		1.079***	
Connectedness			1.018*
Constant	.335	.082	1.243
R^2	.153	.186	.059

Note. *significance at the .1 level, **significance at the .05 level, ***significance at the .001 level. The different models are indicative of tests for different predictor variables.

Discussion

By comparing the perspectives of seed growers, farmers and gardeners, and seed companies, this study highlights bottlenecks along the value chain where there are opportunities to enhance the availability of culturally meaningful (CM) seeds to answer the research questions:

I. What factors influence the demand for CM seeds by farmers/gardeners and seed companies?
II. What factors influence the supply of CM seeds from seed growers?
III. What tensions exist among seed companies, farmers/gardeners, and seed growers that are barriers to harmonizing supply and demand of CM seeds?
IV. What commonalities exist among seed companies, farmers/gardeners, and seed growers to harmonize supply and demand of CM seeds?

In general, the qualitative and quantitative data show that at all nodes of the value chain, stakeholders understand the cultural importance of seeds and desire for access to be strengthened, but their perceptions on how to strengthen the seed value chain (SVC) differ in meaningful ways. Building off previous research and knowledge of the importance of seeds to many cultures (Campbell, 2012; Carolan, 2007; Swiderska & Argumedo, 2022), this study highlights the meaning of seeds and foods beyond their material components, such as cultural connection, community building, and familial ties. Importantly, the findings support previous research indicating that CM seed access is key for access to CM foods (Guo et al., 2021; Lyon et al., 2021). We found enhancing access to CM foods as a motivator for farmers/gardeners growing and CM seed availability to be a limiting factor for some farmers/gardeners who wish to grow more CM foods and many farmers/gardeners are engaging in agriculture, in part, to enhance their access of CM foods. As such, this research further highlights that understanding how to bolster CM seed access is essential to ensuring culturally appropriate and preferred diets for individuals. Additionally, results suggest that there is unmet demand for CM seeds by farmers and gardeners, further supporting the need to strengthen the value chain for CM seeds to meet that demand and connect growers to foods that are meaningful to them.

Seed Companies as a Critical Node

Our qualitative and quantitative results point to seed companies being situated at a critical node in the supply chain where they can both support BIPOC seed farmers growing CM seeds and streamline a supply of CM seeds to meet the demand of famers and gardeners. As presented in the findings, seed growers are interested in growing CM seeds and distributing them through market channels to enhance accessibility and alleviate themselves of the primary responsibility of stewarding these seeds, which is time intensive. Consistent with previous research on farmers' seed systems (Mulugeta et al., 2021), farmers and gardeners in this study expressed time constraints as a barrier to their agricultural activities. The ability to purchase seed from seed companies, rather than rely solely on saved seed, may relieve some of that time pressure, while still providing access to the seeds. The focus group data suggest that both CM seed growers and farmers/gardeners perceive seed companies as having the ability and responsibility to coordinate this market. However, findings from the seed company focus group and survey results also suggest that there is some hesitancy from seed companies to bring CM seeds to market due primarily to concerns for cultural appropriation and a perceived lack of consumer demand, which will need to be overcome before seed companies can adequately serve in this interconnecting role.

Our results also point to a disconnect in seed companies' perceptions of demand for CM seeds and the demand noted by participants in the survey. This disconnect between seed companies and growers is highlighted by Donovan at al. (2021) as a key barrier to harmonizing the SVC in the Global South, and these data present it as a pattern in the Global North as well. In the Global South, Donovan et al. (2021) shows how priorities in trait developments for seeds between seed companies and farmers (as well as other SVC stakeholders) may not be aligned, which is leading to an asymmetry in supply in demand, in which farmer demand is not met. This pattern of mismatched priorities emerges in this study as well. Most farmers and gardeners who responded to the survey indicated that they are either already growing CM crops or would like to begin growing them, and that the availability of CM seeds is a barrier to their sourcing of CM seeds. In contrast, seed company representatives indicated that consumer demand for CM seeds was a challenge for their company and many were unsure about the demand for CM seeds. This highlights a need for more extensive market research to better understand the demand for CM seeds. Almekinders et al. (2019) suggests the need for more holistic measures of farmer demand and preferences for seed through coordination of SVC actors and inter-value chain dialogue.

Seed companies also stressed the importance of their efforts to educate their customers on how to cultivate CM seeds and the cultural relevance of them to increase demand, but also felt that they needed education on how to best market CM seeds. A common theme in the focus group findings was importance of educating consumers on the cultural linkages that seeds hold. Previous research suggests farmers and gardeners are interested to learn more about the cultural heritage of seeds and would likely be receptive to this messaging (Mulugeta et al., 2021). The findings further showed that white stakeholders feel seeds are important to their connection to where they live and to familial traditions more than connection to their race or culture. As such, we also suggest that highlighting the regional importance and familial connections of seeds, in addition to their cultural importance as an entry point for new consumers to adopt CM seeds as a strategy to broaden the market for CM seeds. Other characteristics, such as regionally adapted, flavor, and non-GMO were also highly important to stakeholders, indicating that CM is just one of many important characteristics seed companies should consider when marketing seeds. It may be necessary to find co-benefits, such that CM seeds are not only attractive to growers for their cultural significance, but also for their flavor, climate resilience, regional adaptation, etc.

Qualitative and quantitative findings also highlighted the lack of regionally adapted CM seeds available, which is inhibiting farmers from meeting the demand for CM foods. This study echoes previous research highlighting the lack of locally adapted seeds (Isbell et al., 2023), the interest by farmers in learning more about the promotion of regionally adapted seeds (Mulugeta et al., 2021), and the importance of having access to them (Baxley et al., 2020). However, there is less research on the availability of regionally adapted CM seeds and the impact that lack has on the local food system. The results show that some farmers are limited by what they can provide to consumers who want CM crops because they do not have abundant stable access to CM seeds. Soleri (2017) describes how local, in situ seed conservation allows for seeds to be better adapted to growers' specific needs. If regionally based seed companies grew out and sold more regionally adapted CM seeds, this may help to alleviate this barrier. However, it is important to acknowledge that there are certain ecological constraints, particularly in the harsh climate and short season of the Northeastern US, to which some varieties may not be suited regardless of breeding efforts.

Previous research on value chain inclusion emphasizes the possibility of multi-stakeholder partnerships to enhance smallholder access to value chains (Ros-Tonen et al., 2019;

Thiele et al., 2011). Both the qualitative and quantitative findings suggest that the multi-stakeholder connectivity is important to enhancing SVC participation, and there is an opportunity and desire to increase this connectivity. The results indicate that seed companies are eager to strengthen partnerships with seed growers and believe connecting with more CM seed growers would be helpful for them to offer more CM seeds to their customers. This study echoes previous research finding the importance of connectivity in the value chain and desire for networks to be strengthened across the SVC, particularly with community-based seed workers (Mulugeta et al., 2021). However, Jones et al. (2017) emphasizes that multi-stakeholder partnerships in which there is a mismatch of power do not always generate positive outcomes for smallholders. It has been shown that end of the value chain tends to hold greater power in multi-stakeholder partnerships than the beginning, such that the needs and perspectives of small farmers may be overshadowed (Nelson & Taollontire, 2014). Therefore, when forming these partnerships between seed companies and seed growers, care will have to be taken to ensure equal partnership between the two groups. In the context of seed systems, Soleri (2017) shows how there are not stark divides between formal and informal seed systems, but rather a continuum on which different seed systems lie. As such, if CM seeds become integrated into the formal seed system, it should not mean they are no longer existing at all in the informal. The seedkeepers who have stewarded CM seeds prior to their availability in formal channels should remain connected to them if they choose to. In sum, multi-stakeholder partnerships between seed companies and seed growers will be essential to the proliferation of CM seeds, but these partnerships must exhibit shared power between groups and linkages between formal and informal sectors.

Creating an Inclusive CM SVC

We suggest creating a CM SVC that is informed by pro-poor VCD. It is crucial that care is taken to create a CM SVC that is inclusive to participants from all races, classes, genders, etc. to avoid recreating the power imbalances of existing SVCs, further disadvantaging minority groups (Ros-Tonen et al., 2019). In the dominant SVC, there is a majority concentration of the market and genetic resources in the hands of just four companies (Howard, 2021). In the alternative SVC, power is more diffused, but there remains a lack of inclusivity of diverse stakeholders and fewer resources to support seed work on CM seeds (Lyon et al., 2021). The findings on the experience of barriers, challenges, and resource access in the SVC, all of which

can be prohibitory to value chain participation, point to a need to create a SVC in which all stakeholders have equal opportunity to participate. When value chains are inclusive and power is diffused, research has shown positive effects, such as increased income, for small farmers who participate (Reardon, 2009). This research elucidates several ways in which the CM SVC can be more inclusive than existing SVCs as it forms.

Previous research suggests that factors such as gender, race, and class can influence the ability of potential stakeholders to participate in value chains (Kilelu et al., 2017; Tobin et al., 2016). Moreover, research indicates that the Northeastern United States organic seed system has not been adequately inclusive of historically marginalized groups (Mulugeta et al., 2021). This research further supports this claim, suggesting that white seed growers and farmers/gardeners may experience fewer barriers to participating in the CM SVC, such as fewer agricultural barriers, and greater access to resources. Interestingly, this research suggests that despite having less access to resources, BIPOC seed growers are as likely to grow CM seeds. Additionally, seed growers and farmers/gardeners who experience greater barriers in farming are more likely cultivate CM seeds and crops. This may be due to BIPOC growers perceiving the value of those seeds or crops outweighs the resource costs even when resources are not plentiful, though future research should explore to verify this finding. This finding is supported by other research, which suggests that cultural motives are significant predictors of maintaining crop genetic diversity, at times surpassing economic motives (Isbell et al., 2021). These findings, in the context of previous literature, suggest that seed growers and farmers who are already cultivating CM seeds and crops will likely continue to do even in the absence of financial motivation, due to their cultural motivations. Research in the Global South has found that resource-poor stakeholders are often excluded from value chain participation even if they are producing a good for their household's or community's use (Tobin et al., 2015). As such, the CM SVC should be careful to ensure market opportunities exist for growers who are cultivating CM seeds or crops, regardless of resource access.

To create an inclusive SVC, it will also be necessary to reduce the effects of economies of scale that currently dissuade seed companies from carrying CM seeds. The finding of economies of scale as a barrier to participation in the CM SVC is consistent with Porter's (1989) analysis of barriers to entry of value chains. Seed company focus group data suggest that when demand for CM seeds is not as high as for mainstream seeds, seed companies are typically

purchasing only a small quantity of seeds from CM seed growers, which means the seed growers are not receiving a significant profit from those transactions. Seed companies in this study's sample indicated a desire to pay a higher price to their growers and recognize that the low compensation for seeds is a prohibitory factor for prospective CM seed growers. Additionally, qualitative and quantitative data also point to many CM seed growers being small-scale growers who operate on thin margins, so waiting months for a seed crop to mature and harvest represents a large up-front investment of time, financial capital, and labor. The disadvantage faced by small-scale stakeholders is also seen in research on SVCs in the Global South (Donovan et al., 2021). As such, smoothing this tension will be crucial to strengthen this node of the SVC and allow more CM seed growers to participate in the value chain.

One recommendation from a focus group participant is to create a community-supported agriculture (CSA)-like system for seed growers, in which the growers are paid upfront for their seed crop, rather than having to wait until they have the final product for payment. Similar strategies have been used in contract farming, in which a firm has direct investment in a producer. In these contracts, firms sometimes provide resources to farmers under the stipulation that the farm will sell their product through a given channel (Prowse, 2012). Seed companies may consider engaging in contracts with CM seed growers to ensure a supply of CM seed, while also providing a guaranteed market and resources to seed growers. Another solution is to bolster consumer demand for CM seeds, as discussed above, so seed companies purchase larger quantities of CM seeds, thus paying seed growers more. Meinzen-Dick et al. (2009) show how strengthening the value chain for Andean potato producers allowed small famers to work in collectives and lower transaction costs. A similar strategy could be taken with seed companies in the CM SVC where they purchase seeds from growers collectively, rather than individually.

Values Laden CM SVC

When creating a CM seed value chain (SVC), both the qualitative and quantitative results suggest that values and social considerations, such as environmental sustainability, worker compensation, and cultural importance, should be embedded within the value chain. Previous literature suggest that growers of seeds maintain plural values – relational, instrumental, and intrinsic (Tobin, 2022) – so, it is consistent that SVC stakeholders in this study highlight the importance of a myriad of values to their engagement with seeds. At all nodes of the value chain

captured in this study, there is a desire to uphold values that are beyond economic or material in nature.

Purchasers of CM seeds are motivated to purchase for reasons such as personal meaning, cultural connection, and ethical agreement with the values that are embedded within CM seeds. CM seed growers choose to grow varieties of seeds that hold personal, community, or cultural meaning for them. Seed companies see the opportunity to highlight these values when marketing seeds, and they believe that consumers want to see these values present in the seeds they are purchasing and companies they are supporting. We found that cultural significance of seeds or food was generally highlighted as very important for BIPOC consumers, but other values, such as regional or familial connections were more important to white consumers. This suggests different consumers may connect to culture in different ways. In the CM SVC, it does not seem to be enough to follow traditional supply and demand market analysis, but rather it is necessary to embed values at every node of the supply chain to understand patterns within it. These findings are consistent with previous research on the importance of relational values to seed growers in Vermont (Tobin, 2022). Relational values can be seen as bridging the gap between instrumental value and intrinsic value, as they encapsulate the way people interact with and relate to the world around (Tobin, 2022). Thus, if CM seeds are to be integrated into the formal seed market, it will be important to embed values in the market to encourage and allow stakeholders who hold these values to participate in the value chain.

Respondents in this study highlighted several important values related to foods and seeds, such as flavor and food/seeds produced in ethically and environmentally responsible ways. One value of importance to seed growers and farmers/gardeners in this study was the cultural relevance of seeds and crops. This importance of cultural motives to grow and purchase CM seeds and crops is supported by previous research, which suggests that financial incentives alone are not enough to motivate farmers to maintain genetically diverse crops. However, it is important to note that not all respondents seemed to interpret ‘culture’ in the same way. The qualitative and quantitative data suggest that stakeholders, particularly those who were white, experienced the cultural value of foods and seeds via tangential cultural connections, such as community building, familial ties, and regional importance, suggesting a need to emphasize those values alongside culture. In addition to experience cultural value through these tangential connections, BIPOC growers in this study specifically highlighted connected to culture as an

important value. Further, cultural importance was not the most important value to stakeholders, with food/seed quality, regional importance, ethical labor, etc. highlighted as more important. As such, cultural meaning is one of many values that should be upheld in the creation of a CM SVC. These data support previous findings that there should be investment in highlighting the cultural importance, environmental impact, and community aspects of seeds and crops as incentives to maintain diverse foodscapes (Isbell et al., 2021).

We found that profit is not a very important factor for why farmers/gardeners in this study are growing food. The qualitative data further emphasized how all stakeholders viewed seeds as having embedded cultural meaning. This is in line with the idea that seeds carry biocultural heritage and should be considered differently than typical market goods (Swiderska & Argumedo, 2022). Establishing CM seeds on the formal market should not remove them from the informal seed system or disconnect them from their embedded values. Further, if seed companies engage with the Open Source Seed Initiative (OSSI), which ensures seeds that are on the market are not legally owned by a single entity, or take other steps to ensure the possibility of seeds to continue in the informal system, both market- and non-market-based approaches can contribute to CM seed access (Kloppenburg, 2014).

Conclusions and Recommendations

This study elucidates the characteristics of the supply and demand of CM seeds, as well as where along the SVC there are opportunities and bottlenecks to harmonizing supply and demand. There are numerous ways in which the CM SVC can be strengthened to increase the availability and accessibility of CM seeds, supporting both food and seed security. Several salient findings that emerged through analysis are seed companies as an important node moderating supply and demand of CM seeds, strategies to enhance the inclusivity of the CM SVC, and the importance embedding values in the CM SVC.

An important finding of this study is the need to connect seed growers and seed companies, with particular attention paid to the power dynamics at play between the two groups, in which seed companies typically have more power than seed growers. Organizations that are focused on supporting BIPOC growers, such as Ujamaa Cooperative Seed Alliance, seek to bridge these gaps between seed growers and seed companies. Ujamaa is a collective of emergent and seasoned BIPOC seed growers. Being part of a collective may help to alleviate some of the

barriers associated with economies of scale we found in this study. Seed companies should consider building relationships with Ujamaa or other groups working with CM seeds to form connections with seed growers and better understand how to appropriately onboard CM seeds.

We also found that CM seeds play an important role in local food systems, and there is possibility for CM seed access to enhance local food systems if breeding projects focus on regionally adapting CM seeds. Strengthening local food systems is a goal expressed by both the FAO and USDA (Nguyen, 2018; USDA, n.d.). Further, the FAO recognizes the importance of providing culturally relevant foods as part of an equitable local food system (Nguyen, 2018). As the first step in growing food, a robust local seed system is a necessary prerequisite for a thriving local food system (Helicke, 2015). As such, for a local food system to meet the needs of all members of the community, it must include access to CM seeds and foods. While there are some crops that only suited to particular regions, in other cases crops can be naturalized to a region through breeding efforts. Lyon et al. (2021) proposes enhancing regionally adapted seed access, including CM seeds, though partnerships between public universities and grassroots seed and food advocacy groups as a strategy to leverage the resources of university plant breeders to meet the needs of communities. In cases where seeds cannot be adapted to grow outdoors all season, such as in the harsher climates of the Northeastern US, there is an opportunity to provide CM crop growers with greenhouse space to take advantage of longer and warmer growing conditions or for nurseries to provide starts of CM crops (Guo et al., 2021). This would also generate demand for CM seeds and provide plants from which CM seeds could be saved from for the following season. If plant breeding efforts were more focused on CM seeds, and regionally diverse seed companies and plant nurseries offered more regionally specific CM seeds and crops, access to seeds and crops that are both regionally adapted, and CM could be greatly increased. Lastly, there is an opportunity for government funding to support local growers of CM foods. The Vermont Agency of Agriculture received a $500,000 grant to purchase locally grown food from unserved farmers, many of whom are cultivating CM crops, and distribute it to Vermonters facing food insecurity (Putnoi, 2022). In this example, the local food system is strengthened by purchasing food from farmers, farmers are incentivized to continue growing CM crops, and community members are provided with culturally relevant food at no cost to them. More funding to support local, CM food access could be pivotal in assisting both growers and consumers of CM foods.

Finally, this study contributes to the literature and social activism work on the need to reduce systemic barriers for BIPOC farmers and gardeners in the US. A major barrier for BIPOC growers in the US is land access (Newkirk, 2019), which is necessary for seed production and the continued preservation of CM seed varieties. Guo et al. (2022) found access to land to be a major limiting factor for refugee gardeners in Vermont, leading growers to alter their typical practices. When land is a limited resource, access to a stable seed supply means growers can use all their land for food, rather than seed, production. Enhancing the CM SVC is one way the seed system can better meet the needs of BIPOC growers and allow them to provide CM foods for themselves and their communities. Moreover, if CM seeds are proliferated through seed companies, more farmers and gardeners may begin to off CM crops who previously may not have, further enhancing access to CM foods. Policies that reduce the systemic barriers for BIPOC farmers, such as land and loan access (Newkirk, 2019), should continue to be implemented and advocated for.

Our study meaningfully contributes to the body of knowledge on inclusive VCD and how the SVC can be strengthened to make CM seeds more available and accessible. We conclude that VCD can be used to further efforts of seed and food security in the Global North by way of enhancing CM seed access. There are, however, bottlenecks that exist and are prohibiting VCD, including lack of inclusivity in the value chain participation, a lack of connectivity between seed companies, seed growers, and farmers/gardeners, and economies of scale. Before the CM SVC can successfully increase seed and food security, these barriers will need to be addressed. We suggest a number of policy, market, and community interventions that can help alleviate these bottlenecks and enhance food security through an inclusive CM SVC.

Limitations and Future Research

While this study meaningfully contributes to the literature, there are several limitations of its sampling and scope. While we aimed for this survey to be as representative of the SVC as possible, the majority of respondents were white and farmers/gardeners. As such, these findings may be skewed to the perspectives of those individuals. The disproportionate sample sizes also meant that some analyses could not be run because the minimum threshold of responses was not met, or samples were too distinct in size to be statistically comparable. For example, analyses directly comparing what seed characteristics were important to farmers/gardeners and seed

companies could not be conducted. Future research may try additional strategies or sampling methods to reach a more diverse audience, such as allowing more time for recruitment or integrating more community partners into the research team to assist with recruitment.

Additionally, it would be worthwhile for future research to consider reaching stakeholder groups in the SVC that are not considered here, such as downstream value chain actors, plant breeders, or public stakeholders. This study does not consider the downstream members of the SVC, such as producer distributors, grocers, and chefs, but those perspectives would be valuable to include alongside those represented here. This research indicates interest from seed companies and growers in seed varieties that are regionally adapted, so the perspective of plant breeders may shed light on the possibility of breeding more regionally adapted CM seeds. This study also mainly considers private value chain stakeholders, but public stakeholders, such as universities, policymakers, or national agriculture research institutions may have valuable insights to consider. Additionally, this study is most concerned with market opportunities for CM seeds, and so does not assess non-market opportunities that may help proliferate CM seeds, but it is likely that a market-based approach is not the only way to enhance accessibility. As such, future research should consider how non-market-based approaches, such as seed libraries, seed swaps, and community seed organizations can enhance access to CM seeds.

There is much opportunity to build upon this research. Future research should consider the downstream SVC stakeholder perspectives that were not included here, which may expand upon areas in which the CM SVC can be strengthened. Additionally, better understanding how to best embed and understand values that are beyond economic into a value chain is going to be important to ensuring the CM SVC upholds those values that seem to be at the forefront of the data. Additionally, research should investigate how a strong local seed system underpins a strong local food system. We suggest that CM seeds are key to enhancing a local and CM food system that can serve a diverse community, but empirical research to support this will be valuable. Lastly, longitudinal studies on stakeholders in the CM SVC may allow for a better understanding of the experience of barriers and resource access for farmers/gardeners and seed growers growing CM crops/seeds. Despite the limitations we discuss, this study meaningfully moves the literature on CM seeds forward, providing both theoretical and practical contributions to the importance and development of a robust CM SVC in the Northeastern US.

References

Almekinders, C. JM., Beumer, K., Hauser, M., Misiko, M., Gatto, M., Nkurumwa, A. O., & Erenstein, O. (2019). Understanding the relations between farmers' seed demand and research methods: The challenge to do better. *Outlook on Agriculture*, 48(1), 16-21.

Baxley, S., Isbell, C. V., & Tobin, D. (n.d.). Vermont Seed Saver and Producer Survey: 2020 Summary Report. 17.

Bustillo, X. (2024, Feb 22). *Some USDA programs have been mired in inequity. A panel's final report offers changes.* NPR. https://www.npr.org/2024/02/22/1233006778/usda-equity-commission-final-report

Campbell, B. (2012). Open-Pollinated Seed Exchange: Renewed Ozark Tradition as Agricultural Biodiversity Conservation. *Journal of Sustainable Agriculture*, 36(5), 500–522. https://doi.org/10.1080/10440046.2011.630776

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing, 25*(8), 652-661. https://doi.org/10.1177/1744987120927206

Carolan, M. S. (2007). Saving Seeds, Saving Culture: A Case Study of a Heritage Seed Bank. *Society & Natural Resources*, 20(8), 739–750. https://doi.org/10.1080/08941920601091345

Cofie, N., Braund, H., & Dalgarno, N. (2022). Eight ways to get a grip on intercoder reliability using qualitative-based measures. *Canadian Medical Education Journal*. https://doi.org/10.36834/cmej.72504

Creamer, E. G. (2018). *An introduction to fully integrated mixed methods research.* SAGE Publications. https://doi.org/10.4135/9781071802823

Cresswell, J. W. (1998). Qualitative inquiry and research design: Choosing among five traditions. SAGE Publications.

Cresswell, J. W. & Plano Clark, V. L. (2017). Designing and conducting mixed methods research. SAGE Publications.

Curry, H. A. (2022). Endangered maize: Industrial agriculture and the crisis of extinction. University of California Press.

Devaux, A., Torero, M., Donovan, J., & Horton, D. (2018). Agricultural innovation and inclusive value-chain development: A review. *Journal of Agribusiness in Developing and Emerging Economies*, 8(*1*), 99–123. https://doi.org/10.1108/JADEE-06-2017-0065

Donovan, J., Rutsaert, P., Spielman, D., Shikuku, K. M., & Demont, M. (2021). Seed value chain development in the Global South: Key issues and new directions for public breeding programs. *Outlook on Agriculture*, 50(*4*), 366–377. https://doi.org/10.1177/00307270211059551

FAO. 2019. The State of the World's Biodiversity for Food and Agriculture, J. Bélanger & D. Pilling (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome. 572 pp.

Guo, J., Tobin, D., & Mares, T. (2022). Nepali Bhutanese refugee gardeners and their seed systems: Placemaking and foodways in Vermont. *Journal of Agriculture, Food Systems, and Community Development*, 1–14. https://doi.org/10.5304/jafscd.2022.113.005

Hammelman, C., & Hayes-Conroy, A. (2015). Understanding Cultural Acceptability for Urban Food Policy. *Journal of Planning Literature*, *30*(1), 37–48. https://doi.org/10.1177/0885412214555433

Helicke, N. A. (2015). Seed exchange networks and food system resilience in the United States. *Journal of Environmental Studies and Sciences*, 5(4), 636–649. https://doi.org/10.1007/s13412-015-0346-5

Howard, P. (2021). Concentration and power in the food system: Who controls what we eat? Bloomsbury Academic.

Isbell, C., Tobin, D., & Reynolds, T. (2021). Motivations for maintaining crop diversity: Evidence from Vermont's seed systems. *Ecological Economics*, 189, 107138. https://doi.org/10.1016/j.ecolecon.2021.107138

Jenney, P. (n.d.). More and Better Choices for Farmers.

Jones, K., Tobin, D., & Bloom, D. J. (2017). Double movement in hybrid governance: Contestations in market-oriented agricultural development. *Sociology of Development.* 3(2), 95-115. https://doi.org/10.1525/sod.2017.3.2.95

Kaplinsky, R. (2000). Globalisation and Unequalisation: What Can Be Learned from Value Chain Analysis? *Journal of Development Studies*, 37(2), 117–146. https://doi.org/10.1080/713600071

Khanal, A., Tegegne, F., Li, L., Goetz, S., Han, Y., Tubene, S., & Wetherill, A. (2020). Small and Minority Farmers' Knowledge and Resource Sharing Networks, and Farm Sales: Findings from Communities in Tennessee, Maryland, and Delaware. *Journal of Agriculture, Food Systems, and Community Development*, 1–14. https://doi.org/10.5304/jafscd.2020.093.012

Khoury, C. K., Bjorkman, A. D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., Rieseberg, L. H., & Struik, P. C. (2014). Increasing homogeneity in global food supplies and the implications for food security. *Proceedings of the National Academy of Sciences*, 111(11), 4001–4006. https://doi.org/10.1073/pnas.1313490111

Kilelu, C., Klerkx, L., Omore, A., Baltenweck, I., Leeuwis, C., & Githinji, J. (2017). Value Chain Upgrading and the Inclusion of Smallholders in Markets: Reflections on Contributions of Multi-Stakeholder Processes in Dairy Development in Tanzania. *The European Journal of Development Research,* 29(5), 1102–1121. https://doi.org/10.1057/s41287-016-0074-z

Kloppenburg, J. (2014). Re-purposing the master's tools: The open source seed initiative and the struggle for seed sovereignty. *The Journal of Peasant Studies,* 41(6), 1225–1246. https://doi.org/10.1080/03066150.2013.875897

Love, B., & Spaner, D. (2007). Agrobiodiversity: Its Value, Measurement, and Conservation in the Context of Sustainable Agriculture. *Journal of Sustainable Agriculture*, 31(2), 53–82. https://doi.org/10.1300/J064v31n02_05

Lyon, A., Friedmann, H., & Wittman, H. (2021). Can public universities play a role in fostering seed sovereignty? *Elementa: Science of the Anthropocene*, 9(1), 00089. https://doi.org/10.1525/elementa.2021.00089

McGuire, S., & Sperling, L. (2011). The links between food security and seed security: Facts and fiction that guide response. *Development in Practice*, 21(4–5), 493–508. https://doi.org/10.1080/09614524.2011.562485

Meinzen-Dick, R. S., Devaux, A., & Antezana, I. (2009). Underground assets: Potato biodiversity to improve the livelihoods of the poor. *International Journal of Agricultural Sustainability*, 7(4), 235–248. https://doi.org/10.3763/ijas.2009.0380

Minh, T. T., & Osei-Amponsah, C. (2021). Towards poor-centred value chain for sustainable development: A conceptual framework. Sustainable Development, 29(6), 1223–1236. https://doi.org/10.1002/sd.2220

Mulema, A. A., Farnworth, C. R., & Colverson, K. E. (2017). Gender-based constraints and opportunities to women's participation in the small ruminant value chain in Ethiopia: A community capitals analysis. *Community Development*, *48*(3), 351–369. https://doi.org/10.1080/15575330.2016.1267785

Mulugeta, M., Isbell, C., & Tobin, D. (n.d.). Northeast Organic Seed System (NOSS).

Nelson, V., & Tallontire, A. (2014). Battlefields of ideas: Changing narratives and power dynamics in private standards in global agricultural value chains. *Agriculture and Human Values*, 31(3), 481–497. https://doi.org/10.1007/s10460-014-9512-8

Newkirk, V. R. II. (2019, September). The great land robbery: The shameful story of how 1 million black families have been ripped from their farms. The Atlantic. https://www.theatlantic.com/magazine/archive/2019/09/this-land-was-our-land/594742/

Nguyen, H. (n.d.). Sustainable food systems: Concept and framework.

Pastakia, A. (2012). Building Pro-poor Value Chains: Experiences from Rural India. *The Journal of Entrepreneurship*, 21(2), 269–288. https://doi.org/10.1177/0971355712449410

Porter, M. E. (1989). How Competitive Forces Shape Strategy. In D. Asch & C. Bowman (Eds.), Readings in Strategic Management (pp. 133–143). Macmillan Education UK. https://doi.org/10.1007/978-1-349-20317-8_10

Prowse, M. (2012). Contract Farming in 12 Developing Countries—A Review.

Putnoi, J. (2022, October 15). New USDA grant will increase local access to culturally responsive food grown by Vermont farmers. Vermont Public. https://www.vermontpublic.org/local-news/2022-10-15/new-usda-grant-will-increase-local-access-to-culturally-responsive-food-grown-by-vermont-farmers

Reardon, T., Barrett, C. B., Berdegué, J. A., & Swinnen, J. F. M. (2009). Agrifood Industry Transformation and Small Farmers in Developing Countries. *World Development*, 37(11), 1717–1727. https://doi.org/10.1016/j.worlddev.2008.08.023

Ros-Tonen, M. A., Bitzer, V., Laven, A., Ollivier de Leth, D., Van Leynseele, Y., & Vos, A. (2019). Conceptualizing inclusiveness of smallholder value chain integration. *Current*

Opinion in Environmental Sustainability, 41, 10–17. https://doi.org/10.1016/j.cosust.2019.08.006

Skjott Linneberg, M., & Korsgaard, S. (2019). Coding qualitative data: A synthesis guiding the novice. *Qualitative Research Journal*, *19*(3), 259–270. https://doi.org/10.1108/QRJ-12-2018-0012

Snapp, S. S., Bezner Kerr, R., Bybee-Finley, A., Chikowo, R., Dakishoni, L., Grabowski, P., Lupafya, E., Mhango, W., Morrone, V. L., Shumba, L., & Kanyama-Phiri, G. (2023). Participatory action research generates knowledge for Sustainable Development Goals. *Frontiers in Ecology and the Environment*, *21*(7), 341–349. https://doi.org/10.1002/fee.2591

Soleri, D. (2016). Civic seeds: New institutions for seed systems and communities—A 2016 survey of California seed libraries.

Stoien, D., Donovan, J., Elias, M., & Blare, T. (2018). Fit for purpose? A review of guides for gender-equitable value chain development. *Development in Practice.* 28(4), 494-509. DOI: 10.1080/09614524.2018.1447550

Swiderska, K., Argumedo, A. (2022). Indigenous Seed Systems and Biocultural Heritage: The Andean Potato Park's Approach to Seed Governance. In: Nishikawa, Y., Pimbert, M. (eds) Seeds for Diversity and Inclusion. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-89405-4_.

Thiele, G., Devaux, A., Reinoso, I., Pico, H., Montesdeoca, F., Pumisacho, M., Andrade-Piedra, J., Velasco, C., Flores, P., Esprella, R., Thomann, A., Manrique, K., & Horton, D. (2011). Multi-stakeholder platforms for linking small farmers to value chains: Evidence from the Andes. *International Journal of Agricultural Sustainability*, 9(3), 423–433. https://doi.org/10.1080/14735903.2011.589206

Thrupp, L. A. (2000). Linking Agricultural Biodiversity and Food Security: The Valuable Role of Agrobiodiversity for Sustainable Agriculture. *International Affairs*, 76(2), 265–281. https://doi.org/10.1111/1468-2346.00133

Tobin, D. (2022). Towards quantifying relational values: Crop diversity and the relational and instrumental values of seed growers in Vermont. *Agriculture and Human Values*. https://doi.org/10.1007/s10460-022-10410-6

Tobin, D., & Glenna, L. (2019). Value Chain Development and the Agrarian Question: Actor Perspectives on Native Potato Production in the Highlands of Peru. *Rural Sociology*, 84(3), 541–568. https://doi.org/10.1111/ruso.12251

Tobin, D., Glenna, L., & Devaux, A. (2016). Pro-poor? Inclusion and exclusion in native potato value chains in the central highlands of Peru. *Journal of Rural Studies*, 46, 71–80. https://doi.org/10.1016/j.jrurstud.2016.06.002

UCFA. (n.d.). *About Ujamaa.* Ujamaa Cooperative Farming Alliance. https://ujamaafarms.com/about-ujamaa

Appendices

Appendix A: Examples of seed companies' offerings of CM examples through screengrabs of their websites.

Truelove Seeds:

SEEDS OF THE LEVANT

We began this collection as a focus on seeds from Syria. As our growers network has expanded their focus on Palestine, Lebanon, Iraq, Greece, and beyond, we've decided to rename the collection Seeds of the Levant.

Some of these seeds were grown by our friend Mason at Bear Bottom Farm, whose grandfather Francois immigrated to the US from Syria. Some were grown by Experimental Farm Network, who have rescued many varieties from the USDA that originated in Syria and other areas of the world experiencing war and natural disaster. Some were grown by several Palestinian friends of ours, and now we are very excited to be building a relationship with the Iraqi Seed Collective. Together, we help to maintain and share the agricultural biodiversity from these regions so that future generations may enjoy their food heritage.

PHILADELPHIA COLLECTION

This is a collection of seed varieties that help us tell the story of the historic Philadelphia area through our gardens and our dinner plates.

These seeds come to us thanks to:

- Lenni-Lenape people (the original people of our area).
- Horace Pippin, the now-famed painter, who shared beautiful peppers from the Black catering communities of Philly and Baltimore with H. Ralph Weaver in the early 1940s.
- The thriving seed and nursery world of our city starting with John Bartram in the 1700s and later in the 1800s with companies like Upsal Botanic Garden, Moore and Simon, and David Landreth & Sons.
- The Pennsylvania Dutch communities of the region.
- Russian plant breeder Marina Danilenko who named a beatiful, delicious tomato after Philly's hometown hero Paul Robeson.

Click on the varieties to read more about their stories and connections to Philly. Thanks also to all of the people who first formed relationships with these food plants around the world, and who shared these varieties with people in the Philadelphia area.

AFRICAN DIASPORA COLLECTION

As you walk through the African Diaspora Garden towards the river-side corner of Sankofa Farm at Bartram's Garden, you will pass towering sorghum, flowering sesame, okra, cotton, black-eyed peas, climbing gourds and luffa. Many of the farms that produce seed offered in this catalog are focused on growing crops connected to the experience of Africans in America. This collection includes many crops that either originated in Africa, or that became important staples in the new world. "Sankofa" is a Twi word that means go back and get it. It is often associated with a phrase that translates to "It is not wrong to go back for that which you have forgotten." The Akan depict this concept with an Adinkra symbol of a bird looking back with an egg (or seed) in its mouth while walking forward. Planting ancestral seeds is a way to embody this life-giving principle. Thank you to Chris Bolden-Newsome of Sankofa Farm for co-curating this collection.

ITALIAN COLLECTION

Truelove Seeds could have been called Vigilante Seeds. Keeping seeds requires *vigilance* to ensure that we protect our food supply for future generations. The Vigilante, Lauriello, and DeMarco families came over from Southern Italian villages of Salento (in Campania) and San Marco in Lamis (in Apulia), holding on to their traditions of growing their own food. That tradition was lost as these immigrant families assimilated. In order to honor and stay connected to his grandparents and their homelands, Truelove Seeds founder Owen Taylor grows heirloom crops from their regions, and encourages everyone to grow, eat, and share their ancestral seeds.

Southern Exposure Seed Exchange:

Three Sisters Garden Package

$10.50

1 Add

Item #92001

For thousands of years, Indigenous Americans have practiced companion planting with the three sisters - squash, corn, and pole beans. This traditional gardening method not only honors the cultural heritage of indigenous peoples but also offers a beautiful and productive way to grow crops.

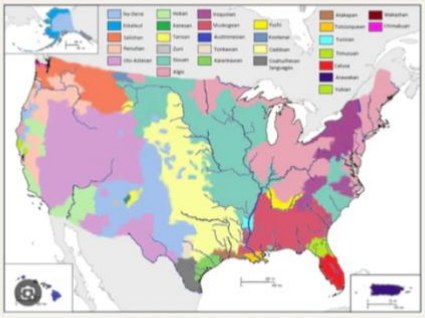
In a well-maintained three sisters garden, each plant plays a vital role. The tall stalks of corn provide support for the beans to climb, while the transpiration from the corn leaves offers mild cooling for the beans. In turn, the beans have the remarkable ability to fix nitrogen from the atmosphere, enriching the soil. The squash serves as a living mulch, suppressing weeds and shielding the earth from the hot summer sun.

Beyond its productivity, a three sisters garden is a thing of beauty. The circular yet directional pattern creates a serene space to work in, while the bean flowers cascading from the corn leaves and the large squash leaves add a touch of elegance.

Our Three Sisters Garden Mix includes enough seeds of Texas Gourdseed corn, Kentucky Wonder beans, and Seminole pumpkin squash to plant a 25 ft. circular garden. Also included is our comprehensive planting guide providing valuable insights and tips for cultivating a successful three sisters garden. (Click for PDF.)

Ujamaa Seeds:

FIRST NATIONS GARDEN



First Nations Garden – Our collection includes the Three Sisters of corn, squash, and beans along with peppers, tomatoes, herbs and more from First Nations peoples of the Americas.

CARIBBEAN GARDEN

Caribbean Garden – Caribbean cuisine consists of culinary influences from Africans, Amerindians, Europeans, and Asians. Our collection includes varieties valued by peoples from both the Western and Eastern Caribbean.

SOUTHERN SOUL GARDEN

Southern Soul Garden – Southern Soul Food is one of the most recognizable cuisines coming out of the United States. The foods recognized as ingredients in Southern Soul Food include many hearty, and sumptuous crop varieties from African, Amerindian, and European cultural foodways.

Appendix B. Focus group protocol used for all six focus groups

Culturally Meaningful, Regionally Adapted Seed: Making the Ujamaa Cooperative Farmers Alliance Market Ready

Focus Group Prompts/Instructions

Before beginning the focus group, please ensure everyone has read the consent form and agrees to be part of this study. Reiterate the following:

Thank you so much for willingness to participate in our focus group today. The purpose of this focus groups is to better understand interest in, preferences, and requirements for culturally meaningful seed. Through our conversation today, we'll be better able to identify where opportunities exist and where barriers or bottlenecks need to be addressed to support the marketability of culturally meaningful seed. This will specifically help the Ujamaa Cooperative Farming Alliance in meeting their goal of facilitating access to culturally meaningful seed.

Please remember that you can at any time choose whether to participate in the focus group, and you may stop at any time during the study. Please note that there are no right or wrong answers to focus group questions. We want to hear the many varying viewpoints and would like for everyone to contribute their thoughts. Out of respect, please refrain from interrupting others. However, feel free to be honest even when your responses counter those of other group members. This meeting will also be recorded, unless anyone has objections. Does anyone have any questions or concerns before we begin?

Questions

1. If you could pick five food crops which you believe are important to your identity and to the work that you do, which would you pick?
    1. Do you frequently purchase and/or produce these crops? If not, why is that? [seed not accessible, unsure where to purchase, no interest, other barriers, etc.]
    2. [if they purchase] Are you able to purchase them locally?
2. Tell me about your relationship with these different crops. How does it relate to the rest of the work that you do?
3. Consider the food crops you already purchase and/or produce. What are the most important aspects/characteristics of the food crops that you value?
    1. Can you think of any characteristics that are important to the seeds that produce these food crops in particular?
    2. Are there, if any, important cultural elements to these seeds that you purchase and/or produce? What do you think it means for a seed to have ‘embedded cultural meaning’?
4. What do you see as potential commercial opportunities for seed(/food) embedded with cultural meaning, and for whom?
5. What do you believe needs to be done to enhance the marketability of culturally important seed(/food)?
    1. What do you believe the main challenges to marketing culturally important seed are? Price/Understanding/Lack of Availability/Ethics/etc.?

    2. Should there be a price premium for culturally meaningful seed? Would you personally pay more?
6. Is it important for a business to incorporate issues of social justice? What is the role for commercial businesses in supporting socially conscious organizations?

Appendix C. Survey questions and answer choices.

Section B: Questions Applicable to All

How important are the following farm characteristics to the foods you prefer to consume?

Please select one answer for each of the following items.

[1 = Very unimportant; 2 = Somewhat important; 3 = Neither unimportant nor important; 4 = Somewhat important; 5 = Very important]

Produced by a regional or local farm
Produced on a farm using environmentally sustainable practices (e.g., crop rotation, no-till, etc.)
Produced on a farm using ethical labor standards (e.g., fair wages, regular hours, etc.)
Produced on a farm maintaining culturally meaningful crops
Produced on a farm using organic practices
Other, please specify:

In considering the foods you prefer to consume, **to what degree do you feel that the seeds from which those foods are grown are important** to the following?

Please select one answer for each of the following items.

[1 = Very unimportant; 2 = Somewhat important; 3 = Neither unimportant nor important; 4 = Somewhat important; 5 = Ver important]

Connection to a food movement (e.g., veganism, Slow Food, food sovereignty, etc.)
Connection to family traditions
Connection to my ethnicity, race, or culture
Connection to my religious or spiritual practices
Connection to where I live
The quality of the food (e.g., taste, nutritional content, etc.)
Other, please specify: [open response]

Please consider the definition of CM seed and select the most appropriate response for each item regarding **how difficult it is for you to find CM seed within**:

[1 = Very easy; 2 = Somewhat easy; 3 = Neither easy nor difficult; 4 = Somewhat difficult; 5 = Very difficult]

My neighborhood
My town or city
My county
My state
Mail order catalogues

Online websites

This survey focuses on the seed value chain, which can be thought of as all the activities required to take seed from production to consumption (e.g., seed sourcing, seed/crop cultivation, food distribution, etc.).

Which of the following **best describes your position in the seed value chain**?

Please select only one option.

- Gardener
- Urban farmer
- Rural farmer
- Seed company representative (e.g., owner, employee, sales representative, etc.)
- Seed retail representative (e.g., garden store, hardware store, etc.)
- Food distributor representative
- Value-added food business representative
- Grocer representative
- Professional chef
- Restaurant representative (e.g., owner, manager, etc.)

Section C: Seed Companies/ Retailers

[Only filtered to this section if answered 'Seed company representative' or 'Seed company retailer' to question B4]

SC_numbervar: Considering the seed company/retailer you work for or represent, **how many total varieties of seeds are offered** in the company's catalogue?

- Fewer than 100 [1]
- 100-249 [2]
- 250-499 [3]
- 500-1000 [4]
- More than 1000 [5]
- Unsure [6]

seedsales_OG: Among the seed types listed below, please select up to **four** categories that **contribute the most to the seed sales** of the company/retailer you work for or represent.

- Certified organic
- Genetically modified
- Heirloom (Open-pollinated varieties 50 or more years old)
- Hybrid
- Open-pollinated

- Regionally adapted
- Other, please specify:

Considering the seed company/retailer you work for or represent, **which of the following best describes the largest contingent** of the company's customer base?

- Home gardeners, community gardeners, and/or urban growers (less than 5 acres)
- Small-scale growers (fewer than 50 acres)
- Medium-scale growers (50-150 acres)
- Large-scale growers (more than 150 acres)
- Unsure

SC_saleoutlets: Considering the seed company/retailer you work for or represent, **which of the following retail outlets contributes the most** to the company's total seed sales?

- In-person, at retail stores (supermarkets, hardware stores, etc.) [3]
- Online, on another retailer's website (e.g., Amazon, garden center website, etc.) [2]
- Online, on the company website [1] (reoder)
- Phone/mail orders from seed catalogues [4]
- Other, please specify: [5, SC_saleoutlets_TEXT: open response]

How important are the following seed characteristics to the company/retailer you work for or represent when making business purchasing decisions (e.g., buying seeds for your store/catalog, sourcing seeds from growers, etc.)?

Please select one answer for each of the following items.

[1 = Very unimportant; 2 = Somewhat unimportant; 3 = Neither unimportant nor important; 4 = Somewhat important; 5 = Very important]

Certified organic
Climate resilience (e.g., resistance to increased extreme weather events, rising temperatures, etc.)
Cultural meaning
Flavor
Heirloom
Non-GMO
Pest resistance
Quality standards (e.g., uniformity in size and shape, cleanliness, etc.)
Regionally adapted
Other, please specify:

Which of the following statements **best describes the CM seeds offered** by the company/retailer you work for or represent?

- The company currently offers CM seeds and would like to offer more than it does now.
- The company currently offers CM seeds and would not like to offer more than it does now.
- The company does not currently offer and CM seeds but would like to begin offering them.
- The company does not currently offer any CM seeds and would not like to begin offering them.
- I am not sure if the company offers CM seeds.

*: To what **extent would each of the following be helpful** to the company/retailer you work for or represent in expanding its offerings of CM seed?

Please select one answer for each of the following items.

[1 = Very unhelpful; 2 = Somewhat unhelpful; 3 = Neither unhelpful nor helpful; 4 = Somewhat helpful; 5 = Very helpful]

Information on where to find CM seed stock
More education on what CM seed is
Opportunities to directly interact with growers of CM seed
Resources to inform culturally appropriate advertising
Training on how to develop relationships with growers of CM seed
Other, please specify:

: If there are any CM crop varieties that the company/retailer you work for or represent has **tried to purchase but have not been able to reliably source, please list them below: [open response]

: When thinking about marketing CM seeds, **how challenging would you rate each of the following for the company/retailer you work for or represent?

Please select one answer for each of the following items.

[1 = Not at all challenging; 2 = Slightly challenging; 3 = Moderately challenging; 4 = Very challenging; 5 = Unsure]

Consumer demand for CM seeds
Culturally appropriate advertising of CM seeds
Determining the price point of CM seeds
Selling CM seeds in a culturally appropriate way
Other, please specify:

Please **indicate how connected** the company/retailer you work for or represent is to the following other groups in the seed value chain.

"Connected" refers to having ties to others for support as well as access to resources and information.

Please select one answer for each of the following items.

[1 = Very disconnected; 2 = Somewhat disconnected; 3 = Neither disconnected not connected; 4 = Somewhat connected; 5 = Very connected]

Advocacy groups
Chefs/restaurants
Community-based organizations/non-profits
Consumers
Food distributors
Food processors
Growers
Retailers (e.g., garden stores, supermarkets, etc.)
Other seed companies
Policymakers/government officials
Researchers/academics
Other, please specify:

To what **extent is each of the following items a priority** for the company/retailer you work for or represent?

Please select one answer for each of the following items.

[1 = Not a priority; 2 = Low priority; 3 = Medium priority; 4 = High priority; 5 = Unsure]

Increasing amount paid to seed growers who supply my company
Increasing the number of CM crop varieties offered
Increasing the number of regionally adapted varieties offered
Offering affordable prices for customers
Strengthening connections with BIPOC (Black, Indigenous, People of Color) consumers
Strengthening connections with BIPOC growers
Other, please specify:

What was the 2022 annual revenue for the seed company/retailer you work for or represent?

- Less than $500,000
- Between $500,000 and $999,999
- Between $1,000,000 and $4.99 million
- Between $5 million and $9.99 million

- $10 million or more
- Prefer not to answer

*Question only presented to respondents who answered, 'The company currently offers CM seeds and would like to offer more.' or 'The company does not currently offer any CM seeds but would like to begin offering them.' to question C6.
** Question only presented to respondents who answered, 'The company currently offers CM seeds and would like to offer more.' or 'The company does not currently offer any CM seeds but would like to begin offering them.' or 'The company currently offers CM seeds and would not like to offer more than it does now.' to question C6.

Section D: Farmers and Gardeners

[Only filtered to this section if answered 'Gardener', 'Urban farmer', or 'Rural farmer' to question B4]

Do you come from a **multigenerational farming family**?

- Yes
- No

Which of the following **crops do you grow** in your farm/garden. Please select all that apply.

- Vegetables
- Fruits
- Ornamentals (e.g., flowers, shrubs, etc.)
- Grains
- Legumes
- Herbs
- Roots/Tubers
- Other, please specify

FG_practice_OG: Which of the following **best describe(s) your growing practices**? Please select all that apply.

- Certified organic
- Non-certified organic (i.e., use organic growing practices but not certified)
- Conventional
- Other, please specify:

FG_use_OG: In terms of the seeds you source for your farm/garden, please select the **categories of seeds that you most commonly use in a typical season**. Please select all that apply.

- Genetically modified
- Hybrid
- Open-pollinated
- Heirloom (Open-pollinated varieties 50 or more years old)
- Other, please specify:

Please write in a **numerical answer** for each question below about your land access.

How many **total acres** do you have *access* to for your farming/gardening activities?
How many of those **total acres** do you *own*?
How many of those *acres* were in **production** during the 2023 growing season?

To what **extent does each of the following present a barrier to your ability to farm or garden in ways you would ideally like to**?

Please select one answer for each of the following items.

[1 = Not at all a barrier; 2 = A minor barrier; 3 = A moderate barrier; 4 = A major barrier; 5 = Not applicable]

Access to credit
Access to external funding opportunities
Access to land
Access to markets
Access to technical information
Access to tools/equipment
Cost of inputs
Cost of labor
Lack of social networks
Lack of time
Long term climate change (e.g., temperature change, changes in rainfall patterns, etc.)
Market volatility
Unpredictable weather (e.g., drought, flooding, etc.)
Other, please specify:

To what **extent is each of the following important** to you for why you farm or garden?

Please select one answer for each of the following items.

[1 = Very unimportant; 2 = Somewhat important; 3 = Neither unimportant nor important; 4 = Somewhat important; 5 = Ver important]

Connecting to a food movement (e.g., veganism, Slow Food, food sovereignty, etc.)
Connecting to family traditions

Connecting to my ethnicity or race
Connecting to my religious or spiritual practices
Connecting to nature
Connecting to where I live
Consuming what I produce
Enhancing my access to CM foods
Enhancing my wellbeing (physical and/or mental)
Practicing sustainable agriculture
Producing food for others to consume
FG_import_profit: Profitability
Other, please specify:

Which of the following statements **best describes your current cultivation** of CM crops?

- I currently grow CM crops and would like to grow more than I am now.
- I currently grow CM crops and would not like to grow more than I am now.
- I do not currently grow any CM crops but would like t begin growing them.
- I do not currently grow any CM crops and would not like to begin growing them.
- I am not sure if I currently grow any CM crops.

*: Please rate the degree to which each of the following is a **barrier to your sourcing CM seeds**.

Please select one answer for each of the following items.

[1 = Not at all a barrier; 2 = A minor barrier; 3 = A moderate barrier; 4 = A major barrier; 5 = Not applicable]

Access to CM seed stock
Access to information to identify CM varieties of interest
Access to sufficient quantities of CM seed
Availability of CM crop varieties to my region
Cost of seed
Other, please specify:

*: Please list below if there are any CM crop varieties that you would **like to grow but have been unable to access**.

Considering your place as a grower in the seed value chain: Please indicate **how connected you are** to the following groups.

"Connected" refers to having ties to others for support as well as access to resources and information.

Please select one answer for each of the following items.

[1 = Very disconnected; 2 = Somewhat disconnected; 3 = Neither disconnected not connected; 4 = Somewhat connected; 5 = Very connected]

Advocacy groups
Chefs/restaurants
Community-based organizations/non-profits
Consumers
Food distributors
Food processors
Other growers
Policymakers/government officials
Researchers/academics
Retailers (e.g., garden stores, supermarkets, etc.)
Seed companies
Other, please specify:

Are you **currently affiliated** with Ujamaa?

- Yes
- No

: **Have you grown seed for Ujamaa in the past?

- Yes, and I plan to in the future
- Yes, but I do not plan to in the future
- No, but I plan to in the future
- No, and I do not plan to in the future

*Question only presented to respondents who answered, 'I currently grow CM crops and would like to grow more than I am now.' or 'I currently grow CM crops and would not like to grow more than I am now.' or 'I do not currently grow any CM crops but would like to begin growing them.' to question D8.
**Question only presented to respondents who answered, 'Yes' to question D12.

Section E: Ujamaa Growers

[Only filtered to this section if answered 'Yes, and I plan to in the future' or 'Yes, but I do not plan to in the future', or 'No, but I plan to in the future' to question D13]

The following two questions ask about seed crops you grew for the **2023 growing season**. Please enter a numerical response only.

How many *seed crops* did you **grow for the 2023 growing season**?
How many *seed crops* did you **grow for Ujamaa for the 2023 growing season**?

For the seed crops that you grow, **how accessible are these resources to meet your needs**?

Please select one answer for each of the following items.

[1 = Very inaccessible; 2 = Somewhat inaccessible; 3 = Neither inaccessible nor accessible; 4 = Somewhat accessible; 5 = Very accessible]

Information about appropriate seeds for my region
Information about best growing practices for seeds (e.g., input use, isolation, distances, etc.)
Information about harvesting/processing seeds
Information about what happens to my seed after it leaves my farm/garden
Information about where to source seeds
Sufficient land
Support for business development
Tools/equipment for seed production
Other, please specify:

For the seed crops that you grow, please indicate your **interest in having more information about each of the following topics related to seed production**.

Please select one answer for each of the following items.

[1 = Very uninterested; 2 = Somewhat uninterested; 3 = Neither uninterested nor interested; 4 = Somewhat interested; 5 = Very interested]

Control for pests and disease
Enhancing production efficiency
Germination testing
Increasing scale of seed production
Production requirements for maintaining crop genetic integrity
Seed processing for dry-seeded crops
Seed processing for wet-seeded crops (including fermentation)
Storing seed
Other, please specify:

For the seed crops that you grow, please rate **how challenging you find the following practices related to your seed growing operation**.

Please select one answer for each of the following items.

[1 = Not at all challenging; 2 = Slightly challenging; 3 = Moderately challenging; 4 = Very challenging; 5 = Not applicable]

Accessing labor
Achieving quality standards (e.g., germination rates, crop genetic purity, etc.)
Achieving satisfactory seed yields
Controlling stress on plants (e.g., disease, pests, weeds, etc.)
Data collection/record keeping
Managing a healthy farm ecosystem (e.g., pollinator habitats, water quality, etc.)
Managing farm business activities
Overwintering for biennial crops
Seed processing costs
Seed production costs
Sourcing seed stock
Other, please specify:

Section F: Grocers, Food Distributions, Value-added Food Businesses, Chefs and Restaurants

[Only filtered to this section if answered 'Food distributor representative, 'Professional chef', 'Grocer representative', 'Value-added food business representative (e.g., food processor, product manager, food scientist)', or 'Restaurant representative (e.g., owner, manager, etc.)' to question B4]

When considering what foods to purchase for your business, **how important are the following considerations**?

Please select one answer for each of the following items.

[1 = Very unimportant; 2 = Somewhat important; 3 = Neither unimportant nor important; 4 = Somewhat important; 5 = Ver important]

Aesthetic appeal
Certified organic
Consistency of supply
Cultural meaning
Flavor
Heirloom
Locally or regionally produced
Non-GMO
Personal relationship with grower
Profit potential
Storage/shelf stability
Sustainable produced
Uniqueness or novelty
Other, please specify:

Please select the statement that **best describes your business' current offering** of CM food.

- My business currently sells CM food and would like to expand its offerings.
- My business currently sells CM food and would not like to expand its offerings.
- My business does not currently sell CM food but would like to offer it.
- My business does not currently sell CM food and would not like to offer it.
- I'm not sure if my business currently sells CM food.

*: To what **extent does your business find each of the following a challenge** to selling CM food?

Please select one answer for each of the following items.
[1 = Not at all challenging; 2 = Slightly challenging; 3 = Moderately challenging; 4 = Very challenging; 5 = Unsure]

Customer interest
Profit margins
Selling CM food in a culturally respectful way (e.g., advertising, labeling, etc.)
END_challenge_supply: Supply uncertainties (e.g., insufficient quantity, inconsistent quality, etc.)
Other, please specify:

: To what **extent would each of the following be helpful to your business in expanding its offerings of CM food?

Please select one answer for each of the following items.

[1 = Very unhelpful; 2 = Somewhat unhelpful; 3 = Neither unhelpful nor helpful; 4 = Somewhat helpful; 5 = Very helpful]

More education on what CM food is
Opportunities to directly interacts with growers of CM food
Resources to inform culturally appropriate communication with customers
Training on how to develop relationships with businesses that CM food
Other, please specify:

Considering your place as a food-related business in the seed value chain: Please indicate **how connected you are** to the following groups.

"Connected" refers to having ties to others for support as well as access to resources and information.

Please select one answer for each of the following items.

[1 = Very disconnected; 2 = Somewhat disconnected; 3 = Neither disconnected not connected; 4 = Somewhat connected; 5 = Very connected]

Advocacy groups
Chefs/restaurants
Community-based organizations/non-profits
Consumers
Food distributors
Food processors
Growers
Policymakers/government officials
Researchers/academics
Retailers (e.g., garden stores, supermarkets, etc.)
Seed companies
Other, please specify:

*Question only presented to respondents who answered, 'My business currently sells CM food and would like to expand its offerings' or 'My business currently sells CM food and would not like to expand its offerings.' or 'My business does not currently sell CM food but would like to offer it.' to question F2.
** Question only presented to respondents who answered, 'My business currently sells CM food and would like to expand its offerings' or 'My business does not currently sell CM food but would like to offer it.' to question F2.

Section G: Demographics

What is the highest level of formal education that you have completed?

- Some high school
- High school degree or GED
- Technical education degree or certification
- Associate's degree or equivalent
- Bachelor's degree or equivalent
- Post-graduate degree (M.S., J.D., M.B.A., Ph.D., M.D., etc.)
- Formal apprenticeship and/or hands on guided learning experience
- Prefer not to answer

In what year were you born? [Options range 1923-2005]

In which US state or US territory do you currently reside? [dropdown options including all 50 states, D.C., and a 'US territory' option]

*: In which US territory do you currently reside? [open response]

What is your gender identity? Please select all that apply.

- Woman

- Man
- Non-binary
- Genderqueer
- Unsure
- Prefer not to answer
- Another gender, please specify:

What race(s) or ethnicity do you identify as? Please select all that apply.

- American Indian or Alaska Native
- Asian
- Black/African American
- Native Hawaiian or Pacific Islander
- White
- Hispanic/Latine
- Another race or ethnicity, please specify:
- Prefer not to answer

**: Please share more about your tribal affiliation.

American Indian. Please list tribal affiliation(s) below:
Alaska Native. Please list tribal affiliation(s) below:
Canadian Inuit, Metis, or First Nation. Please list tribal affiliation(s) below:
Indigenous Mexican, Central, or South American. Please list tribal affiliation(s) below:
Prefer not to answer

Please select all of the place(s) from which you family comes.

- East Africa
- Middle Africa/Central Africa
- Northern Africa
- Southern Africa
- West Africa
- Central Asia
- East Asia
- Southeast Asia
- Western Asia
- Central Europe
- Eastern Europe
- Northern Europe
- Southern Europe
- Western Europe
- Australia

- New Zealand
- Pacific Islands
- Caribbean
- Central America
- North America
- South America
- Other, please specify:
- Prefer not to answer

Which of the following best reflects your work status? Please select all that apply.

- Full-time employment for another person/organization
- Full-time self-employed/contractor/freelance
- Part-time employment for another person/organization
- Part-time self-employed/contractor/freelance
- Not able to work
- Unemployed
- Retired
- Other, please specify:
- Prefer not to answer

***: To what extent does your employment, combined with the other income in your household, meet your household's basic living needs?

- Fully
- Mostly
- Barely
- Not at all
- Prefer not to answer

What is your current total annual household income?

- Less than $25,000
- $25,000 - $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- $100,000 - $149,999
- $150,000 - $199,999
- $200,000 - $249,999
- More than $250,000
- Prefer not to answer

D_extra_TEXT: Please use the space below to include any additional information you believe is important for us to know or any feedback you have regarding this survey. [open response]

*Question only presented to respondents who selected ‘US territory’ for question G3.
**Question only presented to respondents who selected ‘American Indian or Alaska Native’ for question G5.
***Question only presented to respondents who selected ‘Full-time employment for another person/organization’ or ‘Full-time self-employed/contractor/freelance’ or ‘Part-time employment for another person/organization’ or ‘Part-time self-employed/contractor/freelance’ for question G7.

Appendix D. Codebook used for all three focus groups.