The challenges facing agricultural systems – biodiversity loss, climate change, corporate consolidation, and loss of food sovereignty, to name a few – demand transitions to more environmentally and socially sustainable agricultural systems [(Hebinck et al. 2021)](https://www.zotero.org/google-docs/?rSRxF3). Supporting sustainability transitions, however, is no easy task. The decision to adopt a new technology or change behavior is made at the individual level, which is influenced by factors like attitudes and available resources [(Buttel, Jr, and Larson 1990; Rogers 2003)](https://www.zotero.org/google-docs/?Y0Mte3). These individual factors, however, are shaped by the broader innovation system in which an individual is nested [(Klerkx, van Mierlo, and Leeuwis 2012)](https://www.zotero.org/google-docs/?DvQAj1). Innovation systems (IS) are the interactions between actors and institutions that nurture and diffuse new technologies or practices based on several interdependent processes, such as knowledge creation and policy guidance [(Bergek et al. 2008)](https://www.zotero.org/google-docs/?sr9u3m). Which processes to foster, at what scale, and to what end, are core questions in the niche management and innovation system literature [(Binz and Truffer 2017; Musiolik et al. 2020; Smith and Raven 2012; Suurs 2009)](https://www.zotero.org/google-docs/?Y02tfR); the answers help support the governance of successful transitions towards more sustainable forms of management [(Jacobsson and Bergek 2011)](https://www.zotero.org/google-docs/?pDfkR9).

This dissertation addresses questions about sustainability transitions at both the individual and system level using the case of the organic seed system. Among the inputs necessary for supporting a sustainable agricultural system, seeds are one of the most foundational. While the dominant seed breeding approach in countries like the United States is based on high-input, low-diversity and highly centralized conventional agricultural practices [(Lammerts van Bueren et al. 2018)](https://www.zotero.org/google-docs/?QxCtrS), several niche alternatives have developed to support a more sustainable system. This work focuses on organic agriculture, in which seed production systems are typically low-input and high diversity with polycentric modes of management [(Colley 2022; Rohe et al. 2022; Shelton and Tracy 2015)](https://www.zotero.org/google-docs/?ZMVKpi).

The organic seed research community has inspired the work of this dissertation, particularly Organic Seed Alliance's *State of Organic Seed Reports* [(Dillon and Hubbard 2011; Hubbard and Zystro 2016; Hubbard, Zystro, and Wood 2022)](https://www.zotero.org/google-docs/?T9FO7R). Their research positions organic seed as part of a broader system; seed is about breeding and agronomy, of course, but also policy, funding, community building, and small business development. These reports mirror the innovation systems approach, where environmental challenges require systems-level assessments that connect and transcend disciplines.

Using the case of organic seed, this dissertation includes three chapters. The focus of Chapter 1 is on the flexible policy setting in which organic growers are situated – namely the organic seed loophole which allows organic growers to use conventional seed based on commercial availability. We ask whether the loophole helps reduce growers' undue seed sourcing burden or enables them to free-ride. The results suggest that growers use the loophole differently depending on their motivations and operational profiles. These findings guide us in making several policy recommendations, and help open up a wider conversation about niche identity in sustainability transitions.

Chapters 2 and 3 broaden the scope of study to take a systems-level focus on organic seed. Both of these papers draw on theories of innovation systems, combined with the policy network and social network literature, to quantify the organic seed innovation system as a network. Chapter 2 focuses on the spatial boundaries of the organic seed system, testing the conditions defined by the Global Innovation Systems framework for predicting spatial innovation system structure. We find… support for the framework, which proposes that innovation mode and production valuation are two key conditions predicting a network's spatial structure. The organic seed system is a 'spatially sticky' innovation system, in that both the knowledge and market subsystems of the IS are regionally embedded. These results highlight the importance of… regional or state level policies to tailor to the needs of the seed system, while still relying on

Chapter 3 looks at the social structures occurring in the organic seed network, and draws on resource-based theory to test the relationship between existing system resources and paired, cooperative efforts. We find…

Both Chapters 2 and 3 make theoretical and methodological contributions to the field of sustainability transitions. I engage with IS and sustainability transitions theories that seek to do more than describe the system, but rather, understand the conditions that shape it. By using inferential network analyses, exponential random graph models, we broaden the toolkit for testing IS theories that are developing around network formation. These methods help directly test and validate two theories in the field, Global innovation Systems framework and the resource-based theory of strategic system building

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