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# EXPLORING POTENTIAL DOMAINS OF AGROECOLOGICAL TRANSFORMATION IN THE UNITED STATES

A Dissertation Presented

by

Catherine E. Horner

to

The Faculty of the Graduate College

of

The University of Vermont

In Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
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Dissertation Examination Committee:

V. Ernesto Méndez, Ph.D., Advisor
Cheryl Morse, Ph.D., Chairperson
Joshua Faulkner, Ph.D.
Teresa Mares, Ph.D.
Nils McCune, Ph.D.
Cynthia J. Forehand, Ph.D., Dean of the Graduate College

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## ABSTRACT

There is now substantial evidence that agroecology constitutes a necessary pathway towards socially just and ecologically resilient agrifood systems. In the United States, however, agroecology remains relegated to the margins of research and policy spaces. This dissertation explores three potential domains of agroecological transformation in the US. Domains of transformation are sites of contestation in which agroecology interfaces with the industrial agrifood system; these material and conceptual spaces may point to important pathways for scaling agroecology. To explore this concept, I examine formal agroecology education (Chapter 1), extension services and statewide discourses around soil health (Chapter 2), and models of farmland access not based on private property (Chapter 3). While these constitute three distinct topics, I seek to demonstrate that they are linked by similar forces that enable and constrain the extent to which these domains can be sites of agroecological transformation.

First, I use case study methodology to explore the evolution of an advanced undergraduate agroecology course at the University of Vermont. I examine how course content and pedagogy align with a transformative framing of agroecology as inherently transdisciplinary, participatory, action-oriented, and political. I find that student-centered pedagogies and experiential education on farms successfully promote transformative learning whereby students shift their understanding of agrifood systems and their role(s) within them. In my second chapter, I zoom out to consider soil health discourses amongst farmers and extension professionals in Vermont. Using co-created mental models and participatory analysis, I find that a singular notion of soil health based on biological, chemical, and physical properties fails to capture the diverse ways in which farmers and extension professionals understand soil health. I advocate for a principles-based approach to soil health that includes social factors and may provide a valuable heuristic for mobilizing knowledge towards agroecology transition pathways. My third chapter, conducted in collaboration with the national non-profit organization Agrarian Trust, considers equitable farmland access. Through semi-structured interviews with 13 farmers and growers across the US, I explore both farmer motivations for engaging with alternative land access models (ALAMs) and the potential role(s) these models may play within broader transformation processes. I argue that ALAMs constitute material and conceptual 'third spaces' within which the private property regime is challenged and new identities and language around land ownership can emerge; as such, ALAMs may facilitate a (re)imagining of land-based social-ecological relationships.

I conclude the dissertation by identifying conceptual and practical linkages across the domains explored in Chapters 1-3. I pay particular attention to processes that challenge neoliberal logics, enact plural ways of knowing, and prefigure just futures. In considering these concepts, I apply an expansive notion of pedagogy to explore how processes of teaching and (un)learning can contribute to cultivating foundational capacities for transition processes.

## CITATIONS

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## DEDICATION

This dissertation is dedicated to the people and landscapes who have supported my own transformation.

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# INTRODUCTION

There is widespread evidence that corporate-dominated industrial agriculture is driving multiple intersecting social and ecological crises (Patel, 2013; Sánchez-Bayo & Wyckhuys, 2019; McKay & Veltmeyer, 2021). These crises necessitate widespread shifts across multiple dimensions of agrifood systems, from economic markets to on-farm practices and the choices and engagement of food consumers. Unfortunately, the industrial food regime is highly resilient (McMichael, 2009). Despite the documented social-ecological consequences of industrial agrifood systems, policy, research, and practice remain largely focused on increasing agricultural production while offering tweaks at the margin. Sampson (2018) calls this fixation 'productivism' and identifies the ways in which this ideology ironically perpetuates hunger, injustice, and ecologically unsustainable agriculture.

Agroecology constitutes an important alternative to industrial agriculture and associated productivist narratives, and as such is increasingly acknowledged as a vital pathway towards more socially just and ecologically resilient agrifood systems (IPES Food, 2016; HLPE, 2020). Emerging from agrarian struggles in Latin America, agroecology is grounded in traditional, indigenous, and peasant knowledge and practices, and endeavors to synthesize these approaches with Western scientific knowledge (Meek 2014). Although born out of the application of ecological principles to agriculture, agroecology has evolved as a transdiscipline to encompass "the ecology of food systems" (Francis et al., 2003). In recent decades, the term has further evolved and is now

commonly understood to encompass scientific inquiry, on-farm practices, and social movements (Wezel et al., 2009). The result of this multidimensional expansion of agroecology is the presence of diverse 'agroecologies' (Mendez et al., 2013). This diversity is enabled by a focus on agroecological principles (CIDSE, 2018) or elements (FAO, 2018), rather than prescriptive 'recipes' for improving the social and ecological viability of agri-food systems. Consequently, agroecology generates and advocates for place-based solutions to complex social-ecological issues. In this dissertation, I invoke an explicitly transformative and political agroecology. This framing explicitly emphasizes the centrality of power, equity, and justice in efforts to transform agrifood systems (González de Molina, 2013; Anderson & Anderson, 2020).

In the United States, agroecology remains largely relegated to the world of 'alternative' practices and remains underfunded and under-represented in national agricultural policies (Siegner et al., 2019; Franzluebbers et al., 2020). Despite the deeply entrenched dominance of industrial agrifood systems, however, interest in agroecology is growing in the US, particularly amongst scholars and educators (Fernandez et al., 2016). To foster this interest and move agroecology beyond alterity, it is necessary to identify (1) where and how transitions towards agroecology are occurring, and (2) what forces enable and constrain such transitions within the US context.

This dissertation humbly aims to make a small contribution towards addressing these research gaps. To do so, I explore what enables and constrains agroecological transitions across three distinct research endeavors exploring various aspects of

agroecology in the United States. In my first chapter, I consider how higher education may enable or constrain agroecology through a case study of an advanced undergraduate agroecology course at the University of Vermont. I examine how course content and pedagogy align with a transformative framing of agroecology as inherently transdisciplinary, participatory, action-oriented, and political. In my second chapter, I use co-created mental models and participatory analysis to examine diverse soil health discourses amongst farmers and Extension professionals in Vermont. My third chapter, conducted in collaboration with the national non-profit organization Agrarian Trust, considers equitable farmland access. Through semi-structured interviews with farmers and growers across the US, I explore both farmer motivations for engaging with alternative land access models (ALAMs) and the potential role(s) these models may play within broader transformation processes. I aim to identify how transitions within each of these contexts may contribute to broader transformations towards more socially just and ecologically viable agrifood systems.

To provide a unifying theoretical frame across these diverse research projects, I apply Anderson et al.'s (2019) concept of 'domains of transformation.' Within this framework, domains of transformation refer to material and conceptual sites of contestation in which agroecology interfaces with the industrial agrifood system; specifically, domains comprise "discernible sets of relationships, norms, rules and activities, where enabling and disabling dynamics emerge from niches in relation to the dominant regime" (*ibid*). In their framing, the 'niche' refers to agroecology writ large, but

niches can also be more broadly "conceived of as sites of radical socio-technical alternatives that differ in their principles and configurations from the dominant ways of operating" (*ibid*). The 'regime,' on the other hand, refers to "the locus of established practices and associated rules that stabilize existing systems" and often generate path-dependencies and 'lock-ins' that reproduce the regime and maintain a status quo that is powerfully resistant to change (*ibid*). The authors note that the interface wherein agroecological practices, research, and movements confront the dominant industrial agrifood regime are important liminal spaces of transformation.

Based on an extensive review of the agroecology transitions literature, Anderson et al. (2019) propose six domains within which agroecological transitions occur: access to natural systems, knowledge and culture, systems of exchange, networks, equity, and discourse. Within these domains of transform, the authors identify multiple, potentially conflicting forces that function to enable or disable transitions towards agroecology. In their words,

> enabling factors represent those that support communities to self-organize in ways that reflect the principles of agroecology whereas disabling factors undermine the agency of niche actors to develop agroecology or that prevent agroecology altogether.

While enabling and disabling forces are highly context dependent, Anderson et al. (2019) argue that transformative systems change (e.g., agroecology) requires analyses of and shifts in power structures and governance systems across all domains. A central

component of the domains of transformation framework is attending to social dynamics that mediate transition processes, rather focusing narrowly on technical means of transitions.

This framework provides a framework to attempt to integrate findings from the three chapters of my dissertation while also relating this analysis to broader processes of agroecological transformation. An additional benefit of applying this framework is the link it provides between transition and transformation processes. Anderson et al. (2019) assert that "agroecology entails a process of continuous transition." In their framing, transitions are individual cases of change towards agroecology; multiple transitions "that will intersect, overlap, and conflict in unpredictable ways" then constitute wider processes of agroecological transformation. The distinction is subtle, and Anderson et al. (2019) seem to use the two terms somewhat interchangeably. In this dissertation, I follow their lead, identifying cases of change towards agroecology as transitions that, in turn, contribute to agroecological transformation processes. At points, I, too, use the terms somewhat interchangeably and this reflects their inherent interconnectedness: if we understand agroecology to be a transformative paradigm, any move in that direction is a move towards, or a process of, transformation.

As noted in Chapter 1, "reflexive practice is necessary to grapple both individually and collectively with the complexity of a transformative approach to agroecology" (Horner et al. 2021). To that end, and to align my writing with the notion of transformation, I attempt to convey my own reflexive process via short subsections

within the discussion sections of Chapters 2 & 3. My hope is that this provides deeper insight into how I engaged in the research processes that constitute this dissertation. Written documents provide a static overview of processes that, in fact, often remain in motion. Though brief, reflexive sections are an attempt to bring some of the dynamism of agroecological transformations into this document.

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# CHAPTER 1: CULTIVATING PEDAGOGY FOR TRANSFORMATIVE LEARNING: A DECADE OF UNDERGRADUATE AGROECOLOGY EDUCATION

## 1.1 Introduction

Courses and degree programs related to sustainable agriculture and food systems are becoming increasingly common throughout North America (Parr et al., 2007; Galt et al., 2012; Jordan et al., 2014; David and Bell, 2018). The rising popularity of sustainable agriculture and food systems education (SFSE) is in part a response to the complex and interwoven social-ecological problems created by industrial agrifood systems (Meek and Tarlau, 2016). Agroecology programs are a popular subset within the diverse courses and degree programs that comprise SFSE (David and Bell, 2018; Runck et al., 2015; Fernandez et al., 2013).

Agroecology is commonly understood to have three dimensions: scientific inquiry, on-farm practices, and social movements (Wezel et al., 2009). Many scholars, practitioners, and activists now emphasize explicitly transformative agroecology that attends to issues of power, agency, equity, and ecological renewal (Anderson and Anderson, 2020). We define transformative agroecology as a transdisciplinary, participatory, action-oriented, and political approach to working towards socially just and ecologically sound agrifood systems. This integrates previous work by Méndez et al. (2013) and González de Molina (2013) on the systems and structures that shape relationships, knowledge, and power within agrifood systems. As in participatory action

research processes (Méndez et al., 2017), reflexive practice is necessary to grapple both individually and collectively with the complexity of a transformative approach to agroecology. Reflexive practice allows producers, consumers, researchers, activists, students, and educators to continually and critically assess the impacts of positionality on transformative endeavors.

Transformative agroecology requires distinct approaches to teaching and learning (Anderson and Anderson, 2020). Pedagogical approaches within agroecology education have important implications for which types of knowledge are valued. This, in turn, has important implications for transformation and transition processes (Anderson et al., 2019b). Anderson & Anderson (2020) highlight recent work exploring pedagogy to support transformative agroecology learning, but none of the cited work explores higher education in the U.S. To date, existing scholarship on agroecology pedagogy within U.S. colleges and universities has focused primarily on cultivating students to be future professionals working in agrifood systems (e.g., Runck et al., 2015). Developing students' skills and competencies, though vitally important, may not suffice for supporting transformative learning.

The concept and theory of transformative learning was originally introduced by Mezirow (1978). Transformative learning entails a shift in a student's frame of reference. Drawing on social constructivist theory, Mezirow's theory of transformative learning suggests that meaning is constructed through experience and reflection (Probst et al., 2019). As a result, transformative learning aligns with experiential approaches to

education (Cranton, 1994). Designing learning opportunities that support students in reflecting on their own positionality within food systems, and then facilitating engagement with selected components of their own local food system serve as mechanisms for leveraging higher education to transform agrifood systems. Although scholar-educators exploring agroecology and SFS education cite Mezirow's theory of transformative education (e.g., Galt et al., 2013b; Migliorini and Lieblein, 2016), to date there has been limited explicit consideration of specific pedagogies for transformative learning as defined above. Questions remain regarding how to both identify and assess transformative learning within agroecology and SFS education. What pedagogies facilitate transformative learning? More broadly, how can agroecology education support broader processes of agroecological transformations in the U.S.?

These questions inspired our evaluation of an advanced undergraduate agroecology course offered at the University of Vermont. Over the past decade, course instructors (incl. Méndez, Izzo, Faulkner, Caswell, Horner and Kinnebrew) have made iterative adjustments to the course in response to emerging research on effective pedagogy for sustainability and critical food systems education. This includes integrating critical reflection, student leadership, and teamwork with several high-impact educational practices (Kuh, 2008) such as experiential- and service-learning and student participation in a long-term participatory action research (PAR) project. Changes to course pedagogy and content have been intentionally cultivated to catalyze action toward transforming agrifood systems.

In this article, we employ case study methods to critically assess this iterative approach to transformative agroecology education within a U.S. institution of higher education. To gain a holistic understanding of how evolving course pedagogy contributes to the broader goals of transformative agroecology, we used the following questions to guide our evaluation: How well do course content and pedagogy align with our definition of transformative agroecology as transdisciplinary, participatory, action-oriented, and political? and, To what extent does our approach enable transformative agroecological learning, and how is that identified? We also explore an innovative evaluative method to identify and assess transformative learning. Our analysis indicates that experiential learning on farms, peer-to-peer learning, teamwork, and reflection all contributed to transformative learning experiences for students.

Reflexive practice amongst scholar-educators, as well as critical and iterative course evaluation, are necessary to align pedagogy with transformative agroecology. This article aims to contribute to the ongoing work of exploring the complex connections among pedagogy, transformative student learning, and collective struggles to realize viable and equitable agrifood systems.

### 1.2 Literature Review

There are few scholarly articles exploring formal agroecology education and effective pedagogy in the U.S. context. By contrast, there is a robust body of scholarship on SFSE and attendant pedagogies, which provides valuable commentary on extant efforts to design effective courses and degree programs. We briefly review this

scholarship with an eye towards identifying the goals of SFSE, the pedagogical approaches employed to achieve those goals, and the methods for evaluating pedagogical efficacy. We then compare the goals, pedagogies, and evaluative methods of SFSE with the smaller body of work on formal U.S. agroecology education. Finally, we identify knowledge gaps related to pedagogy for transformative agroecology learning; this provides the context within which we situate our course evaluation.

Recent SFSE scholarship has focused primarily on identifying key pedagogies for cultivating students' professional capacity to address 'wicked problems' within food systems (e.g., Jordan et al., 2005; Galt et al., 2012; Francis et al., 2020; Ebel et al., 2020). Trends within this scholarship are synthesized by Valley et al. (2018), who propose a signature pedagogy for SFSE (SFSESP). They identify four major pedagogical themes comprising a SFSESP: systems thinking; multi-, inter-, and trans-disciplinarity; experiential learning; and participation in collective action projects. Valley et al. (2018) propose that a signature pedagogy framework can be used to identify approaches for educating future professionals working within agrifood systems.

The professional framing of Valley et al.'s (2018) SFSESP builds on earlier work emphasizing competency development within SFSE. Galt et al. (2013a) proposed a focal shift from content to student skill development, arguing this will support a future generation of professionals capable of tackling 'wicked problems.' Within this competency framework, values-based pedagogy (Galt et al., 2012) and critical pedagogy are presented as building blocks in the development of a skilled workforce. The concept

of educating for professional skills and competencies remains central in recent SFSE scholarship (Valley et al., 2020; Ebel et al., 2020) as well as broader calls for a sustainable food systems workforce (Carlisle et al., 2019).

While the signature pedagogy and competency frameworks highlighted above focus on cultivating students' professional capacity, Meek and Tarlau's (2016) framework for critical food systems education (CFSE) offers a more political approach focused on developing students' transgressive subjectivities. They argue that rather than focusing exclusively on students' understanding of food systems complexity, education and innovative pedagogies should be leveraged to support agrifood systems transformation. In proposing their CFSE framework, Meek and Tarlau (2016) contend that there is a tension between these two educational paradigms. Rather than being mutually exclusive, however, Meek and Tarlau advocate for complementarity between professional and transformational approaches to food systems education. They propose integrating innovative pedagogies from SFSE with critical insights and pedagogies rooted in grassroots movements and popular education. Despite the potential of this integrated approach to food systems education, the CFSE framework remains underutilized within scholarship proposing and analyzing food systems pedagogy in the U.S. (Classens et al., 2021 are a notable exception). More frequent use of signature pedagogy and competency frameworks within this body of work is further indication of an educational approach oriented towards professionalization rather than transformation.

The limited scholarship on agroecology education also focuses on skills and competencies. In an early review of an undergraduate agroecology course, Jordan et al. (2005) identify service-learning as a valuable pedagogical tool for applying systems thinking. The service component of the course was framed as an attempt to cultivate a sense of civic professionalism, defined by the authors as "professionals who orient work to projects of civic innovation and renewal". Similarly, Runck et al. (2015) propose an extended classroom framework integrating systems action education with adventure learning to develop students' capacity to tackle 'wicked problems.' Within agroecology education, capacity building is defined as "the process used in education to improve students' abilities to work effectively with challenges they will face in agriculture and food systems development and research programs" (Francis et al., 2012). Capacity building aligns with the competency frameworks guiding SFSE and suggests a focus on agroecology education as an avenue for professionalization.

Of the articles we reviewed that examine formal agroecology education in the U.S., only one aligned with a more transformative approach to agroecology education. Code (2017) explores research methods and experiences driving the design, development, and delivery of innovative agroecology pedagogy. In their analysis, they argue that epistemological innovations must be included as a component of pedagogical innovations within agroecology education. The author defines epistemological innovations as ways of knowing beyond Western scientific inquiry, disciplinary education, and systems thinking. Instead, Code (2017) advocates for pedagogical approaches that emphasize the relational,

contextual, and experiential foundations of knowledge. They contend that attending to epistemological innovations within agroecology education is necessary for transformation towards more holistic ways of knowing that encompass the full complexity of agroecosystems. Expanding the types of knowledge included enables agroecology education to contribute to what the authors term 'paradigmatic change,' in addition to cultivating skillful future professionals. This aligns with Meek and Tarlau's (2016) proposal for complementarity between professional and transformational approaches to food systems education. Code (2017) does not explicitly espouse transformative agroecology or transformative learning, though their insights on the interconnections between epistemology and pedagogy imply a holistic and equity-oriented approach to agroecology education that aligns with transformative agroecology.

In exploring the development of pedagogical innovations within agroecology education, Code (2017) reviews a subset of the scholarship focused on agroecology pedagogy within the U.S. and Europe. Their review demonstrates the dominance of the Norwegian graduate program within the agroecology pedagogy literature. Although scholar-educators involved in the Norwegian Master's program have developed and shared formative insights on agroecology education, their work emerges from a unique context. As a result, it may not translate fully to undergraduate courses in North America. This suggests the need for further research on pedagogical innovations and their efficacy in U.S. institutions of higher education.

Classens et al. (2021) note that scholarship has largely overlooked how the pedagogical approaches and efficacy of SFSE are mediated by the institutional conditions within which teaching and learning occur. Specifically, Classens et al. (2021) review how the neoliberalization of higher education has contributed to a focus on "education as a tool for the reproduction of a globally competitive workforce". The authors argue that CFSE must attend to the diverse institutional conditions of colleges and universities in order to contribute to agrifood systems transformation.

Based on our review, it is evident that there are many shared goals and pedagogical approaches across SFSE and agroecology education. With some notable exceptions (e.g, Galt et al., 2013b; Code, 2017; Classens et al., 2021), much of the scholarship exploring food systems and agroecology education emphasizes education as a tool for professionalization. This common goal translates into common pedagogical practices. Experiential education, action education, inter- or trans-disciplinarity, and systems thinking are emphasized across the literatures. In addition to pedagogical overlap, there is a commonly identified need for more dynamic evaluative methods and long-term research on student learning experiences to assess the efficacy of innovative pedagogies within agroecology and SFS education (Galt et al., 2012; Code, 2017; Valley et al., 2018).

The need for evaluations of pedagogical efficacy must be considered alongside the specific and possibly competing goals of agroecology and SFS education (Meek and Tarlau, 2016). Courses and programs designed to train future professionals may have

distinct pedagogies when compared to courses or programs focused on transformative learning. Where goals and pedagogical approach differ, so too will methods for evaluating pedagogical efficacy. There is a need for scholarship exploring how professional and transformative approaches to agroecology and SFS education can be integrated, and how to evaluate the efficacy of this integrated approach. To date, however, there has been relatively little attention paid to transformative learning in agroecology or SFSE scholarship. Assessments of effective pedagogies for transformative learning constitutes a vital next step for agroecology and SFS education.

We situate our course evaluation within these gaps in the scholarship on SFS and agroecology education. In evaluating the evolution of our course pedagogy over time, we explore how to align pedagogy with transformative agroecology and introduce a novel evaluative methodology for identifying and assessing transformative learning.

### 1.3 Methods

Interactions between course design and student learning constitute complex social processes. To attempt to make sense of this complexity, we integrated multiple analytical methods and data sources within our process of course evaluation. Our methods follow a non-experimental, interpretive, and retroactive case study approach. Case studies have previously been useful in course evaluations that seek to explore relationships between student learning and course pedagogy in the context of food systems education (Galt et al., 2013b). The case study method also aligns with the concept of 'agroecological

lighthouses' (Altieri, 1999), which have been described as examples "from which agroecological principles radiate out" (Nicholls and Altieri, 2018).

We begin with a description of the course, which provides important context for the ensuing analysis and discussion. We then provide an overview of the data sources and analytical methods employed to evaluate various aspects of course design. Our analysis includes two components. First, we conduct a curricular review based on syllabi from the past ten years. Second, we share results of thematic analysis of student evaluations over the same ten-year period as well as student reflections from the most recent iteration of the course, which took place from September through December 2020.

### 1.3.1 Case Study Context

The University of Vermont is a Land Grant university located in Burlington, Vermont. The Advanced Agroecology course has been taught in the Plant & Soil Science Department since 2008. The course is required for undergraduate students studying Agroecology. It is also popular with students in the Food Systems and Environmental Studies programs, who consistently constitute about 50% of the class. The course is usually composed of third- and fourth-year undergraduate students and a few graduate students.

Advanced Agroecology holds twice weekly lectures and a weekly 3-hour lab. There are typically 5 lab sections, and each section is paired with a local farm. In 2020, however, we worked with 3 partner farms after one farmer partner retired and another farm was unable to host students during the Covid-19 pandemic. The three farms we

partnered with in 2020 include: an urban collective farm focused on annual vegetable production, a peri-urban diversified livestock-vegetable operation, and a working educational farm affiliated with the University.

We use the term ‘farm teams’ in this course to foster the sense that each lab section constitutes its own micro learning community. Over the course of the semester, the farm teams spend most labs at their partner farm. As of 2018 the Advanced Agroecology course also includes undergraduate agroecology research fellows (UARFs) who function as farm team captains, providing peer leadership. This role requires liaising with farmer partners, coordinating use of shared lab equipment, and organizing peers for on-farm lab activities.

### 1.3.2 Curricular Review

To explore the extent to which course design aligns with the tenets of transformative agroecology, we conducted a curricular review of the course over a ten-year period. Curricular reviews can identify key pedagogical themes across multiple curricula (Valley et al., 2018). We began by qualitatively identifying course learning objectives, teaching methods, assigned content, and evaluative assignments as presented in course syllabi from 2010-2020. This process enabled comparative analysis of how course design and pedagogy have evolved over time. We then employed content analysis to identify focal topics and prominent voices within assigned materials and compared content analyses from 2010 and 2020 to identify changes over time.

The curricular review was guided by the tenets of transformative agroecology. We considered whose voices were represented in assigned materials, where those voices were located, and whether course materials, focal topics, teaching methods, and evaluative assignments aligned with a transdisciplinary, participatory, action-oriented, and political approach to agrifood systems transformation.

### 1.3.3 Thematic Analysis

To evaluate the efficacy of course pedagogy for transformative learning, we conducted thematic analyses of open-ended student comments in end-of-semester course evaluations as well as student reflective essays submitted at the end of the 2020 course. Prior research indicates that conventional course evaluations are not well suited for assessing student-centered instruction, problem-based learning, and complex learning (Frick et al., 2010). Open-ended evaluative comments do, however, provide insight into students' experience of the course over time. To address the limitations of student evaluations, we integrated a most significant change (MSC) reflection. In the MSC reflections, students responded to a prompt asking them to identify the most significant change in their thinking about agrifood systems during the course. MSC methodology was developed by Dart and Davies (2003) as a holistic, participatory tool for evaluating development projects. Moving beyond evaluation of pre-defined outcome metrics or indicators, MSC techniques allow individuals most impacted by an intervention to share their experiences in a holistic manner. In an educational setting, MSC techniques require critical reflection on the outcomes or changes experienced through participation in a

project or course (Choy and Lidstone, 2013). Acton (2019) notes that inclusion of MSC techniques facilitates student self-reflection on their own educational experiences.

All student evaluations and MSC essays were uploaded to NVivo 1.4.1 and coded. We used sensitizing concepts related to our research questions to guide the initial analysis (Bowen, 2006). Charmaz (2003) posits that "sensitizing concepts offer ways of seeing, organizing, and understanding experience". Within grounded theory research, sensitizing concepts are used as a foundation for analysis. Initial sensitizing concepts of transformative agroecology and transformative learning guided the first phase of coding for both the student evaluations and the MSC essays.

In developing initial codes, we used a constant-comparative method. This analytical approach entails constantly comparing data during the process(es) of coding (Leech and Ongwuegbuzie, 2007). This process also enabled us to identify linkages between data sources. We grouped initial codes of student evaluations and MSC essays to identify major themes relevant to our course evaluation (Creswell, 2013). We identified a unique set of themes for the two data sets, but we compare these themes, along with results from the curricular review, within our discussion. Themes provided a frame for making sense of students' learning and transformation in relationship to course pedagogy.

The final step of our thematic analyses entailed 'member checking' our results (Creswell, 2013) with individuals who were students in the course. Sharing findings with individuals who have intimate knowledge of the case being studied is an important

method for validating interpretative case study analysis (Yin, 2013). These prior students all served as farm team captains in their role as UARFs. As a result, they carried unique insight into the experiences of their peers. We asked the students if thematic analyses of student evaluations and MSC reflections resonated with both their own experiences and with the informal feedback they received from their farm teams. They validated our analyses and provided critical feedback that helped us better represent the full complexity of student experiences. Confirming our analyses with prior students, integrating multiple data sources, and applying multiple analytical methods enabled a more holistic evaluation of course pedagogy and student learning.

## 1.4 Results

First, we present findings on the curricular review, focusing specifically on the aspects of course pedagogy that have evolved substantially in the past ten years. After analyzing the evolving curricular context, we present thematic analysis of institutional student evaluations over the same ten-year period. Finally, we turn to the MSC essays to identify themes across students' transformative learning experiences. This section focuses disproportionately on students' 2020 MSC essays. Due to the nature of the prompt, these essays yielded an extremely rich source of data on how course content and design supported transformative learning. Additionally, as the most recent students to have taken the course, this content presents the most relevant means of assessing the efficacy of current pedagogy for supporting transformative learning.

### 1.4.1 Curricular Review

In our review of syllabi from 2010-2020, we identified six aspects of course pedagogy that we deem central to course design and intended student learning. These include course learning objectives, the evolution of a collaborative and transdisciplinary teaching team, the integration of the course with a long-term PAR project, the integration of undergraduate agroecology research fellows (UARFs), assigned content, and student-led discussions (SLDs).

The learning objectives of the course essentially remained unchanged despite the multiple changes implemented in response to both student feedback and emerging research. Between 2010 and 2020, 'practical skills' and 'reflection skills' were added to course learning objectives (Table 1.1).

| | 2010 | 2020 |
|---|---|---|
| LTO 1 | Students become familiar with current research and applied concepts and applications within the field of agroecology. | Students become familiar with current research and applied concepts and applications within the field of agroecology. |
| LTO 2 | Through hands-on field and ***laboratory*** exercises in local farming systems, students learn ecological and social research and analytical skills, which are commonly used in agroecology and agrifood systems research. | Through hands-on field exercises in local farming systems, students learn ***practical***, ecological and social research and analytical skills, which are commonly used in agroecology and agrifood systems research. |
| LTO 3 | Students practice working in groups. | Students practice working in groups. |

| | | |
|---|---|---|
| LTO 4 | Students practice their critical thinking and communication skills throughout the course by participating in discussions and preparing written and visual material. | Students practice their critical thinking, ***reflection,*** and communication skills throughout the course by participating in discussions and preparing written and visual material. |

Table 1.1. Learning and teaching outcomes (LTOs) as listed in course syllabi. Changes are italicized. Despite substantial changes to course content and pedagogy, there is little substantive change in the learning outcomes guiding the course.

The earliest pedagogical shift is the introduction of teaching team members. Initially the course was taught by Professor Méndez. Over time, Méndez incorporated multiple faculty collaborators whose work aligned with the expanding course content and focal topics. The creation of a teaching team co-evolved with the formalization of farmer partners' role in the course via integration of a long-term PAR project started in 2017. The PAR process was formalized to integrate on-farm research in a way that was beneficial to both student learners and farmer partners. As a pedagogical tool, PAR leverages student learning to support farmers' management processes. The PAR project also created greater coherence between the service-learning and soil science research components of the course, insofar as initial weeks of service-learning enabled relationship- and trust-building foundations for engagement between farmers and students within the PAR project. Shifting to a PAR approach also required greater reflexive practice among the teaching team as we collectively navigated iterative cycles of service-learning and research. This complemented a growing emphasis on reflexive practice in the curriculum as evidenced by reflective essay assignments and in-class

reflective exercises (Figure 1). Through this work instructors sought to engage students in thinking about their previous and current experiences and their connections to food, the food system, and the agroecological content of the course.

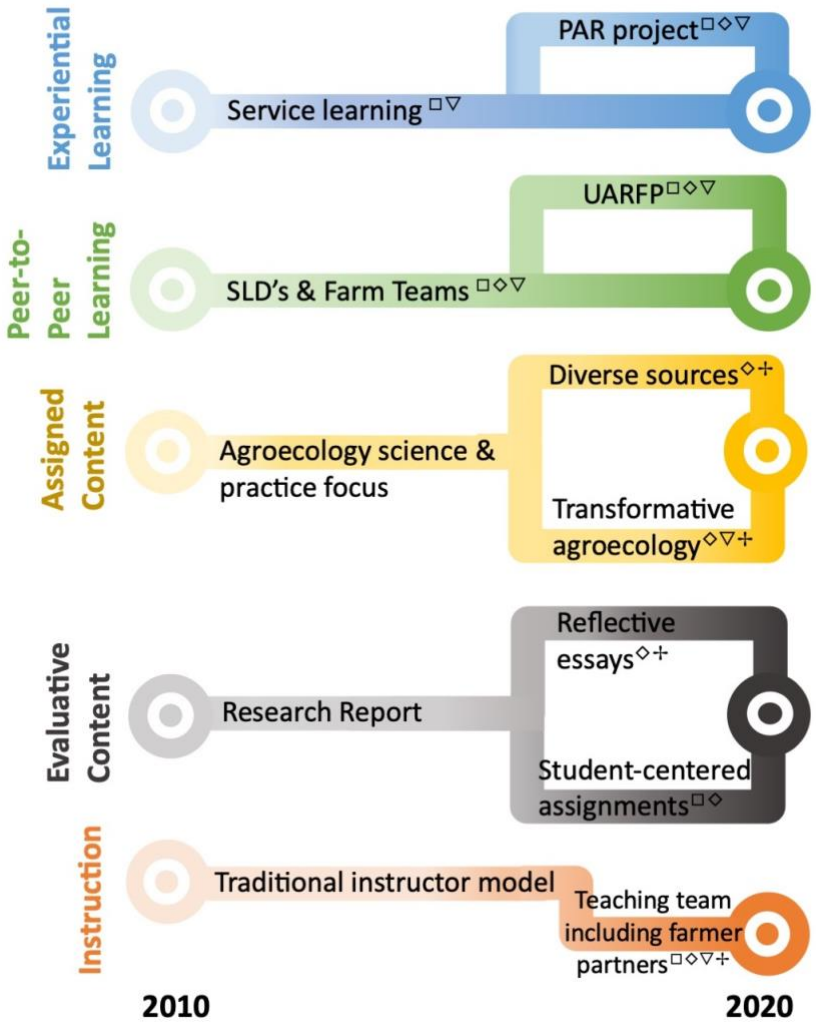


Figure 1.1. This highlights the evolution of course pedagogy from 2010 to 2020. Major course components are grouped into pedagogical elements to provide a sense for how all elements of course pedagogy have co-evolved. The color saturation gradient represents the intentional shift over time towards pedagogies more aligned with a transformative approach to agroecology. Superscripts indicate the tenets of transformative agroecology supported by each pedagogical innovation: □- Participatory, ◇ – Transdisciplinary, ▽ - Action-oriented, ✢ - Political

The integration of a long-term PAR project with the course necessitated additional support for managing the considerable logistical challenges of coordinating not only five lab sections, but also five partner farms. To address this challenge, instructors incorporated UARFs to liaise with farmer partners and provide peer leadership within farm teams. The integration of UARFs was also designed to align with course learning objectives and key pedagogies that emphasize peer-to-peer learning.

We conducted content analysis on all assigned materials and evaluative assignments. We found a marked shift in both the agroecological topics and sources highlighted within course materials from 2010 to 2020 (Figure 2). This finding aligned with qualitative coding of the syllabus, which revealed a transition from a predominant emphasis on agroecological science and practices towards greater inclusion of food sovereignty, social movements, and PAR.


Figure 2. Comparative content analysis of assigned course materials in 2010 and 2020. The size of sub-rectangles represents the quantity of sources of that type in the respective year's syllabus. Gray Literature includes policy briefs, research briefs, and content from popular books and newsprint sources. 'Other sources' includes movement manifestos and encyclopedia entries. *New in the 2020 syllabus

We also identified substantial changes in the evaluative assignments required of students over the past decade. Although SLDs occupied one out of two weekly lectures in 2010, this decreased to five SLDs over the course of the semester in 2020. SLDs provided a chance for students to assume the role of teacher and to learn from peers, disrupting the traditional student-teacher hierarchy and top-down model of knowledge transfer (Anderson and McLachlan, 2016). The semester-long research paper was substituted for a shorter assignment with greater creative license granted to students, who were able to choose between a blog post and a research brief. Providing choice within both course materials and evaluative assignments pushed students to reflect on what types of learning suit their learning goals and preferences. Student choice regarding assignments also evidences a more participatory pedagogy designed to facilitate students' sense of agency within their education. The introduction of reflective essays also demonstrates a transdisciplinary pedagogy that seeks to integrate multiple types of knowledge as well as students' past experiences, beliefs, and values within course learning.

### 1.4.2 Student Evaluations

Across ten years of formal student evaluations administered through the University, we identified three major themes: experiential learning, peer-to-peer learning, and critiques of course design.

Since 2010, student evaluations have clearly demonstrated widespread appreciation for on-farm learning. Students' on-farm experiences evolved over the years

from a service-learning and soil sampling lab hybrid to a combination of service learning and PAR. Student evaluations consistently emphasize the power of hands-on learning from farmers, with a distinct emphasis on the service-learning portion of the course. Despite the integration of a long-term PAR project, students do not explicitly mention participating in the PAR project as a valuable component of experiential learning.

In addition to hands-on learning on farms, students emphasized the value of peer-to-peer learning. Student evaluations indicate widespread appreciation for student-led discussions. Students reported high levels of course engagement when preparing SLDs with their farm teams and learning from their peers when other groups led discussions. Although course redesigns decreased the number of student-led discussions over the years, reported appreciation of SLDs increased. The year in which students most commonly and forcefully emphasized the value of SLDs was the first year of the UARF program. As part of their fellowship, UARFs took a lead role in coordinating SLDs, which may explain the particularly forceful emphasis on SLDs as an important site of peer-to-peer learning.

Despite appreciation of experiential and horizontal learning, student evaluations presented substantial critiques of course design. Many student critiques were constructive, such as a 2020 student's suggestion to further highlight and honor indigenous knowledge and spiritual ways of knowing. More frequently, students identified frustrations and deficits with course content. Three consistent critiques appeared across all ten years. First, students expressed a desire for more emphasis on

local examples of agroecology and were frustrated by the emphasis on Latin American case studies in lectures. Second, students cited frustration with the theoretical or abstract content presented in lectures. Specifically, students expressed a desire for less emphasis on PAR, social movements, and the political aspects of agroecology. This ties into students' desire for more practical "how-to" content, which constitutes the third major critique that appeared across the years. Students' interest in hands-on learning over distant case studies lends credence to a central argument of transformative agroecology: that theory and practice mutually complement one other when theory is built out of practical dilemmas. It is not necessarily a less political agroecology that students seek, but rather one built out of their experiences and the cognitive-emotive complex. The fact that, as students in lab, there is no reason to "struggle" for access to seeds, water, or land can make the more overtly political aspects of the course less tangible. These critiques also imply a disconnect between lectures and lab; students struggle to understand their on-farm experiences as exposure to local agroecological practices constrained and shaped by social, political, and environmental forces.

Despite offering feedback on student satisfaction with key components of course design, survey comments did not provide indications of transformative learning. Responses focused on what students enjoyed, and more often on what was lacking or frustrating regarding course design. Survey responses can inform instructors' iterative redesign of course materials and pedagogies but offer little insight into how these changes influence student learning outcomes.

### 1.4.3 Most Significant Change Reflections

Our analysis of student MSC essays revealed five categories of transformative learning during the most recent 2020 semester. The transformative learning categories include student empowerment, relationship-building, learning related to social justice, systems thinking, and transdisciplinary learning. These categories capture forceful themes within the students' reflective essays on their most significant learning during the semester. These categories also include references from all 25 of the essays considered.

Due to the nature of the writing prompt, nearly all students identified one or more areas of transformative learning during their engagement with the Advanced Agroecology course. Although in certain instances students self-identified their learning as transformative, it was more common that interpretation was required. We interpreted instances in which students expressed shifts in perspective and consciousness or awareness as indicative of transformative learning.

#### 1.4.3.1 Empowerment

Students' perceptions of their roles and responsibilities within agrifood systems changed in multiples ways as a result of taking this course. We identified three sub-themes that capture students' sense of empowerment in contributing to agroecological transformations: shifting consumer identities, increased self-efficacy, and future visioning.

Multiple students viewed their learning through the lens of consumer identity. These students reported developing a deeper awareness of their responsibilities as

consumers alongside increased capacity to make ethical consumer choices. For example, one student wrote, “I have gained confidence as a consumer because I feel I am more aware of the food system I am a part of, which can help me make more informed decisions.” Other students echoed this sentiment, confirming that their learning in the course enabled them to become more ‘sustainable’ consumers. These statements indicate a degree of personal transformation as students become aware of their embeddedness within agrifood systems.

Other students, however, demonstrated what Anderson et al. (2019b) term ‘more-than-consumer’ consciousness, which implies awareness of the political implications of consumers’ decisions and role(s) within agrifood systems. For some students, this shift in consciousness was deeply personal, as with one student who wrote, “I know that what I have learned in this class will be the beginning of my process of reconnecting with the food that I eat.” For others, their more-than-consumer consciousness extended outward:

> By being able to critically address the issues of food sovereignty within our food systems, as well as being able to recognize the role of agroecology in politics and as a social movement, I truly became aware of my duty as a student to speak up and fight against the social, environmental, and political injustices of our time.

This student experienced a shift in their understanding of the ‘duty’ they have to engage with agrifood systems beyond the role of consumer.

The perception of personal responsibility and capacity to participate in agrifood systems as more than a consumer aligns with an increased sense of self-efficacy evident in many student essays. One student reported that through learning about the political dimensions and implications of agroecology, they perceived that they could have an impact in agroecological movements. This student went on to share a new commitment to participating in local politics. Others similarly communicated intentions to mobilize their learning from the course to participate in social movements related to agriculture, food, and racial justice more broadly.

For other students, increased self-efficacy was framed in a more internal way. One student reflected,

> As the semester draws to a close, I realize that the experiences and lessons I learned through [Advanced Agroecology] have allowed me to recognize my strengths as a student and the possibilities for expanding this role well beyond just an academic setting.

This reflected a transformation in the student's perception of themself and their capacities. Another student similarly reflected on the leadership role they assumed in their group, noting "I really have not identified myself as a leader in much of my life. However, working on the farm made me question why I don't see myself fitting in those shoes." Through their experience working with peers on their partner farm, this student began to perceive their leadership capacity and question why they had not previously identified as a leader.

Finally, multiple students communicated an intention to utilize the skills and knowledge gained through the course in their future endeavors. For some students, the experience of service learning on partner farms affirmed or strengthened a preexisting desire to work in agriculture. For example, one student reflected, “I feel grounded in the fact that what I’ve learned from this class, combined with everything I’ve learned outside of it, will help me do the work I always knew I was meant to do, the work of fighting for a just world through… food.” Other students, however, directly connected their learning in the course to changes in their perceived capacity to integrate agroecology into their professional futures. One student noted that “Advanced Agroecology has enlightened me with future career pathways and skills that I didn’t realize that I was capable of.” This demonstrates how course content can transform students’ plans and perceptions of the possible.

#### 1.4.3.2 Social Justice Learning

Nearly all (20 out of 25) student essays connected their learning in the course to an enhanced awareness of social justice issues. Within this category, we identified three subthemes that captured the range of students’ transformative learning related to social justice: systemic racism within food systems, collective action, and critical consciousness. Considered together, student reflections indicated that when course pedagogy pushes students to consider issues of justice and equity, it enables students to connect the ecological and social-political dimensions of agroecology.

Several students explicitly named systemic racism as one of the social justice issues entangled with agrifood systems. Many students related their learning in the course to a heightened awareness of racial inequities, exploitation, and oppression. As one student explained,

> Racial justice goes right along with food justice and agroecology, because our food system is racialized. To practice agroecology should also mean to fight for racial and social justice of all kinds, because they all intersect--we cannot solve one of these issues without solving the other.

In communicating their learning, awareness, and engagement with issues related to racial justice, students demonstrate the application of Freirean praxis, which Meek and Tarlau (2016) define as a dialectic between learning and taking action "to change the inequitable social, economic, political, and agricultural systems that shape our lives". Indeed, several students shared the ways in which their learning in the course motivated them to engage directly with social justice projects and movements. One student connected their participation in Black Lives Matter protests and political engagement with their new capacity to "critically [apply] what [they] learned in this course to recognize the importance of valuing the ecological knowledge and practices of various cultures, knowledge systems, and disciplines."

In learning about the social-political dimensions of agroecology, many students reported a transformed understanding of the role of social movements, grassroots organizing, and collective action in realizing sustainable agrifood systems. For instance,

one student reflected that “after gaining a better understanding of agroecology as a movement, I would suggest the movement is at least equally as important as practices and principles, if not more important”. Another student reflected on their “newfound recognition that farmers can be active agents of transformative change in a food system, rather than solely responsive to and restricted by market forces and policies.” These statements demonstrate enhanced awareness of the power of collective action and grassroots organizing for change within agrifood systems.

Some students framed their perception of social movements in more deeply personal terms, such as one student who stated that their new understanding “of how social movements function and why they are necessary in agroecology… changed the way I think about the world and my role in it.” Another student went a step further in reflecting on how their learning transformed their perception of the role of collective action in creating viable agrifood systems:

> I’ve realized that maybe focusing on my own situation and my family's farm is not going to achieve much, and that I would probably fail by myself. The interconnectedness and prevalence of agriculture across our societies forces any transition in food systems to be undertaken by whole communities that can support themselves and not by individuals fighting their own ‘good fight’.

These quotes demonstrate the powerful linkages across social justice learning, self-efficacy, and systems thinking as students’ awareness of the social-political dimensions

of agrifood systems transforms their perceptions of their roles and responsibilities in working towards sustainability.

Finally, many students demonstrated development of a critical consciousness. General statements regarding the impacts of globalization and neoliberal trade agreements on peasant and rural livelihoods indicated critical consciousness of the intersection of agrifood systems and international political economy. Many students also explicitly reflected on their increased awareness of the inequities stemming from capitalism and industrial agriculture.

> If anything has changed this semester, it has been my thinking around capitalism. It has never been so apparent to me the ways in which it hurts so many members of our society. While agroecology can be a solution within this system, I don't think it can reach its full extent with farming corporations ruling our food system.

This example demonstrates that not only did students develop critical consciousness through course pedagogy, but they were also then able to apply that critical consciousness to their understanding of agroecological transformations.

As with earlier sub-themes, some students developed their critical consciousness in more personal terms. For example, one student reflected that how gender operates within agrifood systems had become a topic of increasing interest and importance. It is interesting to note, however, that despite a vast majority of female students, the intersection of gender and equity within agrifood systems was not a prominent theme.

More students focused on critical analysis of economic and racial inequities. In reflecting on their social justice learning, students integrated multiple aspects of course pedagogy, from their discussions with farmer partners, to lectures, student-led discussions, and assigned content related to food sovereignty and food justice.

#### 1.4.3.3 Systems Thinking

Critical consciousness often develops alongside systems thinking capacity. As students become more aware of the systems and structures that (re)produce inequities and injustices, they are better able to consider the full social-ecological complexity of agrifood systems. Systems thinking is evidenced by students grappling with complexity, identifying the interdependence of social and ecological dimensions of sustainability, and perceiving their embeddedness within agrifood systems.

For many students, increased awareness of and engagement with social justice and food sovereignty movements led to shifting perception of what constitutes sustainable agriculture. One student reflected,

> What a grower does day-to-day, I thought, was the backbone of agroecology. But after discussing the Declaration of Nyéléni, I realized that to study agroecology as a whole is not just to study agriculture. It is a whole philosophy on global food systems made to support growers' livelihoods, food sovereignty, and living in harmony with nature.

While some students came to perceive the social-ecological interweaving of agroecology through assigned material and discussions, other students did so through their on-farm

experiences. For example, one student reflected, “I had never considered that a farm could have much of an impact beyond the soil they grow on and the surrounding ecosystem”. After spending time on their partner farm during labs, this student came to see that farms play a vital role in supporting communities and preserving culture. Other students noted that both readings and farmer conversations around livelihoods and PAR expanded their awareness of the social components of sustainable agrifood systems.

The process of grappling with the full complexity of agrifood systems was not always a comfortable one for students. Many students reflected on ways in which they perceived their prior education to be lacking. For example, one student noted that their previous courses “oversimplified the life of a farmer” in ways that promoted an incomplete understanding of agrifood systems. In reflecting on their learning in the course, another student wondered, “How can agroecology work within the system to create change? How can two sets of conflicting values, agroecological principles and agricultural production that exists within a capitalist society, manage to create some change within the system?” Asking complex questions can lead to frustration when no simple answers are possible, but the process of considering such questions is indicative of complex systems thinking and is vital for agroecological transformation.

#### 1.4.3.4 Relationship Building

While systems thinking often arose in conjunction with learning about social movements and justice, systems thinking also developed alongside student perceptions of the importance of relationships in agroecology. Interactions with peers, the teaching

team, farmers, and the farms fostered new relational awareness. As one student put it, “It was the people and the conversations that have helped me to grow throughout the course of the semester.” In exploring student learning tied to relationship building, we identified three sub-themes: appreciation for cooperative agriculture, appreciation for community, and relational processes of horizontal learning.

Multiple students reported a change in their perception of farming as a communal or community-building endeavor. One student reflected, “I always perceived farmers as being more profit oriented and worrying about the market prices and whatnot. However, [our partner farmers] revealed that their priorities lie in their community’s needs.” This is representative of students’ shifting awareness of the ways in which farms play important roles in supporting and building communities.

Students also reflected on the ways in which cooperative approaches to agriculture benefited farmers. On one farm a student noted, “in the same way my lab group aided me this semester, it is [the farm’s] collaboration of perspectives, thoughts, and ideas that helps them continuously improve.” On another farm, a student reflected that over the course of the semester she became aware that farming “is something that I truly believe one cannot do on their own… farming is also an experience that I believe should be shared between people and allows for unique and strong connections.” Despite differing partner farm business models, students from all farm teams reflected on the community-wide relevance of agroecology.

Students also shifted how they personally related to the concept of community within the context of agroecology. One student reflected "I really loved working with people who were just as passionate about learning and growing as I was, and it helped us not only grow food well, but also foster community well, something that felt especially important during this time of Coronavirus." Interacting with peers and farmers during lab periods enabled students to engage in learning about agroecology in the context of building relationships. This experience fed back into transformative learning, as students were able to identify the power of relationships for realizing agroecological transformations. For example, a student reflected that,

> Through my involvement in our class, my farm team, and Catamount Farms I have found belonging and community in a way that lacked in my previous experiences. Fundamentally, finding a sense of belonging through active involvement is a principle that I will use going forward as I look to influence change and build relationships in my future.

Service learning on farms enabled students to build relationships with both peers and farmers. These relationships, rooted in place, enhanced student learning regarding the relational nature of agroecology and transformative processes.

One way that relationship-building enhanced student learning was by enabling peer-to-peer or horizontal learning. Multiple students noted the power of learning with and from their peers. In reflecting on their learning experience within their lab group, one student shared appreciation for the diverse backgrounds of their peers and the "excellent

perspectives, thoughts, and ideas" they added to the on-farm learning portion of the class. For some, these experiences led them to shift their understanding of who can be an educator and how learning happens. One student noted, "So much valuable knowledge is shared and considered when done through horizontal learning that my past classes failed to teach me." Experiences cultivating and learning in community settings, in which peers and farmers became important sources of knowledge, expanded students' notions of the purpose and processes of education and transformative learning.

#### 1.4.3.5 Transdisciplinary Learning

This was the most forceful category we identified in the students' reflective essays. We identified transdisciplinary learning through both explicit and implicit language related to critical learning that transgressed traditional boundaries that define higher education courses. Through this process, we identified three sub-themes of transdisciplinary learning: expanding perceptions of education, epistemological plurality, and critical reflection. Across these sub-themes, students emphasized the power of experiential learning and the ways in which course pedagogy enabled learning beyond academic disciplines.

The experiential education students received on their partner farms during weekly lab periods provided the primary pathway to transformative transdisciplinary learning. For many, this experience contributed to an expanded sense of the purpose and sites of agroecological learning. After a semester of on-farm learning, one student reflected, "I changed my attitude toward education. No longer was I there to check off a box so I

could get somewhere I actually wanted to be. I was there to be present and observe what was happening around me." While for this student, the process of expanding their conceptualization of education entailed intimate connection with place, for others the process was more fraught. One student recalled,

> Heading into this agroecology class, I was so excited to learn more interesting facts— what plants are best intercropped with one another? How do growers control pests ecologically? Instead, I was met with nebulous theory, philosophy, and paradigm, which actively worked to undo my thorough grasp of the world.

Transdisciplinary learning may require students to unlearn in order to learn, and this can be a disorienting and uncomfortable process.

Transdisciplinary learning requires students to reflectively make sense of complex experiences and diverse knowledges, and to integrate this learning with past experiences and personal values or beliefs. Students demonstrated critical reflection in both explicit and implicit ways. For example, one student continually related course content back to where they grew up, noting that prior to the course, "[their] own reflections have always been focused in looking at alternatives to corn and soybean that can be just as profitable or just as pragmatic to implement." In reflecting on course content, however, they shifted their perception of agrifood systems in their home country. Another student similarly shared, "several of the things we studied I connected with my previous experiences, creating both nuance and a deeper knowledge."

Reflecting on their experiences and learning expanded students' perception of valid knowledge beyond the Western, academic delimitation. Course pedagogy was designed to support epistemological plurality, with students learning from farmers and being exposed to diverse perspectives and knowledge sources in assigned materials. Student reflections demonstrated how the diversity of course content and pedagogies interacted to align the course with agroecological principles of epistemic plurality: "I was intrigued by this term [*diálogo de saberes*] when I first heard it in Ernesto's lecture, but it was not fully illustrated for me until I witnessed [our partner farm] carrying it out." In this example, a student understands the concept of *diálogo de saberes* ("dialogue of knowledges") by contextualizing it within their on-farm experiences. At a different farm, a student similarly reflected,

> The class was an illuminating example of how different ways of knowing can interact and collaborate. For example, while we conducted soil tests with standardized instruments, [our partner farmer] explained that [they] wear sandals in order to feel the textures, humidity, the slope and other physical factors of the soil.

Through the integration of lectures, discussions, reflections, soil sampling, PAR, and experiential learning on farms, students are exposed to multiple ways of doing, learning, and knowing agroecology.

## 1.5 Discussion

Our evaluation reveal that the Advanced Agroecology course has evolved towards a more inclusive pedagogical approach that aligns with our definition of transformative agroecology and effectively facilitates transformational learning (Figure 1).

### 1.5.1 Lessons Learned from Ongoing Curricular Review

Our analysis of course content demonstrated the importance of ongoing review and a willingness to update pedagogical techniques over time. In our course, changes to course content and assignments promoted greater student agency. This aligns with broader efforts to cultivate more inclusive and transdisciplinary pedagogies that do not maintain a dominant emphasis on scholarly research and Western, scientific knowledge (Quaye and Harper, 2007; Posselt et al., 2019). Highlighting diverse knowledge sources and supporting varied learning styles also enable dialogue across multiple ways of knowing (Anderson and Anderson, 2020) and reflect the turn towards more transdisciplinary and holistic framings of agroecology (Mason et al., 2020).

Expanded opportunities for student agency complemented the increasingly diverse set of course materials. Encouraging student agency in course design contributes to a more participatory approach to agroecology education. This aligns with both a core tenet of transformative agroecology and with calls to expand student roles in developing agroecology education (Code, 2017; Francis et al., 2016; Lieblein et al., 2012). We see evidence of the efficacy of this participatory approach to agroecology education in the MSC reflections, in which student empowerment emerged as a forceful theme. For students accustomed to traditional Western higher education, however, the shift to a more

student-centered learning process may be inherently uncomfortable (hooks, 1994; Lieblein et al., 2012; Jordan et al., 2014; Francis et al., 2020). The potential for student frustration and discomfort when presented with greater agency in their own learning process indicates a need to build more resources and time into curricula to navigate these challenges.

PAR projects require more extensive and deeper use of reflexive practice within the course, encouraging students to reflect both in the classroom and as part of the PAR process. In their farm teams, students must navigate the inevitable unexpected bumps of participatory, applied research on working farms. Integrating reflection, research, and on-farm actions, PAR may be a way of simultaneously enabling transformative student learning and leveraging university education as a site of AE transformation towards equitable agrifood systems. This could be explored as a reinterpretation of the dual ladder approach (Francis et al., 2016) in which individual student learning occurs concurrently alongside broader, collective learning that transgresses traditional educational boundaries. Despite the challenges of integrating long-term research and undergraduate education, our course evaluation indicates that PAR holds unique promise as a pedagogical approach for transformative agroecology education.

Introducing multiple changes in course content and pedagogy would not be possible without the simultaneous shift to a teaching team model. The teaching team model diffuses the increased workload required to implement context-based and student-centered pedagogies while also bringing multiple perspectives and skillsets to cultivate a

participatory and transdisciplinary learning environment. The teaching team model also provides instructors with the community support needed to navigate the many institutional roadblocks to implementing innovative pedagogies within the confines of a neoliberal university context (Anderson and McLachlan, 2016; Classens et al., 2021).

### 1.5.2 Participatory Pedagogy is Powerful

Students' appreciation of experiential learning on farms coheres with scholarship advocating for contextual, place-based learning within agroecology education (David and Bell, 2018; Porter et al., 2015; Code, 2017; Fernández et al., 2020). Students' reports of integrating experiential and abstract learning are particularly important in addressing the ontological reversal that defines much of the theory-centric pedagogy within institutions of higher education. Francis et al. (2016) argue that a phenomenological approach to agroecology education is necessary to resituate lifeworld phenomena as the foundation for theoretical, model-based, or conceptual understanding. Considered in this context, experiential learning may support transformative learning by shifting students' perceptions of both learning processes and the validity of lived experience as a foundational source of knowledge (Francis et al., 2016). Experiential learning is intrinsically tied to transdisciplinarity (Francis et al., 2013), which further suggests transformative agroecology learning.

In the classroom, SLDs and collaboration within farm teams facilitated participatory learning, which is a core component of transformative agroecology education. Participatory pedagogies engage students as both learners *and* teachers,

contributing to an educational space that works to dismantle hierarchies between knowers and learners (Code, 2017; Lieblein et al., 2012). In this sense, participatory pedagogies that integrate instructor-led and student-led lessons seem vital for transformative agroecology education.

As we suspected, course evaluations did not enable us to definitively answer our guiding question regarding the efficacy of course pedagogy for transformative learning. Nevertheless, student evaluations did provide insight into how students experienced course pedagogy. This enabled us to infer which pedagogies and student experiences may support specific aspects of transformative agroecology learning. Course evaluations also identified aspects of course pedagogy that are particularly frustrating, overwhelming, or unclear for students. This highlights opportunities for providing additional support for students to enable transformative learning from within a zone of discomfort (Galt et al., 2013b). In this way, despite deficiencies, course evaluations can be a meaningful component of both iterative course design and instructor praxis.

### 1.5.3 MSC Reflections Capture Transformative Learning

Integrated in the course for the first time in 2020, MSC reflections proved to be a valuable method for identifying and assessing transformative learning. Thematic analysis identified 5 dimensions of transformative learning: student empowerment, relationship-building, social justice learning, systems thinking, and transdisciplinary learning. Below we explore the connections between course pedagogy and these dimensions of

transformative learning. We also situate these connections in the broader context of agroecology and SFS education.

Empowerment theory (Gutierrez, 1995) suggests that by changing students' attitudes and beliefs, transformative learning may facilitate or encourage students to participate in collective action for social change (Allen, 2008). In analyzing students' MSC reflections, many linked an increased sense of empowerment and self-efficacy to a new commitment to engaging in social movements. In other instances, students connected a sense of empowerment to their future careers, expressing expanded potential to engage in professional endeavors thanks to course learning. Comparing these learning outcomes suggest there may be different layers of transformative learning. Valley et al. (2018) discuss three levels of impact in proposing their SFSESP. Our course evaluation suggests that further research is needed to explore when and how deeper transformative learning occurs that facilitates student empowerment to engage in collective action and social movements committed to agrifood systems transformation.

Engagement with issues related to social justice constituted a distinct dimension of transformative learning. Many students reflected that course learning prompted them to engage with social movements and grassroots organizing. While some students were drawn to agrifood systems issues and movements specifically, others translated their course learning and experiences into broader engagement with justice and equity, such as the movement for Black lives. A smaller handful of students discussed how course content on food sovereignty invoked a sense of responsibility to engage in equity-

oriented work within future professional endeavors in food systems. This demonstrates that students in agroecology and SFS courses may apply learning in both professional and non-professional capacities, such as engagement with social movements. The potential for students to apply social justice learning beyond professional contexts is underexplored in recent scholarship on the intersection of SFSE and equity. Like SFSE in general, an equity competency model recently proposed by Valley et al. (2021) is designed to "support the development of future professionals capable of dismantling inequity in the food system". Although Valley et al. (2021) identify profoundly important educational goals and pedagogies related to equity and justice within agroecology and SFS education, our analysis suggests that the professional framing of their equity competency model may limit or obscure important non-professional learning outcomes. Moving beyond a primarily professional framing to consider the broader impacts of agroecology and food systems education aligns with a whole systems approach. Systems thinking is frequently cited as vital for learning about agrifood systems (Code, 2017; Valley et al., 2018; Francis, 2020).

Thematic analysis of students' MSC reflections validates these assertions, identifying systems thinking as a key dimension of transformative learning. In attempting to further understand the role of systems thinking for transformative agroecology education, we consider Code's (2017) contention that systems thinking is an insufficient paradigm for developing students' ability to engage with the full complexity of agroecosystems. Code (2017) cites Bortoft's (1996) critique of systems science, which

highlights the paradox of breaking down living systems into artificially distinct elements in order to identify linkages. In lieu of this approach, Code (2017) draws on Schumacher's (1995) proposal for a scientific paradigm of "life in its wholeness". Yet, our identification of systems thinking within students' MSC reflections aligns with this concept of a science of wholeness, suggesting that systems thinking may carry multiple meanings within agroecology and SFS education. Clarifying what is meant by 'systems thinking' is imperative for developing pedagogies conducive to transformative learning.

The critique of systems thinking aligns with our findings that relationship-building is an important dimension of transformative agroecology learning. Based on thematic analysis of MSC reflections, we propose that relationship-building is a vital complement for systems thinking in agroecology education. Many students reflected on the impact that relationships had on their learning about agroecosystems. Students emphasized that the relationships they cultivated with peers and farmers during the course demonstrated the power of horizontal learning and co-production of knowledge. Based on our course evaluation, the role of relationship-building and horizontal learning as transformative pedagogies within higher education institutions warrants further exploration.

Relationship-building also enabled and reinforced transdisciplinary learning, the final dimension of transformative learning that we identified. Student reflections explored how cultivating relationships with peers and farmers transformed their perception of when, where, how, and with whom teaching and learning occur.

Experiential learning on farms transgressed traditional disciplinary boundaries and provided a context for students to experience the value and necessity of integrating multiple ways of knowing within agroecosystems. Opportunities for critical reflection enabled students to integrate transdisciplinary learning within the course with their previous experiences, values, and beliefs.

Critical reflection is consistently identified as a key pedagogical tool for agroecology education (e.g., Francis et al., 2016; Runck et al., 2015; Code, 2017). In the most recent iteration of our advanced agroecology course, we expanded the role of reflection via the partial application of MSC methodology. The MSC reflection proved to be a valuable tool for both transformative learning and holistic course evaluation. Reflections provided rich data on student learning outcomes and enabled critical assessment of how well course materials and pedagogies supported transformative learning. Our experience adapting the MSC methodology echoes prior research in proposing MSC techniques as valuable evaluative tools in educational contexts (Choy et al., 2013). A more complete application of the method would engage students in participatory evaluation of the MSC reflections to collectively identify the MSC experienced by the class as a whole. This evaluative strategy would align with recent calls to redefine the role of students within agroecology and SFS education (Code, 2017). MSC methods also align with a more participatory agroecology pedagogy promoted by scholar-educators in Norway (Lieblein et al., 2012). As a reflective, relational, and

participatory method of evaluation, MSC techniques are particularly well-suited to identifying and supporting transformative learning (Choy et al., 2013; Acton, 2019).

We concur with Meek and Tarlau (2016) that agroecology and sustainable food systems education can and should be leveraged to transform agrifood systems towards justice and ecological viability. Beyond training a workforce capable of engaging with agrifood systems as they currently exist, education provides a venue for forming individuals capable of supporting such transformations. This is evident in the concept of *formación* that guides popular education initiatives led by social movements in Latin America. *Formación* corresponds to training or educating towards a transformative purpose (McCune et al., 2017a). Formal agroecology and sustainable food systems education in the U.S. can serve a similar role, providing liminal spaces that expose students to alternatives to the oppressive and extractive systems in which they are embedded. In this way, agroecology courses may constitute a 'domain of transformation' (Anderson et al., 2019a) where agroecology overlaps and interfaces with the dominant regime - in this case, neoliberal institutions and traditional 'knowledge transfer' approaches to agricultural education. In domains of transformation, there are simultaneously factors that enable *and* disable transformative processes; the reality of the latter does not inherently negate the potential of the former (*ibid*). The tension of teaching transformative agroecology from within the academy may also be clarified through the lens of non-reformist reforms, which prefigure transformation via smaller shifts that cumulatively enable broader change (Gorz, 1967). Viewed in this way, courses that

facilitate transformative learning may cultivate young adults who, at best, are prepared to stand in solidarity with collective struggles for transforming agrifood systems towards justice and equity, and who, at a minimum, are more aware of -and thus more open to- alternatives to the dominant, industrial agrifood system. By contributing to a shift in whose knowledge and expertise are valued, transformative agroecology education also contributes to thick legitimacy for agroecology more broadly (Montenegro de wit et al., 2016).

### 1.5.4 Additional Considerations

This paper evaluates an agroecology course taught in the Northeastern U.S. and is intended to assess and improve student learning. The goal of sharing evaluative results, processes, and insights is to contribute to a broader movement of scholar-educators committed to iteratively and collaboratively developing transformative pedagogies within agroecology and sustainable food systems education (Galt et al., 2013b). To that end, we find it necessary to identify unique factors that call for further consideration and evaluation, both within our own course and in the design and evaluation of other courses. First, the integration of the course with a long-term PAR project conducted in collaboration with multiple farmer partners results in a diversity of students' on-farm learning experiences. Over the years, course instructors intentionally engaged a diversity of farmers and farm types to expose students to the multiple manifestations of agroecological practice. This also provided an opportunity for peer-to-peer learning as students were able to share their experiences with students assigned to other farms. In the

context of evaluating transformative learning, however, the range of students' on-farm experiences may impact student learning. In future iterations of course evaluation, assessing student learning grouped by farm teams may provide insight into whether some farm experiences are more conducive to certain types of learning.

Second, a substantial portion of our evaluation was based on MSC reflections submitted by the most recent cohort of students who took the course in fall semester 2020. The course took place as the world was weathering a deadly pandemic and the U.S. was experiencing widespread protests of racial injustice. Amidst this extraordinary backdrop, it is possible that students were more open to certain kinds of learning. For example, multiple students protested police violence and participated in the movement for Black lives. These experiences likely influenced student learning, contextualizing course materials and pedagogies designed to encourage collective action for social justice. The influence of current events on students' lives and learning highlights the importance of reflexive practice for situating learning and learners within the world beyond the classroom.

Finally, the questions guiding our course evaluation focused explicitly on identifying and assessing transformative learning. This enabled us to deeply explore the alignment of both course pedagogy and student learning with a transformative approach to agroecology. At the same time, however, we did not dive deeply into the full spectrum of student experiences. Future work could integrate assessments of transformative learning within a broader exploration of student experience and outcomes.

## 1.6 Conclusion

In evaluating transformative learning, we observed and reflected on the ways that agroecology education transcends professional preparation to shift students' perceptions of agrifood systems and their place within them. Yet U.S.-based agroecology and food systems scholarship tends to focus on cultivating students as food systems professionals. The reasons for this are multifaceted and complex, and hence difficult to resolve. They include western scientific epistemologies that reject transformation as part of their mission, tension with the neoliberal bent of many universities, and the reluctance of instructors to engage with what could be perceived as political or activist content. Our course, which applies many of the same pedagogical innovations currently leveraged for professionalization, suggests that transformative learning is occurring. This is particularly important in the context of undergraduate education. Many undergraduate students may not go on to work as professionals within food systems, and those who do may need different skills and competencies in the future than those currently emphasized in agroecology and sustainable food systems courses and programs. Expanding educational goals and evaluative methods will enable scholar-educators to identify and unpack the deeper impacts of innovative food systems education currently practiced in multiple pockets throughout the U.S.

Cycles of critical, collective reflection have informed our conceptualization of the purpose of agroecology education which, in turn, informs our pedagogical approach. We perceive education as a critical component of transformative agroecology more broadly.

We therefore seek to align course pedagogy and student learning with the tenets of transformative agroecology as we understand it: transdisciplinary, participatory, action-oriented, and political. A teaching team model serves as the foundation supporting our pedagogical approach, which is built around a framework of experiential learning on farms. As a foundation for the rest of the course, the identities and structure of the teaching team matter greatly. Including farmers and graduate students models a more inclusive and transdisciplinary approach that contributes to dismantling traditional hierarchies of knowledge and expertise. Future work should explore how teaching teams form, interact, and mediate pedagogy and student learning.

Innovations in pedagogy require synergistic innovations in evaluative methods. Traditional course evaluations administered by colleges and universities do not provide opportunities for in-depth, critical reflection on individuals' learning outcomes (Choy et al., 2013). To address the deficiency of standard course evaluations, we complemented 10 years of student comments on university evaluations with most significant change (MSC) reflections. MSC methods are uniquely capable of identifying unintended, complex, and diverse outcomes of a program or intervention and provide a means of qualifying and dignifying anecdotal evidence of transformative impacts (Dart and Davies, 2003). MSC holds potential as an evaluative method aligned with transformative agroecological goals to democratize knowledge and dismantle top-down educational approaches that impose predetermined evaluative metrics.

Our analysis of student MSC reflections indicates that agroecology education can contribute to developing students' political subjectivities as actors embedded within agrifood systems. This suggests the need to critically explore the purpose(s) of agroecology and SFS education beyond professionalization. We propose that a key goal of agroecology education is one of ontologically re-embedding students within agroecosystems and cultivating their identities as more-than-consumers (Anderson et al., 2019b). Emphasizing an ontology of interconnectedness (Vargas Roncancio et al., 2019) will further enable agroecology education to explore power and responsibility beyond the false binary of producers and consumers and will encourage students to examine the roles of relationships, solidarity, and sovereignty movements within food systems.

We contend that agroecology education can be an important site for movement building. As noted above, students may develop expanded political consciousness and a sense of self-efficacy that spur engagement with struggles to realize socially and ecologically sustainable food systems. We also support and expand on Galt et al.'s (2013b) proposal for a movement of sustainable food systems educators. Our case study demonstrates the importance of the teaching team model as a foundation for implementing pedagogies for transformative learning. Collaboration and solidarity amongst instructors implementing innovative pedagogies may function as a compass in navigating the many challenges to designing and implementing courses and programs capable of contributing to broader processes of agroecological transformation.

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# CHAPTER 2: USING CO-CREATED MENTAL MODELS TO COMPARE VERMONT FARMERS' & EXTENSION PROFESSIONALS' UNDERSTANDING OF SOIL HEALTH

## 2.1 Introduction

Soil health is increasingly identified as a key strategy for addressing multiple social-ecological crises (Blum, 2005; Lehmann et al., 2021). In particular, there is a growing focus on the connections between soil health and climate change (Lal, 2004; Lamb et al., 2016; McNunn et al., 2018). Agricultural management practices can drive climate change via increased greenhouse gas emissions and disrupted nutrient cycling (Lal, 2012; Paustian et al., 2016). Simultaneously, degraded soils are more susceptible to the adverse impacts of climate change (Moebius-Clune et al., 2016) with attendant consequences for farmer livelihoods (Hatfield & Brown, 2014).

Despite the social implications of soil health outcomes and the socially embedded contexts in which soil management occurs, soil health research continues to focus primarily on the biophysical dimensions of soil processes (e.g., Stewart et al., 2018; Karlen et al., 2019). This focus is then translated into prescriptive (e.g., cover cropping) and proscriptive (e.g., no-till) on-farm practices for soil health. While this work is vitally important, an exclusive focus on how on-farm practices impact the physical, chemical, and biological properties of agricultural soils fails to address the social factors that mediate farmers' management decisions and attendant soil health outcomes (Bunemann et al., 2018).

Agroecological frameworks offer one possible avenue for broadening soil health research to simultaneously consider the social and ecological factors that influence soil management and outcomes. Within agroecology, there is growing acknowledgement that the socio-political contexts of agroecosystems are as important as practices and scientific inquiry in transitions towards sustainability (González de Molina, 2013; Anderson et al., 2019). Rather than advocating for a 'recipe-based' or prescriptive approach to agriculture, agroecology centers general principles for realizing socially just and ecologically resilient agrifood systems (Wezel et al., 2020).

There are many possible benefits to considering soil health research and efforts through the lens of agroecology. First, principles-based frameworks enable multiple pathways for achieving shared goals around soil health. This is important given the diverse agricultural contexts in which farmers make soil management decisions (Montanarella et al., 2016). Second, in explicitly honoring multiple ways of knowing, agroecology provides a framework for integrating diverse types of knowledge to work towards goals shared by diverse actors (Coolsaet, 2016). This is particularly important in the context of soil health, as research indicates that different actors hold different types of knowledge related to soil health (Ingram et al., 2010; Huynh et al., 2020) and may therefore conceptualize or approach soil health in diverse ways (Lobry de Bruyn & Andrews, 2016; Prager & Curfs, 2016; Winstone et al., 2019; Wade et al. 2021; Mann et al., 2021).

To explore the potential advantages of considering soil health through the lens of agroecology, I consider current efforts to prioritize and promote soil health in Vermont. Specifically, I compare how farmers and Extension professionals understand and assess soil health. In exploring possible meanings and modes of assessing soil health, I also explore the complex and intersecting factors that mediate farmers' soil management decisions. The research questions that informed this research are: (1) How do understandings of soil health differ between farmers and Extension professionals? (2) How do understandings of soil health differ by farm type? (3) How do farmers and Extension professionals assess soil health? (4) What factors enable and constrain farmers' efforts to promote soil health across diverse contexts and approaches to soil health?

To answer these questions, I use mental models of soil health to visualize the complex web of social-ecological factors that (1) constitute diverse conceptualizations of soil health, (2) inform modes of assessing soil health, and (3) mediate individuals' capacity to promote soil health on Vermont farms. Mental models are effective tools for visualizing the factors that inform farmers' decision-making (Moon et al., 2019; Van Hulst et al., 2020) and have been useful in prior research exploring soil health (Lobry de Bruyn & Andrews 2016; Prager & Curfs 2016).

My findings suggest that conceptualizations of soil health vary by farm type, and that social factors play a significant role in not only how farmers and Extension professionals conceptualize soil health, but also in enabling or constraining collaborative efforts to promote soil health. Co-creating mental models and engaging farmers in

participatory analysis of these models proved a valuable way to parse the full social-ecological complexity of soil health. I contend that processes clarifying what individuals understand 'soil health' to mean are key for enabling collaboration between diverse actors with diverse types of knowledge and, therefore, may be a valuable strategy for improving soil health outcomes. The suitability of mental models for integrating diverse soil health knowledges and supporting collaborations between farmers and Extension professionals will be explored in forthcoming publications led by R. Maden of the University of Vermont Extension services.

## 2.2 Literature Review

Multiple review articles in the past decade have attempted to define the term 'soil health' (e.g., Karlen & Rice, 2015; Karlen et al., 2019), which emerged from related concepts including soil fertility and soil quality. While soil fertility narrowly considers soil in the context of crop production (Patzel et al., 2000), soil quality broadly considers soil functions relevant for agriculture and the provisioning of ecosystem services to humans (Bunemann et al., 2018). Lehmann et al. (2021) provide a valuable overview of the evolution and relationship of these related terms. They emphasize that soil health situates soil function within wider ecosystem and planetary health contexts (Doran & Zeiss, 2000; Trivedi et al., 2016) and includes a greater emphasis on the role of soil biological processes (Harris & Bezdicek, 1994; Pankhurst et al., 1997; Lehman & Kleber, 2015). Under this broad umbrella, the chemical, physical, and biological properties of soil constitute the three interrelated 'dimensions' of soil health.

The concept of soil health co-emerged with increasing recognition of many vital soil functions beyond agricultural productivity (Kibblewhite et al., 2008). Reflecting this evolution, the Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture now defines soil health as 'the continued capacity of a soil to function as a vital living ecosystem that sustains plants, animals, and humans' (USDA NRCS, 2012). This widely adopted definition reflects a complex conceptualization of soil health. Recent research trends reflect this conceptual broadening: whereas soil research through the 1980s focused on the role of particular soil properties and their links to crop yields and management, current research centers on the multifunctionality of agricultural soils (Karlen et al., 2019).

The definition of soil multifunctionality, however, remains vague (Creamer et al., 2022) and the concept has largely maintained an emphasis on the biophysical processes that inform functional outcomes. This is evident in recent soil health research, which primarily maintains a narrow focus on identifying measurable properties of soil function to serve as metrics of soil health. Since the 1990s, an integral component of soil health research has been reaching consensus on what soil properties to measure and how to interpret selected metrics (Karlen et al., 2019). While soil quality was traditionally determined by assessing productivity (Bouma et al., 2017), this proved insufficient for assessing the full spectrum of soil functions, including critical issues such as water quality and plant, animal, and human health (Larson & Pierce, 1991; Doran & Parkin, 1994; Romig et al., 1995). Researchers have therefore focused on identifying metrics

capable of quantifying the relationships between management practices, soil health, and desired outcomes (Stewart et al., 2018; Doran et al., 2018).

While important, identifying and measuring biophysical metrics of soil health may neglect important factors that impact soil health. Soil management decisions are made by farmers in their unique local contexts (Bagnall et al., 2020). An exclusive focus on quantifiable metrics may, therefore, miss key opportunities to support farmer decision making, with attendant consequences for soil health outcomes (Wood & Blankinship, 2022). For example, despite the scientific focus on quantitative measurements related to soil physical, chemical, and biological properties (Gutknecht et al., 2022), research indicates that farmers tend to rely most heavily on qualitative, observational assessments of soil health (Doran & Parkin, 1994; Romig et al., 1995; Bagnall et al., 2020). Differing preferences around soil health indicators can result in divergent perceptions of soil health outcomes (Barrios et al., 2006; Wade et al. 2021).

Soil tests are often framed as a tool that can complement farmers' observational assessments of soil health and inform on-farm management decisions (Andrews et al., 2003). Basic soil testing focuses on soil organic matter and soil chemistry; specifically, macro and micronutrients and pH. While such data has the potential to complement farmers' observational knowledge, basic soil testing remains underutilized by many farmers, who cite cost, time for collection, and ability to interpret results as roadblocks to utilizing soil testing to inform management decisions (Lobry de Bruyn, 2019). There is

also a question as to whether soil testing aligns with how farmers think about soil health (O'Neill et al., 2021).

Comprehensive soil health tests include biological and physical indicators (e.g., soil respiration, aggregate stability) and aim to address the disconnect identified between farmer perceptions of soil function and basic soil tests (Fine et al., 2017). Soil health tests offer a more holistic assessment that may align more closely with farmers' observational assessments of soil health (O'Neill et al., 2021). Since the early 2000s, methods for analyzing soils have expanded allowing for more comprehensive assessments such as Cornell's Comprehensive Assessment of Soil Health (CASH) test (Neher et al., 2022). Recent research finds that indicators used in CASH tests are sensitive to management practices, indicating their suitability for guiding farmers' management decisions (van Es & Karlen, 2019). Yet, the extent to which soil health tests are accessible and legible for farmers, and the mechanisms for how such tests influence farmers' management decisions, remain unclear (Wood & Blankinship, 2022).

Amidst this complex information landscape, farmers rely on multiple sources for information regarding soil health. In the US context, Extension services based out of Land Grant Universities historically served as a primary information source, informing farmers' management decisions through top-down 'knowledge transfers' (Carr & Wilkinson, 2005; Hoffman et al., 2015). This strategy, however, stratifies power and knowledge in such a way that research is likely to be disconnected from farmer needs, experience, and knowledge (Warner, 2008). Wick et al. (2019) propose a more

collaborative approach wherein Extension functions as a boundary organization supporting wider knowledge networks. This proposed shift complements findings that suggest farmers increasingly access knowledge through complex social networks (Lubell et al., 2014). Yet, actors within knowledge networks may hold diverse understandings of soil health, which may impede collaborative efforts toward soil health goals (Wade et al., 2021). For example, diverse understandings of soil health may result in conflicting expectations or assessments of soil health (Mann et al. 2020), which in turn may erode trust between actors. Trust plays a key role in whether farmers accept knowledge claims (Carolan, 2006) and adopt recommended practices for promoting soil health (Rust et al., 2021). It is therefore imperative to frame information related to soil health in ways that resonate with the particular understandings of a given audience (Wade et al., 2021). Strategies for navigating diverse types of knowledge are also identified as key for facilitating participatory research and co-creation of knowledge related to agroecology (Utter et al., 2021).

In considering the extant literature on soil health, I identify a clear need to (1) deepen understanding of how social factors mediate farmers' soil management decisions and soil health outcomes; (2) identify processes to clarify diverse ways of understanding and assessing soil health, and (3) facilitate collaborative efforts to promote soil health. I situate this research amidst these gaps.

## 2.3 Methods

To identify how farmers and Extensional professionals conceptualize and assess soil health, I analyzed co-created mental models of soil health. Mental models refer to the cognitive frameworks used by actors to understand or make sense of the world (Jones et al., 2011). These visual representations of complex concepts and relationships are well-suited to research that attempts to identify and analyze the underlying social systems and structures that mediate ecological outcomes (Moon et al., 2019; Jones et al., 2011; van Hulst et al., 2020; Prager & Curfs, 2016). While there is no standard way to construct or analyze mental models, common methods include interviews, participant observation, document analysis, and focus groups (Jones et al., 2011).

Van Hulst et al. (2020) note, however, that common methods for constructing mental models prioritize expert knowledge over farmer knowledge. Typically, researchers conduct elicitation interviews and produce mental models after the fact, based on their own expert interpretation of interview data. This undermines processes of knowledge co-construction and social learning, which have been identified as crucial for effective soil health management strategies (Schneider et al., 2009; Bennett & Cattle, 2013). To better enable collaboration between farmers and other stakeholders, Van Hulst et al. (2020) propose an innovative approach to co-constructing mental models with farmers during elicitation interviews using visual displays and concept sorting.

### 2.3.1 Data Collection

Following methods outlined by Van Hulst et al. (2020), I conducted semi-structured elicitation interviews with 34 farmers and 7 extension professionals between

January and March 2022. R. Maden of UVM Extension and A. Gerlicz, a graduate research assistant, assisted with conducting interviews. To assess how conceptualizations and assessment of soil health vary across farm type, I utilized purposive sampling (Tongco, 2007) to interview farmers managing vegetable & berry; dairy; and non-dairy livestock operations. These farm types employ diverse practices and face unique social and environmental constraints and, accordingly, may have different ways of understanding, assessing, and managing soils. Within these farm types, I also intentionally recruited both organic and non-organic farmers as previous research has found differences across organic and conventional farmers' understanding and assessment of soil health (Mann et al., 2021). Maximum variation sampling (Collins, 2010), a form of purposive sampling, further ensured that participants represented a variety of farm sizes, farmer identities, and geographic locations throughout the state. Key informants within Vermont's agricultural networks helped identify potential participants, who the research team then contacted via email.

Due to the Covid-19 pandemic, interviews were conducted virtually. These semi-structured elicitation interviews centered on participants' personal understanding of the term 'soil health' and included discussions of how participants manage for and assess soil health. Interview protocol differed slightly to accommodate for the unique contexts of farmers and extension professionals. Protocols, which include guiding questions and prompts, are available in Appendix A.

To enable visual displays and concept sorting during virtual interviews, the research team used the web-based software Lucidspark, which enabled real-time construction of mental models of soil health with interviewees. The process of creating mental models during elicitation interviews enabled identification of the full suite of social and ecological factors that inform participants' diverse ways of understanding, assessing, and managing for soil health. Mental models created during interviews were cleaned up by the research team and shared back with interviewees for additional feedback (Appendix A, Figure 1).

The research team then engaged in a process of grouping mental models by stakeholder group and farm type. Hoffman et al. (2014) note that grouped mental models can examine "collective knowledge and understanding of a particular domain held by a specific population of individuals". Grouped mental models also control for personal variability by highlighting important concepts or elements that are commonly identified by individuals in diverse contexts. We created seven grouped mental models, including one for extension professionals and six by farm type (Appendix A, Figures 2-8). There are multiple methods for creating grouped mental models, and appropriate method(s) may vary depending on the research questions and aims.

To get a sense for how approaches to soil health differ across Extension professionals and farm types, we created grouped mental models that included only concepts and practices mentioned by a majority (>/= 50%) of individuals in each group. This process involved iterative comparisons using visual displays and arrays as well as

memoing, which enabled identification of common concepts for which individuals may have used diverse terms. Grouped mental models were shared with the individuals in each group. The research team then conducted focus groups with all six farm type groups to elicit feedback on their group's mental model and how it compared to the grouped mental model of extension professionals (Appendix A, Figure 9). In this way, focus groups provided an opportunity for participatory analysis of grouped mental models, thereby building on the participatory process for creating individual mental models proposed by van Hulst et al. (2020). As this research focused on identifying diverse approaches to soil health and how this diversity impacts farmers' efforts to promote soil health, focus groups were only conducted with farmer groups and not extension professionals. Protocols for both elicitation interviews and focus groups were approved by the University of Vermont's Institutional Review Board and are available in Appendix A.

Farmers were offered hourly compensation for participating in both the individual interview and focus group. This acknowledges the expertise of farmers, reduces the burden of participating in research, and attempts to recalibrate extractive research norms in which farmers are asked to donate their time and experience.

### 2.3.2 Data Analysis

Interviews and focus groups were recorded, transcribed, and analyzed using NVivo software. Braun & Clarke's (2006) framework for reflexive thematic analysis guided the analytical process. Thematic analysis entails identifying themes within

qualitative data (Maguire & Delahunt 2017). A reflexive approach to thematic analysis involves a more iterative process of developing themes from codes to identify "patterns of shared meaning underpinned by a central organizing concept" (Clarke & Braun, 2020).

Interview and focus group transcripts were read through and then open coded (Braun & Clarke, 2006; Maguire & Delahunt, 2017) using an inductive approach (Patton, 1980; Clarke & Braun, 2015). During the initial open coding process, individual and grouped mental models of soil health provided sensitizing concepts (Bowen, 2006). Sensitizing concepts derived from the mental models acted as interpretive devices, drawing attention to particular aspects of the interview data without imposing pre-conceived analytic categories. Initial codes were refined, grouped into tentative analytic categories, and iteratively compared across data sources to identify important themes (Braun & Clarke, 2020). Visual displays and arrays (Creswell & Clark, 2017) and memoing (Charmaz, 2005) supported thematic analysis by enabling triangulation between elicitation interview transcript codes, individual and grouped mental models, and focus group transcript codes. Participatory analysis of grouped mental models that occurred during focus groups supported thematic analysis in that participants had the opportunity to surface the topics they deemed most vital to their understanding of, assessment of, and ability to prioritize soil health.

## 2.4 Results

In this section, I begin by identifying how farmers conceptualize soil health and how this compares across farm types and between farmers and Extension professionals. I

identify three main themes that encompass how farmers and Extension professionals discussed soil health: (1) as a holistic concept, (2) in a context-dependent way, and (3) using the Western scientific paradigm centered on chemical, biological and physical soil properties. Following analysis of the meanings of soil health, I explore how farmers and Extension professionals assess agricultural soils. Finally, I explore the factors that enable and constrain farmers in prioritizing or implementing practices for soil health. I focus on enabling and constraining factors that were consistent across farm types, as these seem to hold the greatest potential for supporting farmers in managing soil health across a wide range of contexts.

### 2.4.1 Holistic Understandings of Soil Health

Of the many ways that farmers and extension professionals spoke about soil health, holistic framings were both common and complex. Soil health as a holistic concept is difficult to define and, as a result, comprises multiple sub-themes. Many farmers and extension professionals identified soil health as a foundation upon which farm businesses and agroecosystems are built. This concept was often expressed in a direct and economical way; as one livestock farmer stated, “the soil is the basic generator. That interaction between sun, grass and soil is basically the foundation for any money that I make here.” Others expressed a foundational understanding of soil health in more expansive terms. For example, an organic livestock farmer stated,

> soil health is essentially the foundation of everything that we do here. I think it's the life force of our ecosystems and our planet, that it's filtering air and water and supporting life above and below, that the cycles of most of the things we're involved with as farmers, production of milk or something, is really this elaborate

> microbiology of what's happening within the soil and in the [animal's] rumen and how those two things relate and how nutrients are cycled through that system.

In this quote, we see how conceptualizing soil health as foundational may lead farmers to connect soil health to broader agroecosystems, food systems, and planetary systems.

Explicit connections to social-ecological forces beyond the physical soil substrate was another way in which farmers and Extension professionals conveyed a holistic understanding of soil health. Some conveyed a more biophysical emphasis in managing their soils holistically, such as one organic dairy farmer who explained, "I have a pyramid on my barn of my priorities, and on the baseline is soil health. Plant health happens after that, animal health after that, and then human health." Many interviewees similarly emphasized (agro)ecological relationships between soils, plants, and animals. Others, however, connected soil health to mediating socio-political factors. One livestock farmer emphasized the need to ask questions regarding how soil health connects to farm viability and equity:

> What creates healthy soil is, 'Do you live where you farm? What are your resources? Are you getting there when you barely can because your farm business can't really help you afford to live a regular life or because you're trying to fit too many things in?' Part of soil health is also the equity component of what do people have to put into [soil health] and what knowledge do they have about it?

Holistic conceptualizations of soil health often included socio-economic factors. Within these framings, soil health could be neither conceptualized nor achieved without considering social factors such as on-farm housing, just livelihoods, and policy processes.

Finally, some individuals expressed a holistic understanding of soil health that centered interdependent processes rather than an outcome. An organic dairy farmer asserted, “You have to constantly be tinkering. You're never done. There's no finish. It's constant. It's a constant cycle that you have to be always tuning into and making slight adjustments.” The notion of soil health as an ongoing process linked directly to the inclusion of on-farm management as a component of soil health. In emphasizing that practices are an intrinsic component of soil health, an Extension professional quipped that they could almost determine that "if you're doing these management practices, you probably have good soil health."

#### 2.4.1.1 Holistic Understandings of Soil Health Across Groups

There was a very clear divide in who conceptualized soil health in a holistic way. Extension professionals, organic and non-organic livestock farmers, and organic dairy farmers all primarily viewed soil health through a holistic lens (Table 2.1). Non-organic dairy farmers, as well as both organic and non-organic vegetable farmers, on the other hand, rarely thought of soil health in a holistic way. One possible explanation for this divergence is that the vegetable farms and non-organic dairies represented in the data had less integrated systems and therefore relied on imported inputs to maintain soil fertility. In vegetable production systems, a holistic view of soil health may be difficult to square with the reality of constantly removing vegetal biomass and importing nutrients and organic matter to replenish soils. Somewhat similarly, non-organic dairy farms often lack sufficient land to supply all their own feed and rely on imported feed. With limited

capacity to graze very large herds, non-organic dairies also often rely on synthetic fertilizers to maximize on-farm feed production. Due to heavier reliance on external inputs, such farms may approach soil health in a more chemically oriented or agronomic way.

| | Context dependent | Experiential knowledge | Holistic | W. Scientific | Soil biology | Soil chemistry | Soil structure |
|---|---|---|---|---|---|---|---|
| **Extension** | 22 | 11 | 40 | 19 | 11 | 7 | 5 |
| **Livestock (non-organic)** | 25 | 14 | 48 | 34 | 12 | 6 | 10 |
| **Livestock (organic)** | 10 | 20 | 25 | 30 | 9 | 11 | 8 |
| **Dairy (organic)** | 19 | 13 | 30 | 30 | 10 | 16 | 4 |
| **Dairy (non-organic)** | 9 | 5 | 7 | 37 | 7 | 17 | 11 |
| **Vegetables (organic)** | 29 | 19 | 8 | 56 | 15 | 36 | 12 |
| **Vegetables (non-organic)** | 19 | 8 | 7 | 21 | 9 | 9 | 3 |

Table 2.1 This depicts code counts for conceptualizations of soil health across Extension professionals and farm types. The 'W. Scientific' code is a sum total of the 'soil biology,' 'soil chemistry,' and 'soil structure' codes. 'Soil structure' was used whenever farmers discussed soil physical health, such as observations of water infiltration rates.

The distinction between farm types that did and did not view soil health holistically raises questions around the role of animals in facilitating nutrient cycling and soil health more broadly. Specifically, are farmers with more integrated (or 'closed loop') systems more likely to conceptualize soil health in a holistic way that, in turn, translates into stronger motivations to promote soil health as a component of wider agroecosystem health? Extension professionals, all of whom worked primarily with livestock or dairy farmers, also conceptualized soil health in a holistic way. This further underscores the potential connection between integrated, animal-based agriculture and a holistic view of soil health.

### 2.4.2 Context Dependent

Many farmers and extension professionals understood soil health to be highly context dependent. As one organic dairy farmer stated bluntly, “soil health is absolutely individual to the land that you’re stewarding.” From this perspective, factors such as soil parent material, topography, climate, and social factors all mediated what might constitute soil health in a given context, with attendant implications for management strategies. A livestock farmer similarly noted that because soil health is so context dependent, “what works well in one place isn’t always the same as what works in another place.” Within this framing, both farmers and Extension professionals emphasized the need to align soil management practices with the particularities of a given farm.

Extension professionals were also highly attuned to the variability of what might constitute soil health in various farm contexts. One Extension professional emphasized that “every farm is such a different situation, and every farm has a different set of issues.” The contextual nature of soil health also complicated extension and outreach; one Extension professional explained, “we don’t always know what the outcomes of practices will be because each farm, each system, is different.” For both farmers and Extension agents who viewed soil health in a contextual way, trial and error was an integral part of identifying the moving target of soil health within unique agricultural settings.

#### 2.4.2.1 Contextual Understandings of Soil Health Across Groups

A context dependent conceptualization of soil health was one of the most consistently mentioned conceptual categories across farm types and extension professionals (Table 1). The only outliers were non-organic dairy farmers and organic

livestock farmers. Non-organic dairy farmers spoke of tailoring practices to their unique contexts but did not directly identify soil health as a context-dependent concept. Organic livestock farmers, on the other hand, recounted using deep, place-based knowledge to guide soil management; it is possible that for these farmers, the importance of context was so intrinsic that it did not bear explicit mention.

### 2.4.2 Three Dimensions of Soil Health

Farmers and extension professionals referred most often to the Western scientific definition of soil health as comprising chemical, biological, and physical soil properties. Some interviewees discussed all three dimensions at once or in relation to each other. For example, one organic livestock farmer summarized their understanding of soil health as, "generally, if the physics and the biology are there, the chemistry just takes care of itself." It was, however, more common that people emphasized a particular dimension when discussing their understanding of soil health. In general, interviewees discussed the three Western scientific dimensions of soil health with comparable frequency. Below, I explore how soil chemical, biological, and physical properties informed farmers' and Extension professionals' conceptualization of soil health and the differences in which dimensions were emphasized across farm types.

#### 2.4.2.1 Soil Chemistry

Soil chemical properties include macronutrients, micronutrients, and pH. Many farmers emphasized the role that soil chemistry plays in plant nutrient availability. Soil acidity was of particular interest to nearly all farmers. As one non-organic dairy farmer

emphasized, “an acidic soil ties up our nutrients so that crops can’t get those nutrients” even if soil tests indicate the presence of nutrients in the soil. The vital role that pH and nutrient availability play in soil fertility and plant growth led many farmers to prioritize soil chemical properties. An organic vegetable farmer explained,

> We've really been trying to get the chemical properties up, because when we moved onto this really sandy soil, our soil tests - everything was just rock bottom. I think there've been some issues with that approach… but our soil tests are looking a lot better now than they were.

This farmer exemplifies the connection between soil test results and a conceptualization of soil health that centers soil chemistry. Despite possible issues associated with a narrow focus on chemical properties, this farmer felt encouraged by soil test results and committed to addressing soil chemistry as a primary path to soil health. Due to scientific orthodoxy around plant growth limiting factors and yields, farmers may feel that focusing on soil chemistry is the only path towards financial viability. This possibility seems to align with the experiences of Extension professionals, many of whom found soil chemical properties to be an important ‘on-ramp’ for farmers to discuss soil health. One extension professional summarized, “mostly when I talk to farmers, it’s in this vein of nutrient management planning.”

Other farmers, however, expressed frustration at agricultural policies and support programs focused narrowly on soil chemistry. An exasperated organic dairy farmer asserted, “you can’t extrapolate one nutrient… in doing that, you’re going to perpetuate the same harmful cycles because you’re going to create imbalances on the other end.” Other farmers expressed similar frustration with the statewide emphasis on phosphorus

reduction, which they felt reduced financial and technical support for farmers who do not struggle with excess phosphorus but may face other soil health concerns.

#### 2.4.2.2 Chemical Understandings of Soil Health Across Groups

Conceptualizations of soil health centered on soil chemical properties differed substantially by farm type. Organic vegetable producers emphasized soil chemistry far more than any other farm type (Table 1). Annual vegetable production requires substantial nutrient inputs to account for the export of nutrients and biomass when produce leaves the farm. In an organic production system, nutrient input options are more limited than in a non-organic production system and may therefore require more careful deliberation. This could explain why organic vegetable producers emphasized a chemical conceptualization of soil health more than their non-organic counterparts. Organic vegetable producers also reported ongoing issues with crop yields, ostensibly due to insufficient macronutrients; providing sufficient nitrogen was a particular struggle in organic vegetable systems.

Organic and non-organic dairy producers also emphasized soil chemical properties in their conceptualizations of soil health. As with organic vegetable producers, this emphasis aligns with dairy farmers' production context. Across both organic and non-organic dairy farms, nutrient management is a key concern in terms of both feed production and manure management.

On the other hand, Extension professionals, non-organic vegetable farms, and both organic and non-organic livestock operations did not heavily emphasize soil

chemistry within their framings of soil health. Extension professionals and livestock farmers emphasized other Western scientific dimensions of soil health, such as biological properties, over chemical properties. Extension professionals explicitly conveyed that soil chemistry represents but one small slice of the soil health pie. For livestock farmers, a decreased emphasis on soil chemistry may be due to the nutrient cycling facilitated by animals and the reduced need to purchase inputs to return nutrients to the soil.

#### 2.4.2.3 Soil Biology

Soil biological properties include soil organic matter and soil organic carbon as well as micro- and macro-organisms. Many farmers and Extension professionals emphasized that their interest in and understanding of soil biology has increased substantially in recent years. An extension professional shared, “one thing that I've been really getting more interested in this last year is the soil microbial community because that is a driver of so many pieces of good soil health.” This sentiment was shared by many farmers, who highlighted ways in which soil biology connected to soil, plant, and animal health as well as farm-scale ecological resilience. These linkages varied across farm types, reflecting the particularities of different production systems. For example, a livestock farmer explained that “if you don't have biodiversity in your soil, you're not going to have biodiversity in your plants, which means you're not going to have the nutrition in the cows that you want.” Within pastured livestock systems, farmers connected soil biology to pasture biodiversity and animal health; some even likened soil microbiology to ‘below-ground livestock’.

In vegetable operations, there was an emphasis on the role of soil biology in plant nutrient availability. For example, one organic vegetable farmer described a healthy soil as one with “a lot of mycelium fungus roots that go broadly throughout the soil [facilitating] exchange of nutrients between the various life forms.” This also demonstrates the ways in which both farmers and extension professionals linked soil biology to other dimensions of soil health, such as soil chemistry.

Finally, across all farm types, farmers linked soil biology to moisture regulation and resilience to precipitation extremes. Many focused on the role of soil organic matter, with one farmer explaining “It's been on the brain in the last couple of years with these swings and it's just so funny. It can help your soil stay more moist yet help it drain better as well. It does both. That's what I see as really important for us on clay soil.” In connecting soil biology to other dimensions of soil health, pasture or crop productivity, and broader processes linked to farm-scale resilience, farmers emphasized soil multifunctionality within their conceptualization of soil health.

#### 2.4.2.4 Biological Understandings of Soil Health Across Groups

References to soil biology as a core component of understanding soil health were even across both Extension professionals and farm types, though organic vegetable farmers emphasized soil biological health slightly more frequently than any other farm group. This aligns with the concerns that organic vegetable farmers expressed around the impact of tillage and cultivation on soil biology. Many organic vegetable farmers emphasized full-season or multi-year cover cropping as an important strategy for

mitigating the effects of tillage on soil biology, though few were able to implement long periods of rest due to economic pressures to produce cash crops.

#### 2.4.2.5 Soil Physical Properties

Physical properties refer to soil structure, which is determined by soil aggregates, porosity, and degree of soil compaction. Some farmers, particularly those managing livestock, focused on soil structure in the context of grazing management strategies to avoid compaction. One farmer emphasized that,

> Soil physics is guiding most of my decisions. It's like, 'Don't turn over the earth. Don't do anything to jeopardize positive soil structure.' It seems like that's the primary goal. Don't compact it, don't squish it. I want good soil, physical characteristics.

This farmer went on to link soil structure to soil biology, emphasizing the importance of creating adequate 'habitat' for soil micro- and macro-organisms. More commonly, farmers emphasized the role of soil structure in water infiltration, with many farmers identifying adequate infiltration and a lack of surface crusting and pooling as important components of soil health. Extension professionals also emphasized the link between soil physical properties and water infiltration in their conceptualizations of soil health.

#### 2.4.2.6 Physical Understanding of Soil Health Across Groups

Relative to biological and chemical properties, physical properties were emphasized less frequently in farmers' and Extension professionals' understanding of soil health. Organic vegetable farmers emphasized soil structure more often than other farmers, which was, again, linked to their concerns around the amount of tillage and cultivation required to produce annual vegetable crops without using agrichemicals to

control weeds. Interestingly, non-organic vegetable growers emphasized soil structure the least across farm types. Many of the non-organic vegetable growers who participated in this research have sandy soils, which are less sensitive to compaction and other consequences from tillage. This raises questions regarding the extent to which soil texture mediates farmers' conceptualization of soil health.

Extension professionals mainly noted that perceived problems with soil physical properties were core to their work with farmers around soil health. As one summarized, "we address what the farmers perceive as not soil health. What is not soil health - soil compaction. It's saturated all the time." While these references were not always indicative of how Extension professionals themselves conceptualized soil health, soil physical properties were clearly a part of how they communicated with farmers around soil health.

### 2.4.3 Assessing Soil Health

As with meanings of soil health, we identified many ways that individuals assess soil health. Farmers and Extension professionals emphasized observational methods of assessment in addition to traditional soil tests. The diversity of assessment tools, and in particular the emphasis on qualitative indicators and sensory observation, align with the holistic and context-dependent conceptualizations of soil health identified in the previous section. Across diverse contexts and understandings of soil health, there was generally great consistency of assessment methods across farm types and between farmers and Extension professionals, with notable exceptions that I explore below.

#### 2.4.3.1 Observational Assessment

In discussing how they assessed soil health, both farmers and Extension professionals emphasized the power of sensory observation grounded in long-term, place-based knowledge. For example, one non-organic livestock farmer used drones to take annual photos to track change over time. They shared, “We've noticed that the density of our pastures, if you look at it from above, it's night and day from where it was a few years ago.” Multiple farmers mentioned similar strategies of visual record keeping. Many more stressed the value of long-term, observational knowledge in determining the health of agricultural soils and identifying best practices for soil health. The power of observation for assessing soil health was exemplified in one non-organic livestock farmer’s approach to grazing and pasture management:

> The power of observation is really my best tool, both looking at the grass, looking at the soil, watching - does the water pool when we get a heavy downfall, or is it running off of the field, or are there certain areas of the pasture that the beef tend to away from? Then, what's there for forage or what's going on there that [the cows] are sensing that I can't see? Also watching their attitude when they eat - are they apprehensive when they go for a bite of what I think looks great?

This demonstrates how, for many interviewees, observation constituted both a tool to assess soil health and a core component of farm management.

Both farmers and Extension professionals also emphasized the value of bio-indicators in assessing soil health. In assessing plant species as indicators of certain soil conditions, one farmer shared “I understand that when you see certain weeds, that says something about the soil. Not that I can read the tea leaves if you will.” While this particular livestock farmer felt unsure of interpreting bioindicators, others felt more confident and used this method to assess the general state of their soils and how soils

responded to management. For example, an organic dairy farmer noted, “we see a lot of wild strawberries and blackberries in pastures that have been depleted of nutrients.” The ways in which farmers rely on observation generally, and bioindicators specifically, aligned with Extension professionals’ primary approach to assessment. All Extension professionals interviewed emphasized careful observation over time as the best tool for assessing soil health holistically. One specifically underscored, “I feel like the power of observation and performance cannot be replaced by a soil health test.” While observation was identified as key for farmers, Extension professionals also emphasized the power of long-term observation in their own work providing guidance and recommendations to farmers. This led Extension professionals to emphasize the need for cultivating long-term relationships with farmers.

Another subset of observational assessment strategies was looking to productivity and yields as indicators of soil health, or lack thereof. This was most often communicated as part of an approach to soil health integrated with wider farm management and decision-making. One organic vegetable farmer emphasized, “yield is a big measure for us. I think our yields are not close to where they need to be.” Many farmers, across farm types, mentioned low yields as indicators of poor soil health and a key motivator in prioritizing soil health. This translated into Extension work as well. All Extension professionals noted that yields constitute a central component of their work with farmers, providing an important entry point into conversations about soil health. For example, one Extension professional shared that they begin soil health conversations by asking farmers,

"What are your crops doing? What are your yields looking like?" This underscores how connections between on-farm practices, soil health, and yields may provide a valuable 'on-ramp' into wider conversations about soil and agroecosystem health.

The final sub-theme that we identified was a hierarchy of knowledge evident in how farmers reflected on their observational assessments of soil health. In many instances, farmers expressed frustration that their observational assessments and experiential knowledge were dismissed by soil scientists. Discussing their observation of building soil through grazing management, one livestock farmer emphasized, "I can just tell you that what I see on my farm is not being explained by A horizons and O horizons and all of that stuff." Other farmers, however, perceived their own understandings and assessments of soil health to be less legitimate without quantitative, Western scientific validation. In describing the observed ecological benefits of grazing, another farmer hedged, "I don't have the numbers or scientific knowledge to back it up, but I think that's what's happening." This farmer repeatedly emphasized that a lack of in-depth scientific knowledge of soil ecological processes made them feel less confident in their assessment of soil health. These experiences provide an interesting juxtaposition with the high value that Extension professionals placed on farmers' place-based, experiential knowledge and the power of observation in assessing and managing for soil health.

#### 2.4.3.2 Soil Testing

Soil tests were the most frequently referenced tool for assessing soil health. In our coding, we included both conventional soil tests and more comprehensive soil health tests

in this category. The frequency with which soil tests were mentioned, however, is not necessarily indicative of their use value, as we asked directly about how farmers and Extension professionals view and use soil tests.

In fact, attitudes towards soil testing and application of soil test results were highly variable. Many farmers reported conducting soil tests merely to comply with state policy or organic certification requirements. Organic farmers in particular expressed ambivalence towards the value of soil tests, noting that they were mainly useful in validating observations or identifying specific chemical imbalances. As one farmer summarized, soil tests were seen as useful in "determining deficiencies, but not really for measuring health as a holistic idea." The tension between soil tests and holistic conceptualizations of soil health was a recurring theme across many farmers and Extension professionals. For example, many interviewees emphasized a desire for more holistic soil tests that centered biological assessments. Ambivalent attitudes make it difficult to determine how soil tests factor into understandings of soil health or farmer decision-making.

The incompatibility of standard soil tests with certain agronomic contexts further complicates efforts to determine the role of soil testing in farmers' soil health management strategies. For example, livestock farmers and organic dairy farmers expressed frustration that standard soil tests are not calibrated to pastures. One livestock farmer emphasized that "a hay field and a pasture are not the same thing. They don't function the same. The soil cover is not the same. The biodiversity is not the same. The

harvest is not the same and those conventional soil tests are not oriented for pastures." This quote demonstrates the ways in which conventional soil testing may be at odds with a context dependent understanding of soil health.

Finally, there were farmers who relied heavily on soil testing, not as an indicator of soil health, but to guide chemical amendments. This was particularly true for organic and non-organic vegetable and non-organic dairy farmers. A dairy farmer emphasized, "we soil sample every three years. Anything that the soil needs - lime or anything to straighten out the pH, we've always done that." This demonstrates a wide range of utility, wherein some farmers conduct soil tests to supplement primary observational assessment methods, and others take soil test results as a trusted playbook to guide soil amendments but not necessarily broader soil management decisions.

Extension professionals expressed similarly mixed attitudes towards soil tests. Some noted that soil tests are a vital starting point for engaging with farmers around soil health. One individual emphasized soil testing as the base of Extension support, stating "if [farmers] don't have a soil test, how can I help [them]?" Others viewed soil testing as an entry point for farmers into more complex discussions around soil health. Despite this, however, there was ubiquitous awareness of the limitations of soil tests. For instance, the same individual quoted above went on to say that a soil test "doesn't really address soil health, except for the chemical aspects of it." A handful of individuals shared deeper reservations regarding the accuracy of both conventional soil tests and the more comprehensive Cornell Assessment of Soil Health (CASH). One Extension professional,

reflecting on perceived discrepancies between observed soil function and CASH results, shared,

> We do these soil health tests from Cornell and pretty much every dairy farm I've ever done it on, they get high scores because of the system they're in. That doesn't mean that we're seeing the results that we want to see. You can measure these things but what are the outcomes and are they truly linked to those results?

Overall, Extension professionals and farmers conveyed similarly mixed sentiments regarding the utility of soil tests to holistically assess soil health.

### 2.4.4 Factors Enabling Soil Health

There were many factors that supported farmers in prioritizing soil health. Many of these factors overlap, representing the complex entanglement of social-ecological factors that mediate farmers' ability to promote soil health. In parsing this complexity, I identified three main factors that supported farmers' soil health management strategies: access to capital, strong knowledge networks, and access to sufficient land base.

#### 2.4.4.1 Access to Capital

Soil health promoting practices were repeatedly identified as costly for farmers to implement. It is not surprising, therefore, that access to capital was the most frequently emphasized enabling factor. Nearly all farmers discussed the importance of support programs (e.g., USDA incentive programs or grants) that provide funding for implementing soil health promoting practices, building infrastructure, and conducting on-farm research. One farmer emphasized, "NRCS has been an amazing support for us… All the cattle lanes, the water to the paddocks, the fencing, et cetera, was all done through EQIP." While a vast majority of farmers relied on such support programs to implement

soil health promoting practices, a select few had sufficient private capital to invest in equipment and infrastructure for improving or maintaining soil health. One farmer explained, “we're spending money on a lot of tools for soil benefit. A spader or no-till drill, those types of things are very, very pricey… but thinking about soil management, we thought they were worth it.” This highlights the extent to which soil health requires long-term, capital-intensive investment.

Extension professionals also perceived the foundational importance of access to capital in mediating farmers’ capacity to manage for soil health. For example, one Extension agent, in discussing a farmer who built their own no-till roller-crimper, explained, “It’s a larger farm - they have the resources to be able to try different things.” Some of the most impactful Extension support that farmers reported was help figuring out how to access capital and equipment.

#### 2.4.4.2 Strong Knowledge Networks

Extension outreach to support farmers’ efforts around soil health fell within broader networks that farmers reported relying on for information and knowledge-sharing opportunities. Across farm types, farmers underscored the value of UVM Extension’s education and outreach programming and the opportunity to develop long-term relationships with Extension professionals. However, farmers also relied on other sources for knowledge and support, including other farmers, government agencies, and private technical service providers.

While the particularities of knowledge networks varied across production contexts, all farmers emphasized the importance of farmer-to-farmer knowledge exchanges around soil health. For some, farmer-led networks provided an entry point for discussing and considering the importance of soil health. As one dairy farmer reflected, "I got involved probably 10 years ago with the Champlain Valley Farmers Coalition. Just got involved with a lot of the farmers that were interested in soil health and trying new things." Discussions with peers prompted this farmer to try no-till and cover cropping practices. For other farmers, knowledge networks were vital in nurturing pre-existing motivations to focus on soil health. In fact, multiple farmers discussed forming their own informal networks to discuss soil health. One organic dairy farmer explained, "We call it a learning group… maybe there's 12 of us, maybe 14. Grazers all over the state who are trying different things and buying stuff together like seed mix for soil improvement."

The importance of farmer-to-farmer learning around soil health was also emphasized by Extension professionals. One Extension agent explained that farmers "are looking at what everybody else is doing... They're reading the research, they're hearing about it, I think they're using that to some extent too. But [they're] relying on each other the most." As a result, some Extension professionals felt that one of their primary responsibilities was to facilitate farmer-to-farmer knowledge sharing as a key strategy to promote soil health on Vermont farms.

#### 2.4.4.3 Land Access

Many farmers identified access to sufficient land base as integral to their ability to prioritize and manage for soil health. While acreage needs and specific land use benefits differed by farm type, land access was mentioned as a factor inherently tied to soil health across farm types. After acquiring new land, an organic vegetable farmer reflected, "having more soil, we are able to do more cover cropping and letting things rest, implementing a lot of practices that we've wanted to do and felt we just didn't have the space if we wanted to make a living." Other vegetable farmers also emphasized the ties between land access and the capacity to let soils rest and recover from annual tillage. An organic dairy farmer, on the other hand, noted that the ability to rent surrounding acreage, while not strictly necessary from a yield perspective, "gives some diversity when the weather changes - it gives me lowland, highlands. It gives me everything I need to keep the cows in the appropriate spots." Across diverse contexts, land access was framed as supporting farm viability and enabling management strategies to protect or improve soil health.

### 2.4.5 Factors Constraining Soil Health

Relative to the enabling factors explored above, farmers and Extension professionals more often emphasized factors that constrained efforts to prioritize and promote soil health. Perhaps unsurprisingly, the thematic categories of constraining factors were the inverse of the enabling factors, underscoring the centrality of these issues in mediating processes and outcomes related to soil health. Access to capital, access to

land, and lack of supportive networks constituted the most significant barriers farmers faced in promoting soil health.

#### 2.4.5.1 Land Access

Farmers repeatedly identified an inability to access sufficient land base as a factor constraining their capacity to promote soil health. When asked directly about the challenges they faced in prioritizing soil health, one livestock farmer succinctly explained "the biggest [challenge] for me is land access." For some, land access challenges were centered on the acreage that they had access to. Insufficient land base was particularly common amongst vegetable producers, many of whom lamented feeling as though razor thin margins meant they had to plant all their land to cash crops. This dilemma was summarized well by an organic vegetable farmer who noted, "That's been a real struggle for us - taking land out of cash crop production to do longer cover crop rotations when the land we have for cash crops, we need every one of those beds planted." This quote highlights not only the importance of production system context, but also the linkages between specific soil health promoting practices (e.g., full season cover cropping) and land access.

For other farmers, land tenure rather than land base was the key challenge constraining their capacity to invest in soil health. In certain contexts, this limited farmers' willingness to implement certain practices. One livestock farmer renting land explained, "Agroforestry just hasn't felt worth investing my time and planning and financing [for] putting trees into land when I don't know how long I'll be there." Farmers

renting land also highlighted the tension between their desire to invest in amending depleted soils and the uncertainty stemming from a lack of secure, long-term tenure. An organic dairy farmer explained, “When you are stewarding land that you don’t own, the financial calculations in terms of putting a ton of fertility into a place that you have no idea how long you’re going to have in management is a constant factor.” In discussing challenges tied to land access, farmers communicated frustration with the inability to align production practices with their knowledge and stewardship values.

#### 2.4.5.2 Access to Capital

Inability to afford equipment, inputs, and infrastructure constituted another major factor constraining farmers’ capacity to promote soil health. Nearly all farmers emphasized feeling unable to invest more in soil health and expressed deep frustration with the systemic and structural factors that contributed to financial constraints. For instance, an organic dairy farmer underscored how years of low milk prices placed a financial squeeze on the farm, which limited their capacity to prioritize soil health in a way that aligned with their values, stating,

> I want to do more but there's no money. I don't get it in my pay price to invest anymore. Organic milk price is at cost of production. Could I do more if we could invest more in fertilizer…? Could we do even more with soil health? Absolutely.

The desire to do more for soil health than present financial realities allowed was a common theme. Across farm types, farmers emphasized that the timescale(s) of benefitting from investments in soil health are difficult to square with economic systems

that prioritize cheap food over living wages for farmers. An organic livestock farmer summarized the temporal tension of capital constraints, explaining,

> Every question becomes a question of, 'Is this a cash flow decision or is this a balance sheet decision? Is this a short-term decision or is this a long-term decision?' Soil health can often, especially if you're trying to do it organically and biologically, it's a long-term decision, but yet the financial needs of now are challenging that.

These challenges highlight that socio-economic factors constrain farmers from fully implementing their substantial existing knowledge related to soil health.

While support programs and grants alleviate some of these financial constraints, they also require substantial administrative legwork on behalf of farmers and do not benefit all farmers equally. As an organic livestock farmer noted, "particular farms may not rank high enough to be able to take advantage" of support programs, which they found to be problematic when "financial cost is the biggest prohibitive factor for most farms" implementing practices for soil health. Beyond support programs, some farmers navigated financial constraints by relying on off-farm income. An organic vegetable farmer discussed their partner's decision to seek full-time work off-farm, explaining, "That income [will] pay for childcare, which [will] allow me to be more focused on the farm whereas these past two years, both of us have been split between childcare and the farm." Considering childcare costs exemplifies how access to capital extends beyond grants and support programs and reveals how systemic and structural factors mediate farmers' capacity to prioritize and promote soil health.

#### 2.4.5.3 Lack of Support

The final category of constraining factors encompasses a range of issues that point to a lack of sufficient support for farmers in their efforts to promote soil health. Many farmers expressed a generalized frustration with support programs. As noted previously, applying to financial support programs requires substantial time and effort from farmers, who often have limited capacity to commit to an application process that may not pay out. Farmers also noted the alphabet soup of federal, state-level, and private funding opportunities; while the opportunities are important, farmers expressed uncertainty around what opportunities exist, who qualifies, and what each application process entails. As one farmer explained, "The challenge is the different programs and the strange hoops that are associated with each." Many farmers expressed a desire for clear guidance and better support navigating the complex landscape of existing support programs. Other farmers, however, communicated frustration with support programs' predominant focus on improving poor soil health. Specifically, they emphasized that this approach often fails to reward and support farmers already practicing exemplary soil health management. An organic dairy farmer asserted, "Even though we're far ahead of the curve, it doesn't mean that there shouldn't be resources in place to meet us where we are. I don't feel that there are enough. I have struggled with that in the state's approach to soil health." Interestingly, many farmers translated available financial support into perceived societal valuation of the role of farmers.

Farmers interpreted insufficient Extension support as indicative of the University of Vermont failing to value farmers. While farmers expressed deep appreciation for the

individuals working in Extension, they also expressed deep frustration with how the University structures and funds Extension agents. In some instances, this frustration reflected geographic disparities in support. For example, an organic dairy producer in southern Vermont emphasized, “There is no UVM extension person down here. Our NRCS person is one person in an office that covers an entire region…this does impact soil health.” Other farmers from the southern and eastern parts of the state conveyed similar frustrations and felt that the University was failing to provide equitable support to farmers in their regions.

More frequently, however, farmers focused on the impact of Extension’s funding structure; specifically, the ways in which a lack of base funding impacts the extent to which Extension agents can support farmers. One livestock farmer explained,

> The part of the Extension service that was focused on grazing, technical analysis, and to some degree, soil, has been completely gutted. The political agenda [at UVM] sucks and they haven't really embraced that they have a public service component here and that they need to figure out how to fund it. Hiring people to do technical outreach and then mak[ing] them fund their own positions on a continuous basis does not allow for effective outreach work. It makes you a good grant writer, but that's all you're doing.

Many farmers connected the loss of long-term, trusted advisors to the ‘political will’ of the University as demonstrated by their unwillingness to pay Extension staff to support farmers. Others noted that Extension’s funding structure made it difficult to form trusting, long-term relationships at all. For instance, another livestock farmer noted, “people come and go from Extension. We've lost people we've worked with, and then they're gone and then no one answers.” Absent reliable support from Extension agents, many farmers

reported feeling uncertain about where to go for information on soil health. The impact of Extension funding structures on farmers' capacity to promote soil health was one of the more unexpected themes within the data and further highlights the role of social factors in mediating soil health practices and outcomes.

### 2.4.6 Extension Constraints

Extension professionals I interviewed shared farmers' frustrations around the geographic and funding structures of Extension services. One long-time Extension agent lamented that Extension has "become less of a part of the community. In other states, the county agent is a strong part of the community locally and in Vermont, that's not the way it is because we're commodity-oriented rather than community-oriented." They felt that transitioning away from county-based agents made it more difficult to fulfill Extension's outreach and education mission; without being embedded in communities, this individual asserted, it is harder for Extension professionals to maintain familiarity with producers' needs. Others noted that the structure of Extension is not conducive to a relational approach. A grazing specialist explained, "The work I do with farmers is slow, it takes time." This aligns with the critique of commodity- over community-orientation; both speak to the decentering of relationships in the Extension process and the implications for soil health, which often requires years of collaboration to troubleshoot and trial innovations.

The most consistent factor constraining individuals' efforts to support farmers in maintaining or improving soil health was the funding structure of Extension. One Extension agent explained that for the most part,

> People are funded through grants and what they have to do is deliver on the outputs of that. You can't really even call them Extension people. They're researchers. They're not doing the daily business of Extension. They work in Extension. You can't be funded through a USDA organic research initiative grant that's focused on grain, and then be out on dairy farms everyday working with them. You have to be working on the deliverables of that grant. That's a huge issue in Extension.

The conflation of research and extension work has important implications for efforts to promote soil health in Vermont. In particular, this raises questions around how research agendas are set, how research is conducted, who research processes are accountable to, the relevance for farmers, and processes for sharing and implementing results. This also suggests that the financial orientation of Land Grant Universities, to the extent that it impacts how Extension services operate, may constitute yet another social force mediating soil health outcomes.

### 2.4.7 Limitations

While frustration with insufficient Extension services was present across all farm types, dairy farmers and livestock farmers reported greater frustration and impact than did vegetable producers. There are several possible explanations for this. First, key personnel supporting dairy farmers in Addison County had recently left Extension at the time interviews and focus groups were conducted. The resulting support gap was magnified by the depth of relationships and trust that farmers had shared with the recently

departed Extension agents. Second, one of the researchers collaborating on this project (R. Maden) is herself an Extension agent who works closely with vegetable farmers throughout the state on soil-related issues. Farmers who work with Maden may have been reluctant to critique Extension services in her presence. On the other hand, her role -and her commitment to that role- may mean that vegetable farmers receive adequate Extension support in navigating issues related to soil health.

The positionality of collaborating researchers ties into another main limitation of this research, which is the self-selection bias of participants. All the farmers (n=34) who agreed to participate in this research did so because they had a pre-existing interest in and commitment to soil health. As a result, their conceptualizations of soil health, methods of assessment, and the factors that constrain and enable their efforts to promote soil health may be different than other farmers throughout the state. Additionally, while we did not collect demographic data, the farmers who participated in this project appeared to be younger than the average age of farmers in Vermont (57 years old). This, too, could impact participants' perceptions and experiences of working towards soil health. Younger farmers may be more motivated to make long-term investments in soil health if they think they will be farming long enough to reap the benefits. Indeed, future research should more deeply explore farmers' diverse motivations to prioritize soil health. Understanding how farmers are motivated by the individual and public benefits of soil health could support more effective design of soil health promoting programs and policies.

Finally, this research did not consider biophysical factors that may influence conceptualizations of and approaches to soil health. Although all farmers shared their soil types during elicitation interviews, I did not consider soil type in my data analysis. This was due to time constraints in the analytical process. It is possible, however, that soil type may influence how farmers' think about and manage for soil health. For example, sandy soils are less susceptible to compaction and have low organic matter; these innate soil qualities may impact how farmers think about the health of particular soil types. Future research should explore how soil type influences farmers' approaches to soil health.

## 2.5 Discussion

My analysis aligns with previous research that different actors conceptualize and approach soil health in diverse ways (Lobry de Bruyn & Andrews, 2016; Prager & Curfs, 2016; Winstone et al., 2019; Wade et al. 2021; Mann et al., 2021). Building on existing research, my findings specifically suggest that meanings of soil health vary across farm types. Farmers managing systems reliant on frequent tillage and external inputs (including organic and non-organic vegetable farms and non-organic dairy farms) tended to articulate understandings of and approaches to soil health focused on chemical, biological, and physical soil properties. Farmers managing highly integrated, animal-based operations (including organic and non-organic livestock farms and organic dairy farms) tended to conceptualize soil health in a more holistic way that incorporated both the wider agroecosystem and social factors that mediate soil health outcomes. Extension professionals also emphasized a more holistic framing of soil health.

The shared holistic understanding of soil health across livestock farmers, organic dairy farmers, and Extension professionals may indicate that certain animal-based farming systems enable more integrated approaches to soil health based on farm-scale nutrient cycling. Another possibility to consider is how the type and frequency of interactions with soil impact farmers' conceptualization of soil health. For example, dairy and vegetable farmers who cultivate their soil more frequently may be more inclined to focus on the biophysical dimensions of soil health. Farmers implementing rotational grazing systems, however, have fewer direct interactions with soil, relying instead on indirect observations and indicators to assess soil health. As a result, these farmers may be more likely to conceptualize soil health in a way that integrates pasture and animal health. Parsing *why* particular farm types have diverse understandings of soil health, and specifically, whether certain farm types or systems are conducive to holistic framings of soil health, are important sites for future research. Holistic framings that enable farmers to contextualize management decisions within broader, landscape-level ecological dynamics have been found to be more conducive to agroecological transitions (Wilson, 2008). Exploring how factors such as the presence of livestock and frequency of cultivation impact both soil function and farmers' conceptualization of soil health across a range of agronomic and ecological contexts warrants further exploration.

It is important to note that across all farmers and Extension professionals, soil health was understood, assessed, managed for, and discussed in complex and diverse ways. Nearly all participants drew on multiple concepts, experiences, and frames of

reference to communicate how they conceptualize and approach soil health. For example, farmers who emphasized a holistic understanding of soil health also spoke about soil chemical, biological, and physical properties. There are two important implications stemming from this complexity. First, there is substantial potential for miscommunication, misunderstanding, and divergent perceptions of soil health outcomes across diverse actors (Barrios et al., 2006; Wade et al. 2021). This potential is amplified by varying reliance on soil testing and perceived discrepancies between soil test results and observational assessments of soil health (Doran & Parkin, 1994; Romig et al., 1995; Bagnall et al., 2020). Further research clarifying both how well soil testing reflects farmers' observation of soil function and the degree to which farmers and Extension professionals trust soil test results is urgently needed.

The second implication is that soil health may function as a discourse that farmers and Extension professionals are using to frame conversations, research, practices, and policies centered on soil management. Anderson & Maughan (2021) cite Hajer & Versteeg (2005) in defining a discourse as "an ensemble of ideas, concepts and categories [expressed in language] through which meaning is given to social and physical phenomena, [and] which is produced and reproduced through an identifiable set of practices." I contend that the diverse, complex, and sometimes conflicting nature of how farmers and Extension professionals discussed soil health is indicative of the discursive nature of the topic. For instance, farmers' struggles with the assumed supremacy of Western scientific knowledge over observational knowledge for assessing soil health

suggest competing discourses that privilege different types of knowledge and, as a result, align with distinctive practices and modes of assessment. Understanding soil health as a discourse, rather than as a term encompassing only biophysical processes, thus has important implications, not only for soil health research, but also for agroecological transitions more broadly. First, discourses play an important role in informing individual and collective actions or practices (Fairclough, 2013). Therefore, attending to how soil health research and outreach is conducted and communicated - including the language used, mode(s) of communication, and the identities of various actors - may have important bearing on how information is translated into practice. Second, Anderson et al. (2019) note that discourse plays a powerful role in knowledge mobilization processes by informing whose knowledge is privileged in decision-making and policy processes, which actors coalesce within a given discursive framing, and which agroecological practices and transition pathways are perceived as feasible and legitimate. Deeper exploration of how soil health functions as a discourse and the attendant implications for on-farm management practices, Extension outreach, and agroecological transitions more broadly constitutes another important area for future research.

A principles-based approach may provide one option for mobilizing diverse discourses of soil health for agroecological transitions. Within agroecology, principles provide a framework for integrating the social and ecological processes that comprise agroecosystems while also enabling flexible pathways for achieving shared goals across diverse contexts (FAO, 2018; CIDSE, 2018). In the context of soil health, my findings

suggest that there is a similar need to integrate the social forces and factors that mediate farmers' management decisions with the ecological dimensions of soil function. Both farmers and Extension professionals emphasized social factors as central components of soil health. This aligns with recent research exploring the importance of social factors in determining farmer adoption of soil health promoting practices (Bagnall et al., 2020). Yet, holistic and context-dependent framings of soil health that integrate social factors may be at odds with the notion of a singular, Western scientific definition of soil health centered on soil chemical, biological, and physical properties. A principles-based approach to soil health may enable complementarity and integration across these distinctive discourses of soil health.

While examples of principles for soil health exist (USDA NRCS, n.d.; Brown, 2018), none of these framings meaningfully integrate the social forces and factors that mediate soil health outcomes. My results suggest that this is a significant omission and may limit the extent to which such principles can support farmer decision-making or mobilize knowledge for transitions towards more just and ecologically resilient agrifood systems. Land access, living wages, childcare, and governance processes were important factors that enabled or constrained farmers' ability to promote soil health. To attend to this complexity, I advocate for collaborative processes to identify social-ecological principles of soil health that center farmers' experiences, knowledge, and needs. Collaboration between farmers, researchers, and Extension professionals is key for ensuring that efforts to promote soil health are relevant and legible to farmers in their

unique contexts (Bagnall et al., 2020). Such processes would also enable principle-focused evaluations of soil health, which previous scholarship identifies as a valuable method for assessing agroecological outcomes (Patton, 2021). Principle-focused evaluation could provide an important complement to soil tests, which Extension professionals and many farmers considered insufficient for a holistic assessment of soil health.

Importantly, my results also indicate that there may be significant roadblocks to the participatory processes proposed above. On one hand, farmers reported substantial economic pressures that limited their capacity to engage in collaboration, trial innovative practices, or even implement existing recommendations. This coheres with previous research identifying economic factors as constraining farmers' conservation efforts (White et al., 2021). On the other hand, Extension professionals were limited in their capacity to respond to farmer needs due to their institutional context. Forced to constantly fund their own positions through grants, Extension professionals reported frustration with the need to prioritize grant deliverables and timelines over developing long-term, collaborative relationships with farmers. Farmers also expressed deep frustration with this situation and interpreted the funding structure of Extension as indicative of the University's lack of political will to support farmers. This research demonstrates how, in failing to fund Extension staff, the University undermines long-term relationships and collaborations. Addressing constraining institutional factors is necessary to strengthen collaborative efforts between farmers and Extension professionals. Specifically,

guaranteed base funding for Extension professionals is an important strategy for improving agricultural soil health in the state.

The extent to which the structure and funding of UVM Extension constrains collaborative efforts around soil health constitutes an important finding of this research. Specifically, it highlights how institutional governance processes mediate soil health outcomes. This, in turn, points to larger questions around the role of universities and Extension services in facilitating agroecological transitions. Asking such critical questions may provide an important context for farmers to engage with the politics of agricultural knowledge. In problematizing institutional structures, many of the farmers interviewed began to question how power operates within knowledge networks to mediate both social and ecological outcomes. In this way, soil health may be a powerful heuristic for agroecological transitions in the United States. Future research should explore the potential for soil health practices, research, and discourses to facilitate engagement with the socio-political dimensions of agroecology.

### 2.5.1 Farmer Basic Income

Holistic discursive framings of soil health highlight the connection between farmer livelihoods and soil health outcomes. Both farmers and Extension professionals emphasized that investing in soil health requires investing in farmers. Direct payments to farmers, or farmer basic income (FBI), may therefore be another impactful strategy for improving soil management and warrants careful consideration where improved soil health is identified as a widely shared goal. Basic (or base) income for farmers and

agricultural workers is an underexplored concept in the academic literature. I found one direct reference to this concept (Power & McBay, 2022), and it does not specifically consider the context of agriculture in the US. Direct payments to farmers would require a shift in governance insofar as the proposal centers on a change in how resources are allocated. Reallocating resources to farmers would: work to counterbalance the uneven impacts of decades of agricultural subsidies that privilege, and therefore incentivize, industrial agriculture; and provide one mechanism for addressing uneven access to capital and credit for women and BIPOC farmers (Daniel, 2013; Minkoff-Zern & Sloat, 2017; Orozco et al., 2018; Escalante et al., 2019). While I contend that FBI has substantial policy merit and warrants further consideration, a full-throated justification of FBI is not possible in this document. Instead, this proposal is included to demonstrate that transitions towards agroecology (e.g., holistic discourses of soil health) both justify and require shifts in governance.

### 2.5.2 Reflexive Discussion

In crafting the results section, I struggled with how to present my analysis. This stemmed, in part, from the sheer size of the dataset and the difficulty of integrating multiple types of data into a single, narrative analysis rather than one disaggregated by data source. In the end, I chose to present a longform results section, which seemed to most accurately represent my analytical process of attempting to identify coherent insights from across multiple data sources. From a research methods standpoint, one of my main takeaways is the need for a collaborative approach when analyzing a large

qualitative dataset. While I engaged collaborators during data collection and the process of creating grouped mental models, I undertook subsequent analysis on my own. This proved difficult in the sense that at many points, I felt my analysis and ability to parse meaning from the data would be strengthened by discussion with collaborators coming from different disciplinary and experiential backgrounds. Unfortunately, the time constraints of this dissertation, along with the time constraints of collaborators, largely prevented this. However, memos from early meetings and discussions with collaborators provided valuable reminders and insights that informed my analysis. While I do not subscribe to the notion that researcher subjectivity invalidates qualitative data analysis, this analytical process underscored the value of collaborative analysis in the context of a highly complex qualitative research project.

Another important lesson I learned through this process centers on the importance of humility and accountability within research. I entered this project with the hypothesis that farmers and Extension professionals would conceptualize soil health in different ways, and that Extension agents would be more focused on the Western scientific dimensions of soil health. What I did not anticipate was the significant emphasis on how the funding and structure of UVM Extension constrains collective efforts around soil health. Attending to this emergent theme required flexibility and a willingness to shift research outputs to be accountable to both research participants and the data itself. Consequently, I will prioritize presenting relevant components of my analysis to UVM Extension with the goal of providing data to support requests that the University change

how it funds Extension. This aspect of the research process has solidified my belief that research cannot be value neutral and that to engage in research is to engage with power dynamics. Furthermore, this brought to life on a local level Anderson et al.'s (2019) assertion that governance processes and power dynamics constitute powerful -often disabling- forces mediating transitions towards agroecology. I am looking forward to continuing to learn through the process of sharing results with different audiences and navigating how to do this in what I hope will be an impactful, actionable way.

## 2.6 Conclusion

This research highlights that soil health is not a singular concept, but a complex, multi-dimensional discourse that encompasses a wide range of meanings, practices, and values. Although the nature of this research precludes broader generalization, my findings indicate that conceptualizations and assessments of soil health vary across farm types. I identified social elements as both central to conceptualizations of soil health and as important mediating factors that enable and constrain efforts to promote soil health. A powerful example is the role of Extension professionals, who play key roles within the complex knowledge networks that farmers rely on for soil health information, but who are limited in their capacity to support farmers by the institutional context of the University. This points to important questions around the roles and responsibilities of universities writ large, and Land Grant Universities in particular, in facilitating agroecological transitions towards more socially just and ecologically resilient agrifood systems.

To begin to parse such complex questions, I advocate for collaborative processes to identify social-ecological principles of soil health. My research indicates that mental models paired with participatory analysis provide powerful tools for visibilizing the connections between social and ecological dimensions of soil health. Principles may effectively expand the soil health research agenda to better reflect diverse discourses of soil health and facilitate knowledge mobilization processes that integrate experiential and scientific knowledge. A principles-based approach also aligns with agroecology. I therefore propose soil health as a heuristic for agroecological transitions, understood as a material and discursive context in which farmers, Extension professionals, and researchers can trial new research methods, practices, language, and relationships to collectively transform agrifood systems towards agroecology.

I conclude by asserting that this research demonstrates that investing in soil health requires investing in farmers and in the social structures that they rely on. This may include things like university extension services, healthcare, and childcare, all of which represent socio-economic factors that may constrain farmers' capacity to prioritize soil health. Viewing soil health through the lens of agroecology validates the inherent interconnectedness of social and ecological dimensions of soil health. The potential to leverage interest in soil health towards agroecological transitions is an important site for future research.

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# CHAPTER 3: EXPLORING THE POTENTIAL OF ALTERNATIVE MODELS OF FARMLAND ACCESS IN THE UNITED STATES

## 3.1 Introduction

Agroecology is increasingly acknowledged as a necessary solution to the social injustices and ecological harms associated with industrial agriculture (IPES Food, 2016; HLPE, 2019). Despite the efficacy of agroecological practices (Amador & Gliessman, 1990; Holt-Giménez, 2006) and related social movements (McCune & Sánchez, 2019; Anderson et al., 2021), there has been limited success amplifying agroecology in the Global North (van der Ploeg et al., 2019; Lang, 2020; Calo et al., 2022). While scholarship in Global North countries has mainly focused on individual farmer behavior and decision-making (e.g., Padel et al., 2019), it is necessary to address the systemic and structural barriers that inhibit the legitimacy and scaling of agroecology (Wezel et al., 2020). Towards this end, scholars are increasingly exploring how land access and entrenched private property regimes constrain transformations towards agroecology and food sovereignty in Global North countries (Calo et al., 2021; Shoemaker, 2021; Calo et al., 2022).

In the United States, land reform has long been identified by both scholars and activists as a necessary step in building more socially just and ecologically resilient agrifood systems (Fernandez et al., 2013; Holt-Giménez, 2017; Penniman, 2018; Shoemaker, 2020). Land reforms address systemic and structural barriers to equitable land access and may include reparations to BIPOC communities, the restoration of

agricultural commons, and creation of community land trusts. In the US context, calls for land reform are situated amidst histories of genocidal dispossession of land from indigenous people, Black land loss, and ongoing socio-political forces that exclude BIPOC individuals and communities from accessing land.

Present-day demographic trends in US farmland ownership reflect the legacy of historical injustices and violence: 95-98% of landowning farmers are white, approximately 65% of landowning farmers are male, and the average age of farmers is over 60 (USDA, 2017). Rising costs due to speculation and demand for rural land following the Covid-19 pandemic are exacerbating disparities in farmland access. Soaring land prices are most detrimental for women and BIPOC farmers, who persistently face institutionalized discrimination in obtaining private and public credit through bank loans and USDA programs (Horst & Marion, 2019; Carlisle et al., 2019; US GAO, 2019; Orozco et al., 2018; Minkoff-Zern & Sloat, 2017; Daniel, 2013).

In response to the institutionalized injustices and attendant disparities noted above, there are increasing examples of alternative land access models (ALAMs). These models build on the legacies of Black-led community land trusts established during the Civil Rights Movement in the 1960s and 70s (White, 2018), as well as Indigenous approaches to community-based food production. Communal and cooperative structures increase secure and equitable land access by deemphasizing private land ownership (Carlisle et al., 2019). This, in turn, reduces the financial barriers faced by women and BIPOC farmers. Many ALAMs also explicitly emphasize stewardship ethics, with some

models promoting agroecological practices or recognizing rights of nature. In amplifying socially just and ecologically resilient approaches to agriculture, ALAMs have potential to support healthy rural communities.

Examining equity-based models of land access may identify systems and structures that more effectively remedy gender- and race-based disparities in land access than do attempts to expand individual private property ownership (Horst & Marion, 2019). To that end, we conducted 13 semi-structured interviews with farmers engaging with ALAMs across the US to explore (1) What motivates farmers and landowners to participate in models of land access not based on private property ownership? and (2) How might ALAMs contribute to broader processes of agroecological transformation?

Our findings suggest that ALAMs provide both material and conceptual sites of contestation in which farmers are able to enact alternatives to private property and reimagine land-based social-ecological relationships. In this way, ALAMs provide important transition pathways towards agroecology. We contend that scholars must continue to actively confront how private property rights and related socio-political structures and economic systems constrain agroecology in the US.

## 3.2 Literature Review

To understand how land access impacts equity and ecological sustainability within agrifood systems, it is necessary to examine the historical roots of land ownership. The history of private property is interwoven with the histories of colonialism, racism, and other systems of oppression (Caffentzis & Federici, 2014; Davis et al., 2019;

Ferrando et al., 2020). In liberal democratic states in the Global North, the dominant property regime is based on an ownership model of "individual, exclusive possession of identifiable things" (Blomley, 2008). Private property ownership is often defined as a 'negative right': owners have the right to exclude others from a given resource, in addition to the right to complete decision-making autonomy (Shoemaker, 2020; Calo et al., 2022). In the US, these rights, and in particular the right of exclusion, are enshrined in law and enforced by the state; this includes the right to use violent force to defend one's property against intrusion or trespassing.

The suite of economic, political, legal, and socio-cultural forces that uphold private property can be understood as part of the private property 'regime'. Runhaar et al. (2020) define regimes as sets of "markets, technologies, policies, regulations, networks and cultural expectations" that determine behaviors or outcomes. The outcome, in this context, is the perpetuation of private property as a hegemonic paradigm governing land use. Trauger (2014) identifies this as the 'episteme of ownership', which refers to the system of principles used to understand resource use; Trauger's terminology implies that payment -or ownership- is the only way to secure the right to use something.

Within private property regimes, individual control of resources is taken as foundational (Alexander et al., 2009). This translates into a prioritization of individual rights over collective concerns such as equity and environmental justice. Importantly, the bundle(s) of rights guaranteed by private property are not derived from human rights, such as access to food and shelter; in fact, some scholars assert that the exclusionary right

of private property is in direct conflict with human rights to land, food, and water (Calo et al., 2022). The Nyéléni declaration (2007) emphasizes that the privatization of land and non-human nature simultaneously underlies the modern nation state and reproduces social inequities.

Indeed, private property is so deeply interwoven in the cultures and laws of liberal democratic states like the US that it is now perceived as a 'natural right' (Christman, 1994; Christophers, 2020). Today, allocating and enforcing property rights remains one of the main functions of the Western liberal nation state (Sikor & Lund, 2009). Attempts to remedy injustices associated with private property through shifts in public policy are thus deemed implausible due to the assumption that to question private property is to question the legitimacy of the state (Trauger, 2014; Calo et al., 2021). This has led to alarming proposals that the system of property rights is 'settled' (Bromley & Hodge, 1990).

The private property regime, and in particular the ownership model, mediate farmland access, farmers' land-use decisions, and the political power of agricultural land holders (Calo et al., 2022). In large part this is due to the ways in which the private property regime entrenches exploitative and exclusionary incentive structures around land use (Shoemaker, 2021). Scholars have therefore asserted that transforming agrifood systems towards agroecological futures is dependent on transforming how property is conceptualized, expressed, and contested (Williams & Holt-Giménez, 2017; Calo, 2020a; Calo et al., 2021).

Privatization of farmland has led to a process of commodification wherein farmland is subject to speculative financial markets. In many parts of the US, speculation is inflating the price of farmland, exacerbating processes of land concentration and exclusion (Fairbairn, 2020; Obudzinski, 2016; Henderson & Kauffman, 2013). The commodification of (farm)land demonstrates how private property plays a pivotal role in the material production of a capitalist political economy (Blomley, 2005) and an industrial agrifood system that serves processes of capital accumulation. Decommodifying models of land access and ownership that remove land from speculative financial markets can thus transform not only agricultural systems, but also broader socio-political and economic systems (DeFilippis et al., 2019). Financial speculation also demonstrates how private property contributes to agricultural exclusion.

The racialization of agrifood systems in the US is evidenced by both the material exclusion of BIPOC farmers from land and the immaterial processes by which they are dispossessed and excluded. In the US, the violent dispossession of land from Indigenous people and the enslavement of Africans preceded the Jeffersonian pursuit of individual ownership that shaped the nation's identity and economy (Carolan, 2018). Historical traumas are compounded in the present as BIPOC communities continue to face land exclusion and dispossession (Horst & Marion, 2019; Orozco et al., 2018; Bittman, 2021).

Today, financial mechanisms constitute powerful barriers of exclusion. Research has identified ongoing discrimination against women and BIPOC farmers within USDA lending and support programs (Daniels, 2013; Orozco et al., 2018; Minkoff-Zern & Sloat,

2017). Women and BIPOC farmers have also been found to carry higher levels of debt associated with farmland ownership than do their white, male counterparts (Escalante et al., 2018; USDA GAO, 2019). Farmer debt has been found to negatively impact farmers' mental health and the socio-economic wellbeing of agricultural communities (Buttel, 1989; Truchot & Andela, 2018; Petersen-Rockney et al., 2021). Heavy debt loads may also hinder non-market endeavors - such as seed saving, food sharing, and spiritual practices - that are vital for sociocultural preservation and food sovereignty (Bliss, 2020).

Due to existing gender and racial disparities in farmland access and ownership, scholars and civil-society organizations predict that farmland will continue to concentrate in the hands of affluent white landowners able to leverage existing assets to acquire land from retiring farmers (Carolan, 2018; Rippon-Butler, 2020). This phenomenon has been identified as the upward wealth effect for landowners (Gunnoe, 2014). Importantly, the upward wealth effect intersects with industrial lock-ins: when shrinking profit margins force farmers to increase production via capital-intensive inputs, they may rely on speculative increases in the value of their land to service rising debt and ensure economic solvency (Petersen-Rockney et al., 2021). The intersection of industrial lock-ins and farmland financialization is accelerating concentration of farmland ownership.

While social justice and ecological health are often treated as separate dimensions of sustainability narratives, inequities in land access constrain transitions to sustainable agriculture (Carlisle et al., 2019; Calo, 2020a). Farmer debt, driven up by the rising costs of farmland, has been found to impede implementation of ecological best management

practices (Carlisle et al., 2019; Prokopy et al., 2019). The accelerating concentration of farmland ownership is also antithetical to food sovereignty and agroecological principles related to equity and justice (Wittman, 2011; Nyéléni, 2007). To the extent that concentration in land ownership coincides with simplified agricultural landscapes, it may also increase ecological vulnerability (Petersen-Rockney et al., 2021; Calo, 2020a; Kremen & Merenlender, 2018; IPES-Food, 2016).

Processes of farmland financialization and consolidation in the US are also driving trends toward tenant farming and absentee land ownership while incentivizing ecologically destructive forms of industrial agriculture (Petersen-Rockney et al., 2021). Multiple scholars suggest that secure land tenure is vital for enabling socially and ecologically desirable outcomes (Lawry et al., 2014; Anderson et al., 2019). Recent research also highlights that the socio-political and economic processes that allocate tenure have profound implications for land management decisions and agroecological outcomes (IPES Food, 2019).

Despite theoretical, historical, and empirical evidence that private property perpetuates social injustice and ecological devastation, land access policy initiatives in the US continue to focus exclusively on expanding private property ownership and, therefore, may not suffice to achieve equitable outcomes (Valliant & Freedgood, 2020). Unwillingness to confront the consequences of the private property regime in Global North countries is identified as a key lock-in impeding agroecological transitions and transformation (Calo et al., 2021). In their analysis of the potential for Scottish land

reform policies to enable equitable land access and agroecological production, Calo et al. (2022) assert that theoretically and practically tackling the barrier of private property is necessary to enable agroecology and food systems transformations.

We situate our research amidst such calls to reckon with the ways that private property regimes inhibit agroecological transitions and transformation. This review also validates that alternatives to private property constitute a vital pathway towards land justice.

### 3.3 Methods

This research was conducted in partnership with Agrarian Trust, a national non-profit organization that helps farmers, farmworkers, and agricultural communities establish Agrarian Commons across the US. In order to ensure that the research process aligned with the justice and equity orientation of the subject matter, a participatory and collaborative approach was key. Initially, iterative rounds of dialogue between Agrarian Trust and the lead author established a working relationship that was grounded in mutual respect and shared interests in exploring farmer engagement with the Agrarian Commons model. Research foci and questions evolved over an 18-month window and were primarily guided by the experiences and needs of Agrarian Trust. Following iterative drafting of research questions, the research team sought input from other non-profit farmer advocacy groups to ensure research findings would be broadly relevant and serve to support work happening across diverse contexts.

Methodologically, the iterative and collaborative nature of this research process aligns with the principles of participatory action research (PAR) outlined in Méndez et al. (2017). PAR offers pathways for accommodating complexity in both research content and process (Bezner-Kerr et al., 2016) and generating co-created knowledge and actionable outcomes (Méndez et al., 2013; Méndez et al., 2017). In emphasizing horizontal collaboration between partners, PAR is particularly well-suited for research that is explicitly concerned with issues of justice, power, and equity-oriented transformational processes.

As the focal issue of this work -equitable farmland access- is not a problem with a single, easily achievable solution, this work is conceptualized as part of wider processes of collaboration between researchers, non-profit & advocacy organizations, farmers, and communities engaging in struggles for equitable farmland access from multiple vantage points. Thus, this work does not constitute a 'complete' PAR project; rather, it is intended to represent an early point of reflection wherein initial research results are shared and collectively processed before translating research to action or identifying future research collaborations.

### 3.3.1 Background

Agrarian Trust (AT) helps US-based farmers create localized Agrarian Commons. Initially, this entails support with fundraising to purchase farmland or, more infrequently, support navigating land donations. During this process, farmers work with AT to establish a local Agrarian Commons, which is a non-profit landholding entity that is

collectively governed by a Commons Board. Farmers and AT staff members serve on the Commons Board along with other local farmers and community members. Once land is secured via purchase or donation, the land is held by the Agrarian Commons; it is not owned by an individual or a business. Instead, farmers sign 99-year lease agreements that they co-create with AT. Every Commons creates a unique lease agreement, but all lease agreements entail commitments to just and ecological farming practices. The Commons Board ensures that the social and ecological commitments outlined in local lease agreements are honored within farm management decisions. This model is intended to alleviate the financial burdens of land access and associated debt accumulation that perpetuate injustice, exploitation, and ecological devastation within agrifood systems.

### 3.3.2 Data Collection

Research partners at AT connected the lead author with farmers at various stages of creating Agrarian Commons. Allied organizations also served as key informants, connecting the lead author with farmers engaging with other ALAMs. Finally, a national organization shared a summary of the research in a monthly newsletter and invited interested farmers and farmworkers to contact the lead author. Potential participants were screened to ensure that their context and interests aligned with the research focus on alternative land access; screening took place via email and phone call. All interested individuals were provided with an information sheet and their continued participation implied consent in accordance with the University of Vermont's Institutional Review Board exempt procedures.

Between July and August 2022, we conducted semi-structured virtual interviews with 13 farmers who have engaged with ALAMs. Semi-structured interviews are appropriate for exploring complex phenomena, in part because the flexible structure allows participants to share information and anecdotes that they deem important to their experience (Yin, 2013; Berg & Lune, 2004). This format also makes semi-structured interviews well-suited to gathering data from a heterogeneous population; in this case, farmers across the country who represent multiple agricultural production systems and who were engaging with various ALAMs. Interviews lasted 60 - 90 minutes and were conducted virtually via video call or, where internet access was an issue, via phone call.

### 3.3.3 Data Analysis

Interviews were recorded, transcribed, and analyzed using NVivo 12 software. To analyze the data, the lead author engaged in reflexive thematic analysis (Braun & Clarke, 2006). While thematic analysis (TA) entails identifying broad, explanatory themes within qualitative datasets (Maguire & Delahunt, 2017), reflexive TA specifically involves an iterative process of developing themes from codes in order to identify patterns of shared meaning that coalesce around a central concept (Clarke & Braun, 2013; Braun et al., 2014). The iterative and reflexive nature of this analytical method is well-suited to analyzing qualitative data from a range of research participants whose contexts vary greatly.

The reflexive TA process began with repeated readings of transcripts to become familiar with the data. I then open coded interview transcripts using an inductive

approach (Patton, 1980; Clarke & Braun, 2015). Following coding, I identified initial themes and engaged in reflexive cycles of reviewing and refining themes. While developing, reviewing, and refining themes, codes evolved to reflect deepening insight into the data. Throughout this process, I continually reflected on implicit assumptions and sought to understand the data in the context of broader socio-political systems and structures related to land access.

To achieve this, the analytical process was also informed by critical theory. Critical thematic analysis encompasses multiple definitions and disciplinary foci (e.g., Terry & Braun, 2011; Anderson, 2020). Although we use different methods of analysis, we align with Lawless and Chen's (2019) assertion that

> A critically informed thematic analysis… seeks to understand individual and shared experiences of participants while being acutely aware of economic, social, historical, and political contexts, social and hegemonic structures, institutional power, and ideological impact.

By situating data analysis amidst intersecting systems of governance and oppression that mediate land access, a critical approach enabled deeper sense-making.

### 3.4 Results

In exploring farmer motivations for engaging with ALAMs, we found that farmers often sought to both 'dismantle' private property and recreate many of the conditions of private property in order to gain entry to a system from which they had been systematically excluded. In the following sections, we explore the tension between farmer motivations to subvert private property regimes and motivations that seemed to affirm the dominance of private property. Following this, we explore the processes by

which farmers enacted ALAMs and the outcomes that emerged from these processes. In analyzing farmers' experience, we identify processes and outcomes as being primarily either relational or transactional.

Farmer motivations and decision-making are inherently complex; so, too, are models and processes of farmland access, which vary greatly across social-ecological contexts. In identifying particular threads of meaning within qualitative data, analytical processes risk reducing this complexity. Through critical thematic analysis, we attempt to weave together farmers' motivations and the processes and outcomes of enacting ALAMs to construct a possible image of alternative farmland access in the US.

### 3.4.1 Farmer Motivations

Interviewees shared multiple motivations for choosing to engage with ALAMs. None of the farmers interviewed gave a single explanation; rather, each communicated unique entanglements of motivations that ranged from affirming to explicitly subverting the dominant private property regime. In their exploration of the transformative potential of community land trusts, DeFilippis et al. (2019) note that Fraser's (1995) theory of affirmative versus transformative remedies to injustice provides a valuable heuristic for assessing the potential for structural change associated with innovative or alternative property arrangements. This proved to be a valuable critical framework for situating our analysis of farmers' motivations to engage with ALAMs within broader systems and power structures.

#### 3.4.1.1 Affirming Dominant Systems

For many farmers, engagement with an ALAM was driven by their inability to afford to buy farmland outright. Specifically, many farmers felt unable to access financing options that are traditionally used to purchase land (e.g., USDA or bank loans). One BIPOC farmer explained, “If I would’ve walked into a bank and asked for a loan, they would’ve laughed me out of there.” This farmer emphasized startup costs for new entry farmers searching for farmland on the open market, where prices “skyrocket once you start to establish anything that resembles infrastructure or a bona fide business on the land.” Without tax returns, equity in existing land holdings, or physical collateral, multiple new entry farmers felt unable to access the financing required to purchase increasingly expensive farmland. Even after securing land through the Agrarian Trust, this farmer felt that “access to traditional capital probably hasn’t changed much”; despite earning a comfortable living, he felt that his tax returns “would scare a bank” due to the high expenses associated with annual diversified vegetable production. This sentiment was mirrored in that of a young farmer, who asserted that young people “just don’t have the capital” to buy land and are unable to pursue agriculture as a viable career path due to a preponderance of financial start-up barriers.

For the rare farmer able to access financing to purchase land, the burden of debt remained a motivating factor. One older farmer shared an ‘epiphany’, stating, “I realized I could die in debt, and I had to pay it off... It seem[ed] like a better idea to get some old money from New England down here and pay the banks off and let me retire”. Despite the potential to be debt free, however, this farmer remained wary of the collective

governance that defines the Agrarian Commons model and sought to “stack the board in [his] favor” rather than embrace the collective decision-making structure of the Commons Board. His skepticism of collective governance and desire to extend the autonomy of sole proprietorship was evident in his explanation for working with Agrarian Trust: “They're offering me a lifetime lease. As long as that's what they claim it is, which means I can keep doing whatever I'm doing, it seems like a win-win situation.” The potential to relinquish de jure ownership while maintaining de facto private control and canceling debt was one of the main factors that motivated this farmer to engage with an ALAM. His experience confirms that, paradoxically, some farmers may engage with alternatives to private property to maintain the individual autonomy of private property while ‘solving’ associated issues around financial viability and security.

Indeed, nearly all farmers were at least partially motivated by potentially affordable options for secure land tenure akin to private property, something which for many constituted an unattainable aspiration. One young farmer, in discussing their aspiration to buy land, noted “it’s not attainable.” An older farmer also emphasized that his engagement with ALAMs stemmed from the blunt reality that he “couldn’t afford [land], period.” The emphasis on engaging with ALAMs due to an inability to afford land paints private property as a primary but unattainable goal. Within the data, repeated emphases on financial constraints and the security of land ownership demonstrated the dominance of private property as a cultural aspiration. An urban farmer directing a community-based nonprofit firmly believed that “land ownership in general is

important." Although this farmer chose not to own land herself, she asserted that municipalities should "give [vacant] land back to the people" who cannot afford to purchase land. For this farmer, publicly funded land access represented a potentially affirmative pathway to increase participation in private property ownership for those who have historically been excluded, particularly BIPOC individuals and communities. Financial motivations indicate that ALAMs may be both affirmative and affirming; that is, expanding access to private property while also reaffirming private property as the dominant system of property relations.

Farmers' emphasis on private property as an unattainable objective indicates that farmers may at least partially perceive ALAMs as new avenues for participation in existing systems of land ownership. Divorced from wider political content, financial motivations seemed to limit the potential for ALAMs to transform property relations. Importantly, however, affirmative motivations often existed alongside motivations and values that centered on subverting the private property regime.

#### 3.4.1.2 Transforming Property Relations

Nearly all farmers interviewed expressed motivations for engaging with ALAMs that centered on subverting private property. Subversive motivations conveyed desires to dismantle the political institutions that uphold private property, create equitable and just alternative models of land access, and redistribute power and land to realize food sovereignty. In challenging private property ownership and the enabling socio-political

conditions built around this concept, farmers framed both themselves and ALAMs as part of broader transformation processes.

Many farmers expressed a philosophical rejection of private property based on the socio-political history of private property in the US and its connections to systematic violence and oppression. In condemning the history of private property, farmers underscored how personal values and worldviews informed their perception of land and property. For example, one farmer communicated his belief that "land is the inheritance of all beings on earth and all people on earth". The notion of exclusion that is central to private property was internally inconsistent with his conceptualization of land. The farmer went on to explain:

> I know there's a lot of argument within European property law and within Western property law and philosophy of real estate and real property: it's like, "Is the right of exclusion actually the foundation of Western notions of private property?" I think it is… you get all these various tools to protect that right and the biggest is violence. You can kill someone in order to have that [right], which is deranged… it's a pathological way of being.

This farmer's analysis of private property exemplifies both the depth of knowledge that many farmers conveyed regarding the political and legal origins of private property and the ways in which those foundations conflict with farmers' personal values related to land. The farmer's emphasis on state-sanctioned use of force in defense of private property also points to the connection between private property and the violent dispossession of BIPOC individuals and communities.

The connections between private property and systemic injustice constituted a common theme within farmers' subversive motivations to engage ALAMs, though

farmers varied in how these connections motivated their engagement with ALAMs. One young, white farmer noted generally that private land ownership "has locked a lot of people out of having land". For this farmer, alternatives to private property were necessary to address disparities in land access based on age, gender, and race. Farmers of colors spoke more directly to the intersections of racial justice and dismantling private property. One farmer explained that "exclusion [from land] is white supremacy culture, so we should completely dispense with the notion of exclusion within land". Addressing exclusion specifically from rural areas, another Black farmer emphasized her belief that "we need to start pushing some of these boundaries. We can't just be confined as the BIPOC community to concrete jungles, especially when it comes to growing our own food and land access for being able to do that." Nearly all BIPOC farmers connected the institution of private property to personal and familial experiences of racism within agrifood systems. These connections motivated both engagement with ALAMs and a concomitant desire to dismantle private property.

In enacting alternatives to private property, many farmers perceived ALAMs as prefiguring broader transformations. One farmer was motivated to "create and build functional cooperatives that can last for multiple generations, because that's the first step. Then I think we can take on being able to dismantle the [private property] regime as a whole… because that's what my hope is." Others discussed things in more general terms, such as one young farmer who felt her motivation to dismantle private property came down to "an anticapitalist worldview" that informed her future visions for agrifood

systems. Still others were motivated to enact examples that would broaden the politics of the possible by demonstrating land access beyond private property. This was a central motivation particularly for older farmers, one of whom was driven to be an 'ambassador' for the Agrarian Commons model, which he perceived as a necessary response to land "being bought up by conglomerates or by land property developers… if we can capture some of that land into this model, build a more power model, I think it creates these hubs of normalization." Enacting just possibilities for the future was a key strategy for subverting the hegemony of private property and constituted a main motivation for many farmers to engage with ALAMs.

Another specific subtheme within efforts to challenge private property and associated institutions and beliefs was the desire to subvert an atomized approach to land access and agriculture writ large. One farmer explained, "private property ownership puts so much weight on an individual ethos and perspective of the world – especially in America, where the majority of land ownership is white." This atomization motivated many farmers to engage in ALAMs: "we need to have communal and cooperative owning situations because we're so individual and even next to each other, we don't connect." For many, the individualism of private property was at odds with personal beliefs; for these individuals, ALAMs offered a pathway to align land access with their worldviews. A farmer originally from South Africa explained that ALAMs aligned with his belief in ubuntu, a concept that emphasizes the resilience of the collective over the individual. While centering interdependence and interpersonal connection may be more

subtly subversive, such motivations challenge the notion of a farmer as a rugged individual, which is deeply intertwined with industrial agriculture, colonialism, patriarchy, and liberal ideology. In challenging individualism, farmers engaged plural values in relating to land, thereby creating a more inclusive space capable of holding diverse connections to land and place.

Finally, many farmers of color expressed motivations centered on equitable (re)distribution of power and land. These farmers connected their engagement with ALAMs to deeply personal family histories and aspirations. Reflecting on the past, one farmer shared,

> I think about how my family on both sides had farmland in Costa Rica and the United States that we lost over generations… we [forgot] about our relationship to the land. It's important healing for all of us when even one of us in our families gets deeper connected.

Others connected their motivations to the future and hopes that "if we are able to create a solid land base for our children, then that will enable them to have greater, not complete, but greater emotional security, physical security." The ties to both historical trauma and future hopes demonstrate how both personal and political contexts mediate farmers' motivations to engage in ALAMs. Farmers were also motivated by visions of broader community empowerment. One farmer described their motivations as "very intentional in wanting people to come together to cultivate community resilience around food sovereignty, and [identifying] what does that look like, and providing a lot of different models going back throughout history." Farmers engagement with ALAMs was motivated by and in alignment with broader visions for redistributing not only land but

power to enable food sovereignty for individuals and communities marginalized and harmed by the private property regime and attendant ideologies and institutions.

Despite the diversity of subversive motivations, there was a strong theme of dismantling private property to enact just futures. Equitable land access was framed as central to these efforts. Thus, subverting private property was framed as a component of broader transformative efforts that collectively influenced farmers' decisions to engage with ALAMs.

#### 3.4.1.3 Navigating Conflicting Motivations

Many of the motivations that farmers conveyed did not fall neatly into the themes of affirming or subverting private property. Farmers also communicated motivations for engaging with ALAMs that, though transformative or subversive in relation to broader dominant forces within agrifood systems, did not directly center on private property. These motivations contextualize farmers' struggles for land access amidst wider efforts or hopes for agrifood systems transformation. Importantly, they also convey farmers' internal struggles to parse the tension of holding both affirmative and subversive motivations for engaging with ALAMs, and the tension of enacting alternatives while constrained by the systems and structures of the private property regime.

Nearly all farmers struggled to navigate conflicting motivations wherein their ideological drive to subvert private property bumped up against cultural narratives and norms embedded in private property. One young farmer exemplified this tension, sharing:

> In my mind I've always held these two different ideas of what a farming life would look like. I think one of them is somewhat isolated and very independent

> and I can do whatever I want and make decisions unilaterally without concern for what other people may want and the dreaminess of that. [There's] also the dreaminess of being surrounded by a lot of people... The accountability that comes with that and the shared decision-making process - I want both to a certain extent… but that rugged individualist is not available and it's not attainable. It's more in the fantasy realm than it is to come together with people, even with all of the difficult dynamics that come with that.

While farmers may align ideologically with collective, cooperative, or communal agricultural production and land access, the time and effort required to enact collaborative approaches stands was juxtaposed with the freedom and autonomy of individual endeavors. An older farmer also struggled to reconcile subversive beliefs with norms around land ownership. Although he shared that when he first bought land, he never felt like he owned it, he later stated that the process of putting his land into an Agrarian Commons required him "to cut loose of this idea that [he] needed to own this place." Others expressed similarly conflicting sentiments in trying to reconcile beliefs around equitable processes of farmland succession with a desire to provide future opportunities for their children. These tensions suggest that farmers struggled to reconcile internalized cultural norms and narratives associated with private property with more deeply held personal beliefs.

Stewardship ethics motivated many farmers to engage with ALAMs and constitute another site of tension between transformative personal values and entrenched ideologies around land access. A stewardship ethic speaks to a way of managing agroecosystems grounded in care for both the land and future generations. While a stewardship ethic represents an important transformation in relating to land, it does not

inherently challenge private property and attendant ideologies. One farmer explained how a stewardship ethic informed her views on land access: “with privately owning, buying land ourselves, I think we’d still be putting it eventually into commons… we’d always have that goal in mind that it’s ours to take care of right now, but it’s not inherently ours.” For this farmer, as with many others, a strong stewardship ethic did not preclude privately owning or buying land. Many farmers whose motivations for engaging with ALAMs affirmed private property also expressed a strong stewardship ethic. In these instances, a stewardship ethic often aligned with an individual ethos. For example, in describing how a stewardship ethic guided his approach to land access and management, one farmer shared

> I have the privilege of having this piece of beautiful farmland, and I know that my role is a transitionary one on this planet. My thing is, I want to leave something behind for somebody else to be able to nurture and carry on that.

The emphasis on ‘I’ statements implies a strong individualism alongside a transformative way of relating to land and future generations. In perceiving their role as stewards, farmers may maintain an individual orientation at odds with collaborative approaches to land access and management.

Frequent internal tension within motivations to engage in ALAMs suggests that alternative approaches may constitute contested territories. These are physical and figurative spaces in which farmers are struggling to enact transformations, form new identities, and cultivate connection between people and land while also struggling with the vestiges of political subjectivities formed in the context of the private property

regime. As one farmer summarized, “most things come at the borders, even in biodiversity and in biology, a lot of the change and things that are dynamic and beautiful – they happen at the edges because they’re having to learn how to integrate.” Thus, ALAMs may be understood as an ‘edge’ in which farmers are integrating transformative and subversive beliefs and ideologies within the constraints of present realities. This process of integration is not, however, singular or assured: conflicting ideologies within farmers’ motivations for engaging with ALAMs suggest that the transformative potential of alternatives cannot be assumed. In some instances, alternatives may function as affirmative projects that expand access to land but do not contest the power structures of the private property regime. Identifying these tensions situates struggles for equitable land access amidst broader processes of transformation towards inclusive, just, and co-created agrifood systems.

### 3.4.2 Enacting ALAMs

To understand the potential for ALAMs to contribute to agroecological transformations, we analyzed the processes by which people enacted ALAMs and the resulting outcomes. We identified processes and outcomes as either relational or transactional. This thematic analysis involved analyzing the enabling and constraining factors farmers initially faced in engaging with ALAMs as well as the challenges, benefits, and frustrations that arose when enacting alternatives.

#### 3.4.2.1 Relational Processes & Outcomes

Relational processes and outcomes centered on cultivating relationships and dismantling power hierarchies associated with private property. For many, the process of engaging with an ALAM was defined by the quality of inter-personal relationships. In discussing their experience navigating multiple alternative land access processes, one farmer stated simply, "it is all built upon the relationships you have." Others spoke more directly about specific relationships. For example, all farmers engaging with the Agrarian Commons model spoke of the process of creating a local Commons Board. While this was not a relational process for all farmers, those for whom it was emphasized building trust and engaging in collective decision-making. One farmer reflected that the Commons Board

> made a lot of the decision-making a lot easier for me - running through some of the scenarios and trying to play these things forward and think with a long-term lens and be sure that we're securing what we need to be able to make it work long-term… It's definitely an exercise in community building.

This farmer's experience exemplifies the support farmers required to engage with alternative models, which often required engaging with novel legal and economic structures. Farmers expressed that partnerships were key to navigating the complex social, legal, and economic processes around alternative land access. Often, this required substantial time and energy, which could be frustrating for farmers. Relational processes were not inherently or consistently positive, but they stood in stark contrast to the individualism associated with private property.

Nearly all those who successfully enacted alternatives emphasized relationality when reflecting on outcomes. For some, alternative land access enabled powerful

individual and collective healing. As one urban farmer in Detroit explained, "because we [didn't] have to spend money on the land, we're able to do more for the community freely… [we] facilitate healing for others." Lifting the economic burden associated with private property enabled this farmer to utilize urban farmland as a site for gathering, connecting and collective healing through both food and holistic wellness programming.

While ALAMs provided an avenue for healing and cultivating relationships with other people, some farmers noted that ALAMs also enabled a different relationship with the land itself. One farmer stated directly, "the way that this really entrenches my relationship to the land is that it is a relationship." Another farmer elaborated, sharing "I always cared but it's just different. I feel like I have a deeper connection to the land because I'm there every day… I feel like I'm a part of the land now and the land is a part of me – something like that." For farmers who were previously not able to access land in a secure or long-term way, alternative land access provided an avenue for relating to land differently, which in turn changed their thinking around issues including land management, community engagement, and future planning. Many farmers celebrated feeling able to invest in perennial plantings or infrastructure.

Finally, some expressed how alternative land access highlighted the connections between interpersonal relationships and relationships with land. Based on her experience, one farmer asserted, "we need each other. I think it's a fallacy to think that we can exist without each other and that our relationship to the land is not inherently connected to us connecting with each other more." Many farmers emphasized that the capacity to

cultivate connection with others was intrinsically tied to their relationship with land. For BIPOC farmers, these connections were situated amidst a process of collective healing of historical and ongoing trauma related to racialized land loss.

#### 3.4.2.2 Transactional Processes & Outcomes

Enacting ALAMs was not an inherently relational endeavor. In fact, many farmers recounted transactional processes and outcomes that, in centering the legal and economic logistics of land access, occasionally perpetuated power imbalances and oppressive systems and structures tied to private property, such as racism and colonialism.

Processes of establishing ALAMs were more often defined by transactional interactions between farmers and intermediaries, whether non-profit organizations or land donors. This is not surprising, given the substantial legal and economic complexity of land access writ large, and the added complexity of establishing alternatives to private property, which can require substantial economic and legal innovation. Farmers emphasized the difficulty of navigating this complexity when discussing the process of engaging with ALAMs. Multiple farmers brought up feeling a sense of urgency that seemed to conflict with the painstaking, collective navigation of dense legal or bureaucratic processes. For example, multiple farmers who engaged in the process of establishing an Agrarian Commons highlighted a disconnect between members of the Commons board, with one farmer explaining, “the frustration from the farming side of it is, it doesn’t move quickly enough sometimes. We get bogged down in bylaws.” Another

farmer elaborated, explaining, creating the Commons was "the most important thing my life, but it might be the sixth or seventh most important thing in their life." Uneven prioritization across farmers and Commons Board members resulted in a "lack of urgency around certain very specific deadlines." These experiences highlight that although legal support is vital for farmers engaging with ALAMs, centering legal concerns can feel transactional for farmers and may inhibit deeper relational processes. This was not unique to the Agrarian Commons model. Farmers engaging with other ALAMs also noted the tendency for land access processes to be transactional, such as one farmer who noted that landowners offering to extend secure tenure to BIPOC farmers "were using the process to make it go longer and longer." The result was that despite access to land, farmers "were planting and growing a lot of things… in a state of insecurity." This experience demonstrates that while ALAMs may expand land access to individuals and communities who have been systematically excluded, the processes by which ALAMs are negotiated and enacted are also important. Rather than a site for realizing interdependence and horizontal power relationships, transactional processes may be another venue in which power imbalances play out, with farmers at the mercy of more powerful land-granting individuals or entities.

Transactional processes often translated into more transactional outcomes in which problematic systems and structures, including colonialism and racism, were reproduced in the context of alternative land access. For example, after experiencing a process in which landowners delayed conferring secure tenure and created a state of

insecurity, this farmer reflected that landowners did not want to meet regularly or establish the kind of place-based relationships that the farmer had anticipated. This farmer exemplified how transactional land access processes impact production decisions and relationships to land, noting that the insecurity arising from the process "changes your relationship to the land, where you're like, 'just got to put these seeds in, get this greenhouse up, super flimsy but let's try and make it work.'" Transactional processes that perpetuate socio-economic power hierarchies recreate conditions in which farmer management decisions are answerable only to economic imperatives, without space to prioritize agroecological approaches, right relations with land, or land justice. How farmers access land outside of private property has clear implications for the potential of ALAMs to contribute to agroecological transitions based on the extent to which both processes and outcomes reify or challenge existing systems and structures tied to private property.

Transactional outcomes were also evident in the extent to which farmers operating within established ALAMs continued to center economic power. Many farmers emphasized the economic outcomes of alternative land access, often noting the ways in which ALAMs did not enable economic security or freedom. For example, one farmer noted that not owning farmland "does make things hard because you just don't have that traditional access to capital that you need because your sweat and emotional equity mean nothing." Multiple farmers referenced being unable to access traditional financing by leveraging owned land and cited this as a difficult outcome of alternative land access.

This demonstrates how ALAMs may valorize the financialization of land in the eyes of farmers and disadvantage those participating in ALAMs who are unable to compete with landowners who are better able to access capital.

The potential for ALAMs to reproduce inequities and injustices was another example of more transactional outcomes. Many farmers noted that despite engaging in apparently equity-driven processes and models of land access, power hierarchies persisted. This manifested as farmers remaining beholden to powerful entities who facilitated alternative land access. One urban farmer reflected on her relationship with the non-profit board who owned the land, noting "it's a little bit discouraging just because when you combine bureaucracy and nonprofits, it gets very messy in terms of politics." This farmer noted that the power imbalance between the non-profit's board and the farmers resulted in farmers having to make demeaning pleas to the board for basic infrastructure such as toilets. Uneven power between farmers and governing or facilitating entities was a common theme. Perhaps one of the most clear and compelling examples of how ALAMs may function to perpetuate social hierarchies was summarized by a farmer engaged in a land rematriation process in partnership with Agrarian Trust. This farmer reflected,

> the tribes in Massachusetts and Connecticut, and Rhode Island, they had to use a guardian system… Those people actually had control over the land and whenever a native family wanted to sell land, they had to go through this guardian. It felt like a reverse, which was funny that Agrarian Trust was like this guardian that they were helping acquire land. In the same sense, you could say that a similar structural reality continues across time. That the colonial order is essentially the same.

This powerful reflection demonstrates how land access alone may not be sufficient for transforming property relations. Instead, horizontal and relational land access processes are required to dismantle racist and colonial relationships.

### 3.5 Discussion

To unpack the potential of ALAMs to contribute to agroecological transformations, we applied Fraser's (1995) theoretical framework of affirmative and transformative remedies to injustice. Many farmers expressed transformative motivations tied to subverting the private property regime; however, transformative motivations existed alongside motivations that affirmed the centrality of private property within agricultural production systems. Farmer motivations are indicators of the potential roles ALAMs may play in transforming property relations. While the value of subversive motivations seems self-evident, we contend that affirmative motivations are also valuable and warrant critical consideration.

Whether ALAMs expand access to farmland in ways that subvert or affirm the centrality of private property, processes that redistribute land inherently redistribute power and are therefore foundational to processes of political transformation (Davis, 2010). In this way, the role of ALAMs in transforming property relations may be understood through the lens of non-reformist reforms (Gorz, 1967), which have been useful for parsing the tension of community land trusts' transformative intentions and affirmative impacts (Meehan, 2014; DeFilippis et al., 2019). In the context of this research, non-reformist reforms may comprise pathways towards equitable land access

that do not inherently transform formal property rights (Calo et al., 2021). Through the lens of agroecology, non-reformist reforms can also be framed as transition pathways. Transitions constitute more contained sociotechnical shifts that make systemic and structural transformations possible. While not inherently transformative, ALAMs do inherently enact plural possibilities for accessing and relating to land. These possibilities expand who has access to land, which over time may engender transformations within the markets, policies, and cultural norms that maintain private property (Holt-Giménez et al., 2021).

The tension of conceptualizing ALAMs and farmer motivations as simultaneously affirmative and transformative suggests that ALAMs may constitute a 'third space' in which property relations are reimagined through complex and iterative social processes. The concept of the third space is used to theorize sites of contestation and hybridization produced by clashes between old and new regimes, structures, or cultures (Bhabha, 1994). At the interstices of the old and new, space emerges to challenge assumptions, generate new ideas, and collectively renegotiate core concepts such as identities, language, and cultural norms (Ajates, 2021). In this framing, ALAMs can be understood as sites where farmers attempt to enact alternatives to the material, cultural, economic, legal, and political norms of private property even as they remain embedded in the systems and structures that constitute private property as a hegemonic regime. Our analysis suggests that within this process, farmers engaging with ALAMs are forming new identities. This was evidenced by the tension many farmers expressed between a

desire to maintain autonomy and their desire to form agricultural collectives or commons. Considered through the lens of political subject formation, this may indicate a process of shedding individuated capitalist identities and cultivating identities centered on collective wellbeing and community-based economies (Roelvink et al., 2015). Relinquishing the identity or perception of the farmer as a rugged individualist (Calo, 2020b) challenges both the liberal ideology and neoliberal economic logics that are inextricable from private property and industrial agrifood systems. ALAMs may offer sites to reform identities through new relationships with land and others.

Conceptualizing ALAMs as a third space also highlights their value as material and conceptual spaces for imagining agricultural production beyond the confines of the private property regime and industrial agriculture. By facilitating collective (re)imagining of land and property logics, ALAMs can play an important role in pre-figuring just futures (Calo et al., 2021; Leitheiser et al., 2022). Challenging existing conceptualizations and enactments of property, many farmers shared notions of property divorced from the ownership model while others grappled with the discomfort of forming a new understanding of property and ownership. Situating these tensions amidst Blomley's (2013) notion of property as 'materialized through the iterative and symbolic actions of people', ALAMs can be understood to provide sites for iteratively enacting new notions of property. This is vital, as transforming agrifood systems towards agroecological futures is dependent on transforming how property is both conceptualized and expressed (Calo et al., 2021; Holt-Giménez et al. 2021).

The processes and outcomes of enacting ALAMs also have bearing on what kinds of property relations and logics it is possible to imagine. In our analysis, transactional processes and outcomes aligned with affirmative motivations that recentered private property; relational processes and outcomes, on the other hand, pointed to new imaginaries around land-based relations, agricultural production, and justice. This was evident in farmers' emphases on (re)establishing place-based relationships as a pathway to cultivating just and resilient agrifood systems. In enabling new relationships to land, ALAMs have the potential to challenge what Trauger (2014) identifies as the episteme of ownership, or the sets of principles and types of knowledge that determine land access and agricultural production processes. I propose that an alternative may be an episteme of commoning, which might be understood as property and land access regimes constituted by principles and ways of knowing that center relationality, pluralism, and interdependence.

In fact, (re)imagining the role of communal and cooperative land access in agriculture is one of the ways in which ALAMs may contribute to agroecological transitions. Most farmers mentioned social relations when discussing both their motivations for engaging with ALAMs and the processes and outcomes of enacting these models. These social relations comprised relationships with self, family, farmer peers, community, and future generations. While not all ALAMs enacted by farmers identified as commons, the emphasis on social relations can be framed in the context of Caffentzis & Federici's (2014) definition of commons as the social relations that form around and

constitute material realities. Considered in this light, it is evident that ALAMs can play an important role in not only redistributing and reimagining land ownership in a physical sense, but also in reimagining and enabling land-based social relations. This constitutes ALAMs as political projects capable of challenging the limitations on social relations imposed by capitalist and neoliberal economic logics that define industrial agriculture and private property. This does not, however, guarantee that ALAMs inherently challenge these logics; Ajates (2021) highlights that cooperative and collaborative agricultural endeavors can be subject to processes of neoliberalization. This highlights that while ALAMs have an important role to play in reimagining possible land relations and agricultural production beyond private property, imaginaries enable, but do not ensure, just futures. As Caffentzis & Federici (2014) note, the hegemony of capitalist relations renders all commoning projects transitional attempts to enact just futures from within the confines of present realities.

### 3.5.1 Reflexive Discussion

I entered this research with the assumption that cooperative, communal, and community-based forms of land access were inherently superior to private property ownership. In analyzing farmers' motivations to engage with ALAMs, however, I came to realize that my assumption around what constitutes a desirable or just form of land access was intrinsically tied to my own positionality. As a critical friend pointed out, my internal hierarchy of land access was overlaying whiteness onto my analysis of private property. It is perhaps too easy to dismiss a socio-political institution that I have not been

systematically excluded from. Although I entered this work intellectually aware of the need to situate land access amongst uneven histories, I came to realize I did not have a firm grasp on what that process required of me as a researcher. Situating land access amidst histories of violence and oppression is not -cannot be- merely an intellectual act. Rather, this requires researchers to engage in reflexivity and bring a willingness to consider personal histories and positionality within the analytical process of sense-making. It bears mentioning that reflexivity alone does not go far enough. I am committed to sharing this work back with my research partners and allied organizations to identify how I can leverage my positionality and research to serve collective struggles for land justice.

## 3.6 Conclusion

In their analysis of the transformative potential of community land trusts, DeFilippis et al. (2019) quote Davis (2010) in declaring that there is "a contest [underway] for the soul of the community land trust," understood as the potential of community land trusts to function as tools of transformation and facilitate social change towards just and equitable property relations. If not, perhaps, a battle for the soul of ALAMs, it is an important time to identify the motivational energies that animate various ALAMs and their potential role in transforming property relations.

Our analysis indicates that farmers engage with ALAMs for diverse and complex reasons. We identified transformative motivations as those centered on subverting private property. Affirmative motivations, on the other hand, seemed to recenter private property

as a cultural ideal and reinforced liberal ideology. Rather than being mutually exclusive, however, transformative and affirmative motivations coexisted in nearly all of the individuals we interviewed. Similarly, there were both relational and transactional elements within nearly all processes of enacting ALAMs. These tensions suggest that ALAMs constitute third spaces, or "innovative sites of collaboration and contestation," which are vital for collectively pre-figuring just futures (Bhabha 1994). Conceptualizing ALAMs as third spaces highlights the potential for these models to serve as domains of transformation where the niche of alternative land access interfaces with the dominant private property regime (Anderson et al., 2019). This, in turn, illuminates the potential role of ALAMs within broader processes of agroecological transformation.

In order for property relations to be internally coherent with agroecology, there must be plural processes and models for accessing farmland. A singular conceptualization of property, property rights, land access, or land ownership inherently perpetuates hierarchy and invisibilizes diverse relationships between humans, land, and non-human nature. Furthermore, no property rights regime will be legible or equitable across the many social-ecological contexts that exist in the US (Quinn et al. 2007). We contend that ALAMs are necessary to ensure a plurality of land access and ownership pathways capable of aligning with the histories and social-ecological particularities of diverse contexts. Future research should seek to clarify what models work well in which contexts, how they function across diverse assemblages of actors and agroecosystems, and, perhaps most importantly, who they benefit. We echo Calo et al. (2022) in asserting

that it is necessary to reckon with the hegemony of the private property regime to advance agroecology in the US.

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# CHAPTER 4: RELATIONSHIPS & PEDAGOGY FOR PREFIGURING AGROECOLOGICAL FUTURES

In this concluding chapter, I explore conceptual and practical linkages across Chapters 1-3. To do this, I use Anderson et al.'s (2019) domains of transformation framework. First, I focus on enabling and disabling forces across the domains of knowledge & higher education (Chapter 1), soil health discourses (Chapter 2), and land access (Chapter 3). Whereas relationship-building proved to be a powerful enabling force, governance structures and processes often inhibited relationship-building and constituted a disabling force across all three domains.

Following this analysis, I explore the connection between transformative learning and cultivating capacities to engage in agroecological transitions. Specifically, I propose transformative learning as a potentially powerful enabling force to facilitate shifts towards agroecology. I develop this argument with examples from Chapters 1, 2, and 3. I conclude the dissertation by reflecting on connections across transformative learning, research, and the shifts in governance that are required for transitions towards socially just and ecologically resilient agrifood systems (González de Molina, 2013; Anderson et al., 2019; Anderson & Anderson, 2020).

## 4.1 Enabling & Disabling Forces for Agroecological Transitions

Each chapter in this dissertation explores what Anderson et al. (2019) identify as a domain of transformation, or "discernible sets of relationships, norms, rules and activities, where enabling and disabling dynamics emerge from niches in relation to the

dominant regime." In Chapter 1, I explore agroecology education in a university setting; this falls under the domain of 'Knowledge & Culture.' My work identifying diverse meanings of soil health (Chapter 2) sits within the 'Discourse' domain. And, in Chapter 3 I explore land access, which is a vital component of the 'Access to Natural Resources' domain.

Each domain constituted a site of contestation between a niche and a dominant regime. In the context of agroecology education, both the teaching team and students struggled to enact horizontal pedagogies and integrate diverse ways of knowing while embedded within a colonial and neoliberal institution that perpetuates both social and epistemic hierarchies. Within soil health discourses, there was a tension between the holistic framing that many farmers and Extension professionals employed and the dominant, Western scientific framing, which obscures social determinants of soil health. Finally, farmers engaging with ALAMs struggled to enact alternatives to the dominant private property regime. In each of these domains, there is potential for agroecological transitions, whether through transformative pedagogies (Chapter 1), holistic discourses of soil health (Chapter 2), or more equitable models of farmland access (Chapter 3). Whether these transitions succeed and contribute to broader processes of transformation, however, is mediated by enabling and disabling forces.

Despite the diversity of issues comprising my dissertation, I identify relationship building as a common enabling force across all three domains. In Chapter 1, students' "capacity for systems thinking developed alongside [their] perceptions of the importance

of relationships in agroecology" (Horner et al., 2021). Both relationship building and systems thinking, in turn, contributed to students' formation of a more critical consciousness, whereby they grappled with their positionality as 'more-than-consumers' and questioned how power operates in agrifood systems. Peer-to-peer learning and the opportunity to form relationships with farmers through experiential education on farms constituted powerful forces that supported students in shifting how they perceived agrifood systems and their role(s) within them.

In my second chapter, farmer-to-farmer relationships were central to how farmers learned, talked about, and managed for soil health. Farmer networks and farm walks, in which farmers shared experiential knowledge about the impact of management practices on soil health, were repeatedly cited as key forces that shaped farmers' understanding of soil as a component of wider agroecosystems. Recounting a pasture walk with another farmer, one interviewee reflected,

> I remember being struck by [him] talking about how he would graze the high areas and the low areas separately and just very organically being able to respond to a landscape rather than impose a will on it. I think that's what hooked me, and then… you start talking about soil health and carbon sequestration and all that.

In this way, relationships with peers enabled farmers to develop holistic and context-dependent discourses of soil health. Such discourses constitute a transition towards agroecology insofar as they move away from "reductionist approaches focused on indicators" and turn towards honoring "the holistic nature and complex interactions of [agroecosystems]" (Anderson et al. 2019). The opportunity for farmers to cultivate long-

term relationships with Extension professionals also showed promising potential to support holistic and context-dependent approaches to soil health.

Finally, in Chapter 3 I identify relational processes as enabling new relationships between people and land. In some cases, land access processes that centered relationships enabled collective governance. One farmer reflected, “we’re trying to develop our own relationship with one another as our local Commons Board. We’re figuring out our particular vision as a Commons.” Making decisions and envisioning futures collectively constitutes a transition away from the liberal ideology associated with the dominant private property regime. For other farmers, removal of the financial burdens typically associated with land ownership enabled deeper community relationships; one farmer explained, “because we [didn’t] have to spend money on the land, we’re able to do more for the community freely.” For many, the capacity to cultivate new relationships with others was grounded in new relationships with the land itself. In cultivating new webs of relationships between people and land, farmers enacting ALAMs prefigure just futures in which land access and property relations are not wholly determined by the private property regime.

In considering how relationship-building acted as an enabling force across each of these domains, I echo Bethea (2021) who contends that transformative processes must be relational. This aligns with a substantial and growing body of agroecology literature, which asserts that social dynamics are a vital component of agroecological transformations (González de Molina, 2013; Pimbert, 2017; González de Molina &

Lopez Garcia, 2021). Transactional processes, by comparison, may enable technical shifts that serve certain people in certain contexts. While such shifts should not be discounted, they are unlikely to enable social-ecological transformation of agrifood systems absent a concomitant shift in governance processes or social relations (Anderson et al., 2019). The importance of relational processes and relationship-building as enabling forces indicates that where agroecological transition is the goal, time and resources should be allocated to build horizontal relationships and establish trust. Such processes constitute vital movement away from the social and epistemic hierarchies that impede collaboration and collective organizing.

Governance structures and processes, however, often function to entrench hierarchy and power imbalances that impede relationship building. Across all three domains explored in this dissertation, governance structures and processes constituted a powerful disabling force. In both Chapters 1 and 2, agroecological transitions (towards transformative agroecology education and holistic discourses of soil health, respectively) were constrained by the governance structures of the University of Vermont. Within the knowledge & culture domain (Chapter 1), enacting transformative pedagogies was difficult within the neoliberal university context, which tends to emphasize education primarily as a pathway for workforce development rather than a site for forming students' political subjectivities. This complicated implementing pedagogies aligned with transformative agroecology in several ways. First, students struggled with the discomfort of a radically different approach to education; as paying 'customers' acculturated to a

'banking' system of education (Freire, 1968), they often wanted information to be provided and balked at the responsibility of co-creating their educational experience. Second, in a neoliberal university context, there is limited institutional support for the additional time and resources required to develop and implement transformative pedagogies or assess transformative learning outcomes. A teaching team model proved to be a key strategy for overcoming the disabling governance structure of the University context, once again demonstrating the power of relationship-building to enable agroecological transitions.

The University of Vermont's institutional priorities and governance structures were also a disabling force in Chapter 2. The University's failure to provide base funding to Extension professionals was identified by both farmers and Extension professionals as a key factor constraining farmers' capacity to promote soil health. Extension professionals identified that ongoing federal funding cuts to Extension services nationwide compounded the disabling governance forces within the University. The resulting reliance on grants limited Extension professionals' ability to respond to farmer needs, as Extension agents were beholden to grant deliverables and timelines. Along with staff cuts and turnover arising from the University's economic priorities, the governance structure within UVM Extension impeded the long-term, collaborative efforts that farmers and Extension professionals identified as a necessary foundation for a holistic approach to soil health. The impact of university governance within both Chapters 1 and 2 raises questions around which institutions are capable of and amenable to supporting

agroecological transitions. For example, What roles can universities play in facilitating agroecological transitions? and, What are the institutional governance shifts required to enable universities to contribute to agroecological transitions? Such questions constitute important sites for future research.

In Chapter 3, governance structures aligned with the private property regime constituted significant disabling forces constraining efforts aimed at equitable farmland access. Specifically, farmers engaging with ALAMs bumped up against landowners or organizations facilitating alternative land access who, intentionally or unintentionally, maintained uneven power dynamics. One farmer described the ways in which economic inequality across farmers and those facilitating alternative land access complicated the process, stating, “That power dynamic - they’re more privileged or we’re embarrassed that we don’t have the money - that’s so uncomfortable.” This quote demonstrates how the ongoing primacy of economic power in determining who has access to resources can constrain collaborative efforts towards equitable processes of farmland access. Another farmer noted similar experiences with entrenched power dynamics between farmers and those facilitating alternative land access, explaining “They used operational paralysis to not allow us to enter into an efficient lease agreement. We were technically farming… with no security, no insurance, no assurance that we could continue or what the future would look like.” Entrenched power dynamics were repeatedly identified as constraining efforts to enact equitable models of farmland access. This points to the need for systemic

economic and policy changes to address power and governance lock-ins that reproduce the private property regime and inhibit transitions towards alternative property relations.

### 4.2 Transformative Learning

Enacting agroecological transitions requires shifts in what is perceived to be possible beyond the industrial agrifood regime (Leitheiser et al., 2022); this, in turn, requires changes in how people perceive the world. In this sense, a disabling force constraining agroecological transitions is the hegemonic perception that there is only one way of organizing social-ecological relationships in the context of agriculture. Broadly speaking, such perceptions have been described as a one-world world (Escobar, 2011). The question for agroecological transitions then becomes, how do we shift perceptions to enact other worlds in which socially just and ecologically resilient agrifood systems are possible?

In confronting this complex question, the concept and praxis of transformative learning, a concept developed by Mezirow (1978) in their analysis of formal educational processes, may be valuable. Transformative learning produces a shift in a student's frame of reference. Such shifts occur as meaning and understanding are (re)constructed through experience and reflection (Mezirow, 1991; Probst et al., 2019). In Chapter 1, I identify experiential learning and peer-to-peer learning as key pedagogical approaches that enabled transformative learning. For students, transformative learning comprised relationship-building, systems thinking, deeper engagement with issues of social justice, and a sense of empowerment to participate in agroecology and related social movements

(Horner et al., 2021). Through this process, students formed a more critical consciousness of agrifood systems, implying that transformative learning may provide pathways for forming individuals capable of both envisioning and engaging in agroecological transformations.

Importantly, transformative learning can (and does) happen outside of classrooms and formal educational contexts. Building on findings from Chapter 1, I argue that ALAMs constitute important sites for transformative learning insofar as they provide examples and experiences of land access, agricultural production, and property relations beyond the private property regime. In describing how engaging with ALAMs influenced their visions of the future, some farmers reflected on historical examples of diverse property relations. One farmer noted, "with Native people, there's a long story of cooperative or collective ownership within this colonial legal system. Then with African Americans, we also have a very long history of cooperative economic development." Examples of alternative land access shaped this farmer's perception of possible place-based social-ecological relations beyond the current constraints of the private property regime.

Other farmers looked to the future and described how experiences with ALAMs allowed them to, as one farmer put it, "imagine newness." This farmer shared,

> A cooperative is important because it inherently, in my opinion, makes the idea of hierarchy less interesting… How can we work together in a way that doesn't default to these other power dynamics that we're used to? When I think of cooperative ownership, it is definitely not the norm. That's why you can't just say we need cooperative ownership, collective ownership, and to dismantle capitalism without understanding how long [they've] been entrenched and embedded in our

> systems. It is not going to just go away because we have a couple of workshops. We have to do some serious, simultaneous unlearning.

This quote emphasizes the importance of experiencing and iteratively grappling with alternatives to the entrenched power dynamics of private property. In juxtaposing ongoing experience and ineffective workshops, this farmer alludes to transformative learning, which includes processes of unlearning in order to imagine and enact forms of collective food production that are not circumscribed by disabling forces such as hierarchical and capitalist logics. These examples confirm that transforming agrifood systems requires shifts in what is perceived to be possible. Reflecting on alternative approaches to land access, whether via personal experiences or historical examples, enabled farmers to envision property relations and agricultural production outside of private property.

In struggling to enact agroecological transitions, farmers may simultaneously experience transformative learning while also providing examples for others to expand their own perceptions of possible agrifood systems (re)configurations. Two important implications stem from this observation. First, agroecological transitions themselves constitute powerful pedagogies for teaching and learning about what is possible. Applying an expansive notion of pedagogy illuminates the value of transitions as 'agroecological lighthouses' (Altieri, 1999; Nicholls & Altieri, 2018) and provides a conceptual linkage to broader processes of transformation. Insofar as examples of agroecological transitions provide opportunities to expand notions of what kinds of agrifood systems are possible, they support transformative learning. This leads to the

second observation: transformative learning may serve as a key enabling force across multiple, if not all, domains of transformation. In addition to envisioning alternatives, transformative learning cultivates capacities to enact new possibilities; these may include practical skills (such as navigating the legalities of alternative land access or building on traditional and indigenous knowledge to produce food in harmony with nature) as well as intra- and inter-personal skills cultivated through processes of collective (un)learning.

As Anderson et al. (2019) note, however, collective capacity to enact transitions towards agroecology are often constrained by governance systems and structures that allocate power unevenly. This raises the question of how existing transitions towards agroecology might enable the governance shifts required for broader transformations. In considering this question, I return to the concept of farmer basic income (FBI) proposed in Chapter 2 to explore how transitions in soil health discourses legitimize a shift in how resources are allocated to support soil health.

In Chapter 2, I identify that the primary factors constraining farmers' efforts to promote soil health are primarily social. One important constraining factor is access to the capital required to implement recommended best practices or trial innovative management strategies. Access to financial capital, along with other social determinants of soil health, were emphasized within holistic and context-dependent discourses of soil health. Within these discursive framings, farmers and Extension professionals highlighted how social forces and factors, including access to financial capital, mediate farmers' capacity to optimize soil chemical, biological, and physical properties. Holistic

discourses of soil health thus integrate social and ecological factors in alignment with a(n) (agroeco)systems thinking approach that considers soil health within wider social-ecological systems. Applying a holistic discursive framing of soil health within policy-making processes thus has the potential to highlight the connection between farmer livelihoods and soil health outcomes. This, in turn, justifies direct financial support for farmers as an investment in soil health, potentially legitimizing proposals for something like FBI.

Considering FBI demonstrates how transformative learning might drive shifts in the governance structures and processes that constrain agroecological transformations. Shifting conversations around soil health towards more holistic framings illuminates the social foundations of agricultural decision-making, with potential implications for policymaking and resource allocation. Similarly, examples of agroecological transitions can function as transformative pedagogies to shift perceptions of what is possible. There are multiple possible mechanisms through which such perceptive shifts can occur, which allows for multiple transition pathways towards socially just and ecologically resilient agrifood systems. The intersection of learning processes, legitimation processes, governance, and agroecological transformations is an important site for future research and theorizing.

### 4.3 Towards Always-Already Possible Futures

This dissertation explores three domains of transformation in which students, educators, farmers, Extension professionals, and farmer advocacy organizations are

collectively and creatively enacting shifts towards agroecology. In academic literature and popular media, agroecology continues to be dismissed as an 'impossible' strategy for 'feeding the world' (e.g., Bellwood-Howard & Ripoll, 2020). Despite these emphatic and repeated dismissals, examples of agroecology and evidence of its efficacy continue to mount (e.g., Amador & Gliessman, 1990; Holt-Giménez, 2006; Nyéléni 2015; McCune & Sanchez, 2019). I hope that the findings presented in this document contribute to this body of evidence, as I identify shifts towards agroecology occurring within higher education, discourses of soil health, and equity-based models of farmland access. Based on comparative analysis across these domains, I identify relationship-building as a powerful force that enables agroecological transitions. Yet, the capacity to build and center relationships within transition processes is often constrained by entrenched power imbalances maintained by governance structures and processes operating at multiple scales, from the university to the federal government.

I propose that transformative learning can be a powerful force for enabling shifts in the governance structures currently constraining agroecology. Applying an expansive notion of pedagogy, extant examples of agroecological transitions can provide powerful pedagogical opportunities for collective reflection and (un)learning related to what is possible, which has implications for what is politically 'palatable'. While pedagogy is not often considered in the same breath as governance processes, I contend that to shift how power and resources are allocated requires shifting the processes by which we, as a society, come to understand agrifood systems. Considering how people come to

understand agrifood systems also provides a valuable opportunity to potentially expand the coalition of people collectively struggling under the banner of agroecology. This, too, may work to cultivate 'thick legitimacy' for agroecology (Montenegro de Wit & Iles, 2016) and support governance shifts towards inclusivity, equity, and justice.

In advocating for decolonial futures, Nishnaabeg scholar Leanne Betasamosake Simpson (2014) notes that "the process(es) by which we learn or come to know determine(s) how communities function." Simpson (2014) goes on to assert that decolonial futures require that Indigenous people learn on, from, and with *aki*, or land. While my work does not focus on decoloniality, in the spirit of solidarity in working towards just futures based on restorative relationships with land, I propose that collective, reflective learning grounded in agroecological transitions is vital for enabling broader transformations.

There is a substantial and brilliant body of agroecology scholarship critiquing the industrial agrifood regime and detailing the social-ecological benefits of agroecology. This work is important and necessary. There remains, however, a need for scholarship that centers collective visioning based on the always-already present enactments of agroecological futures; scholarship that itself prefigures just futures through research processes that center equity, epistemic plurality, and care. That is not to say that this dissertation embodies this ideal; rather, that it has been a venue for my own transformative learning process, through which I have come to perceive this need.

In my research across the three domains of agroecological transformation that I explored in this dissertation, I was struck by the power of people coming together to collectively (un)learn, grapple with the full complexity of agroecosystems, and enact alternatives to dominant regimes associated with the industrial agrifood system. In exploring education, soil health, and land access, I observed how people are planting logics of cooperation and care -for people, plants, animals, and land- amidst cracks in the foundations of liberalism, capitalism, and neoliberal economic logics. I hope I have captured the extent to which these processes, though imperfect and inherently incomplete, prefigure what socially just and ecologically resilient futures could look like in the context of US agriculture and some of the paths we might take to get there.

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# APPENDIX A – Chapter 2

## Figures

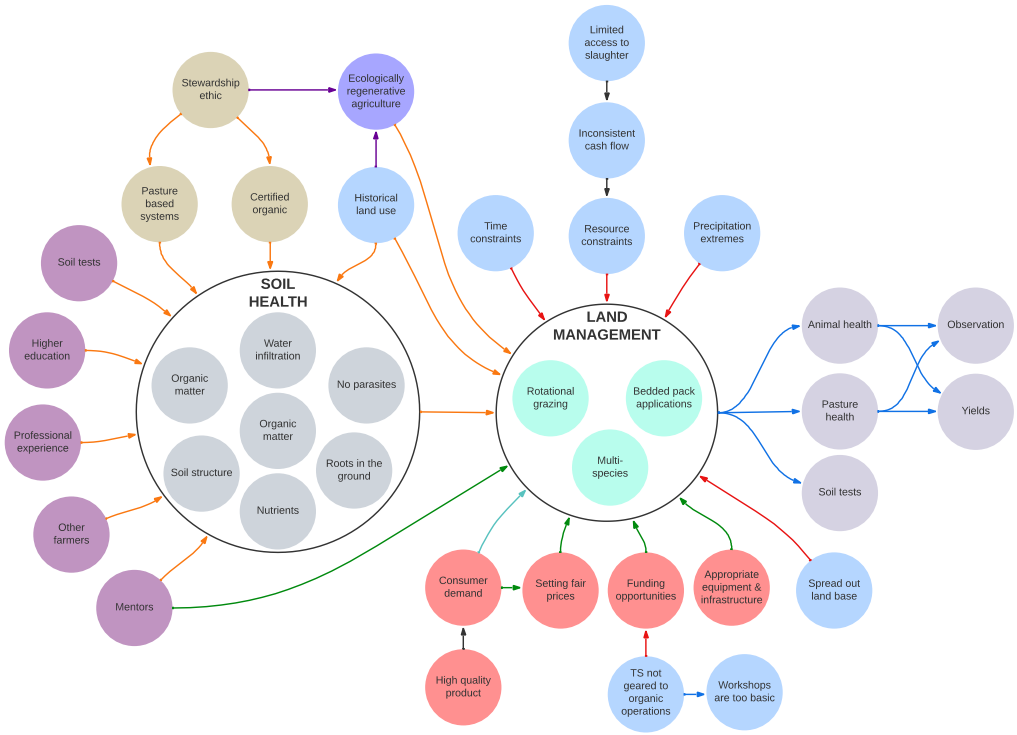


Figure 2.1 This is an example of an individual mental model of soil health co-created during an elicitation interview with an organic livestock farmer. The various colors of virtual 'post its' and arrows were used to group components of the mental model thematically and establish particular causal relationships between factors.

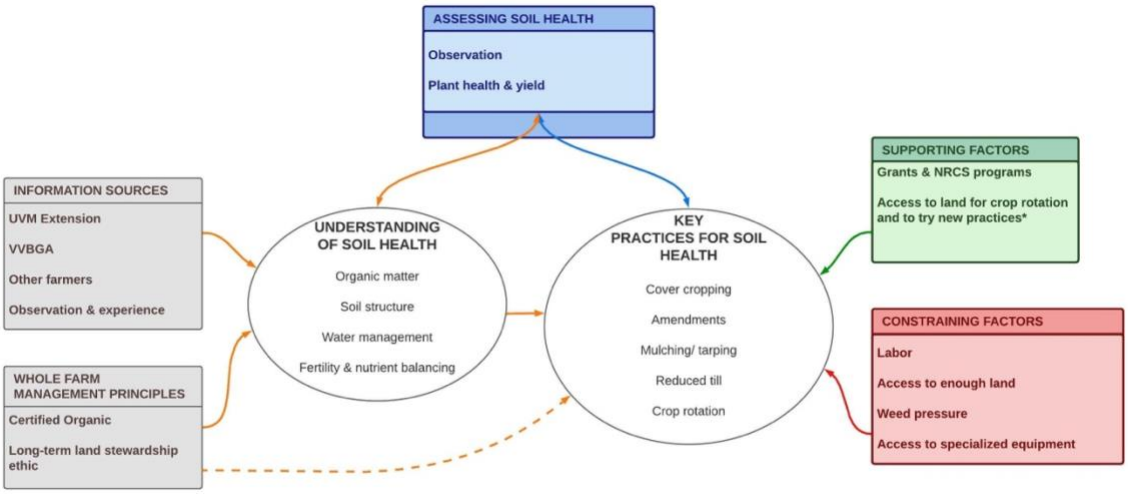


Figure 2.2 This is a grouped mental model created by combining the individual co-created mental models of 7 organic vegetable farmers. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

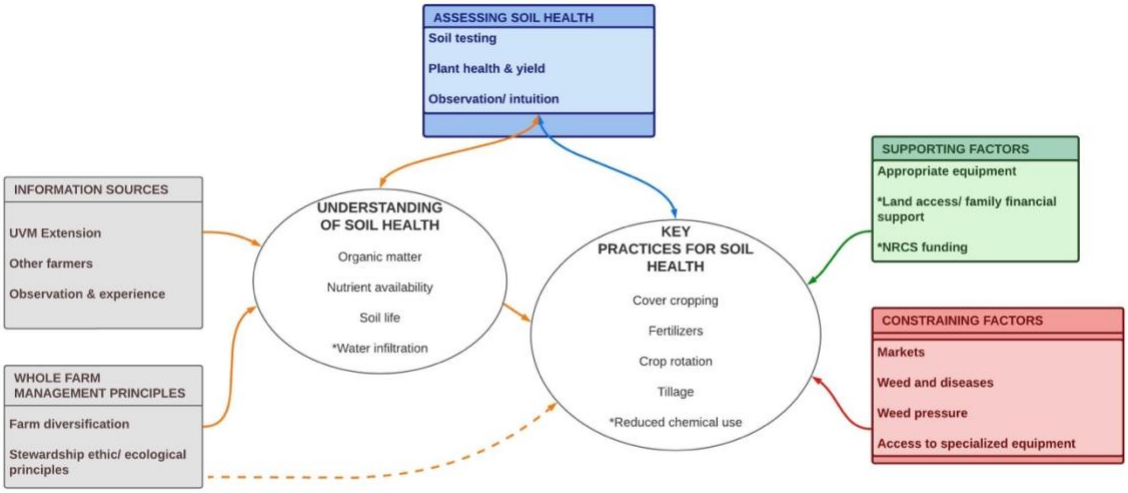


Figure 2.3 This is a grouped mental model created by combining the individual co-created mental models of 5 non-organic vegetable farmers. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

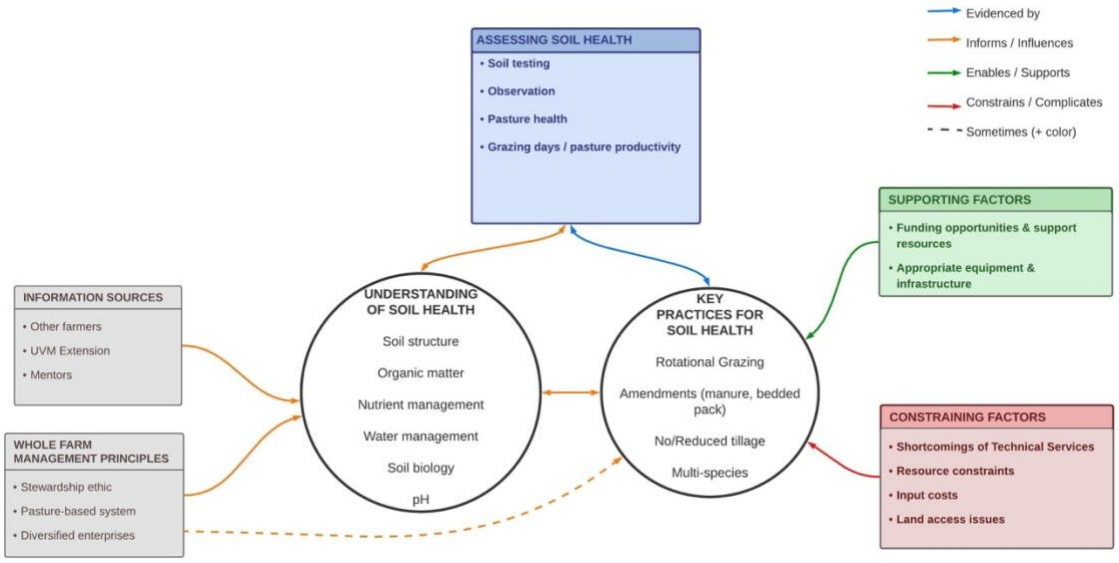


Figure 2.4 This is a grouped mental model created by combining the individual co-created mental models of 5 organic livestock farmers. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

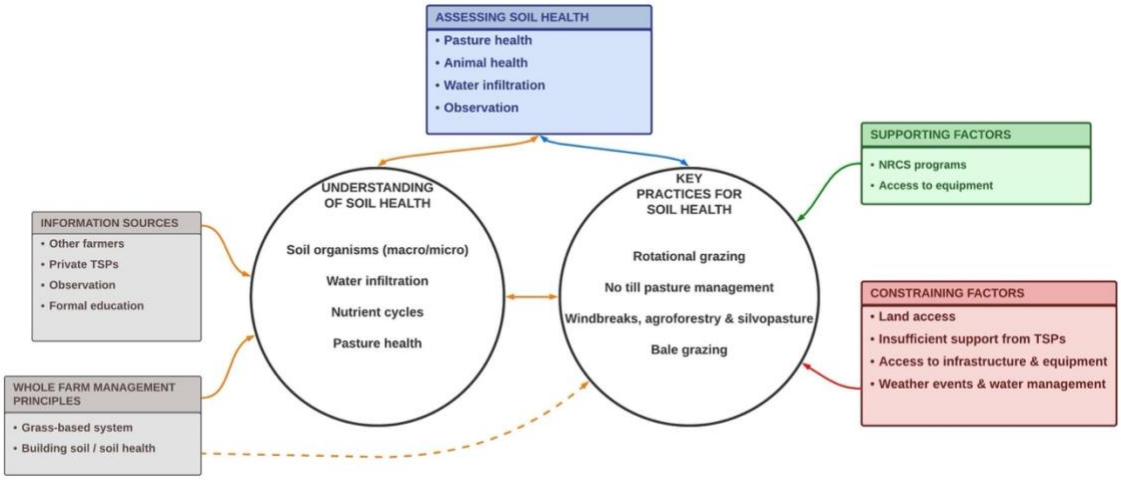


Figure 2.5 This is a grouped mental model created by combining the individual co-created mental models of 6 non-organic livestock farmers. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

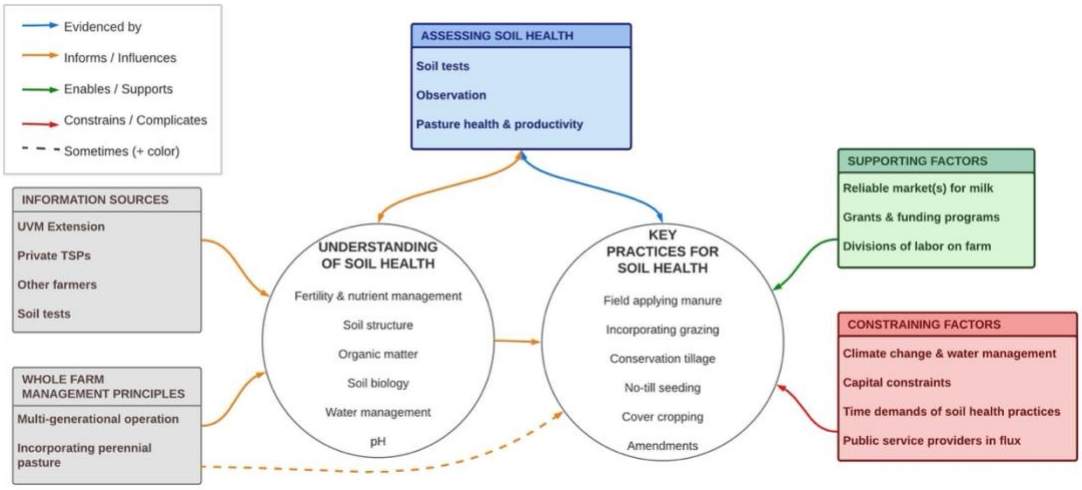


Figure 2.6 This is a grouped mental model created by combining the individual co-created mental models of 6 non-organic dairy farmers. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

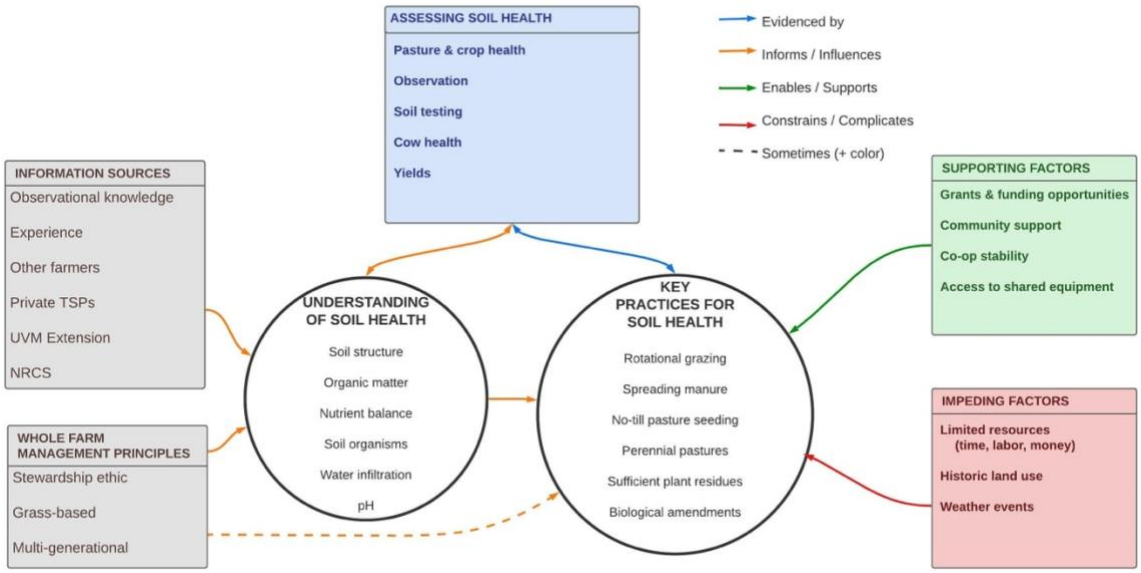


Figure 2.7 This is a grouped mental model created by combining the individual co-created mental models of 5 organic dairy farmers. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

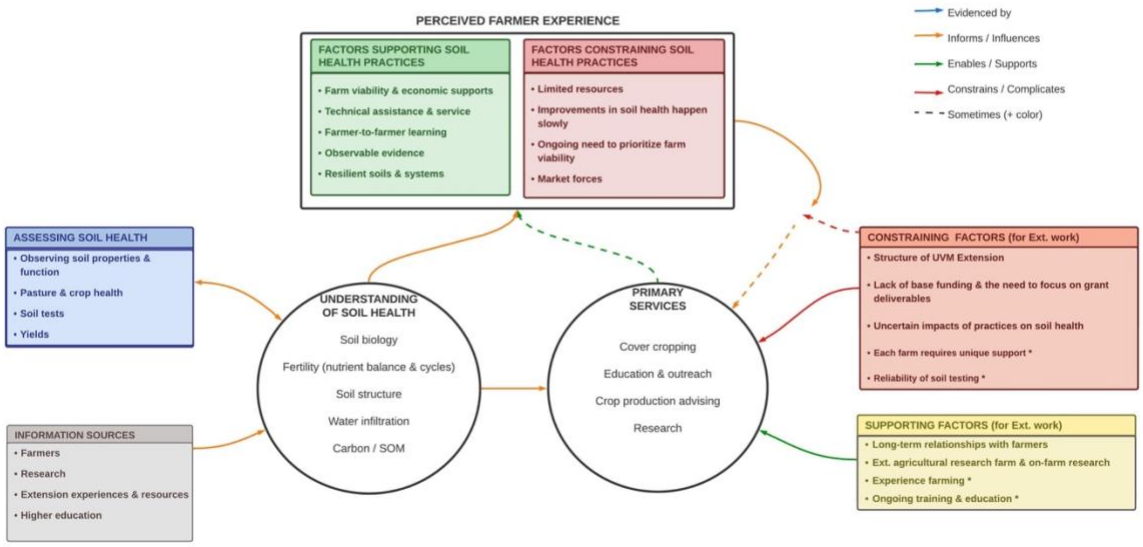


Figure 2.8 This is a grouped mental model created by combining the individual co-created mental models of 7 Extension professionals. The colors of the boxes and arrows were used to identify specific relationships for farmers during focus groups.

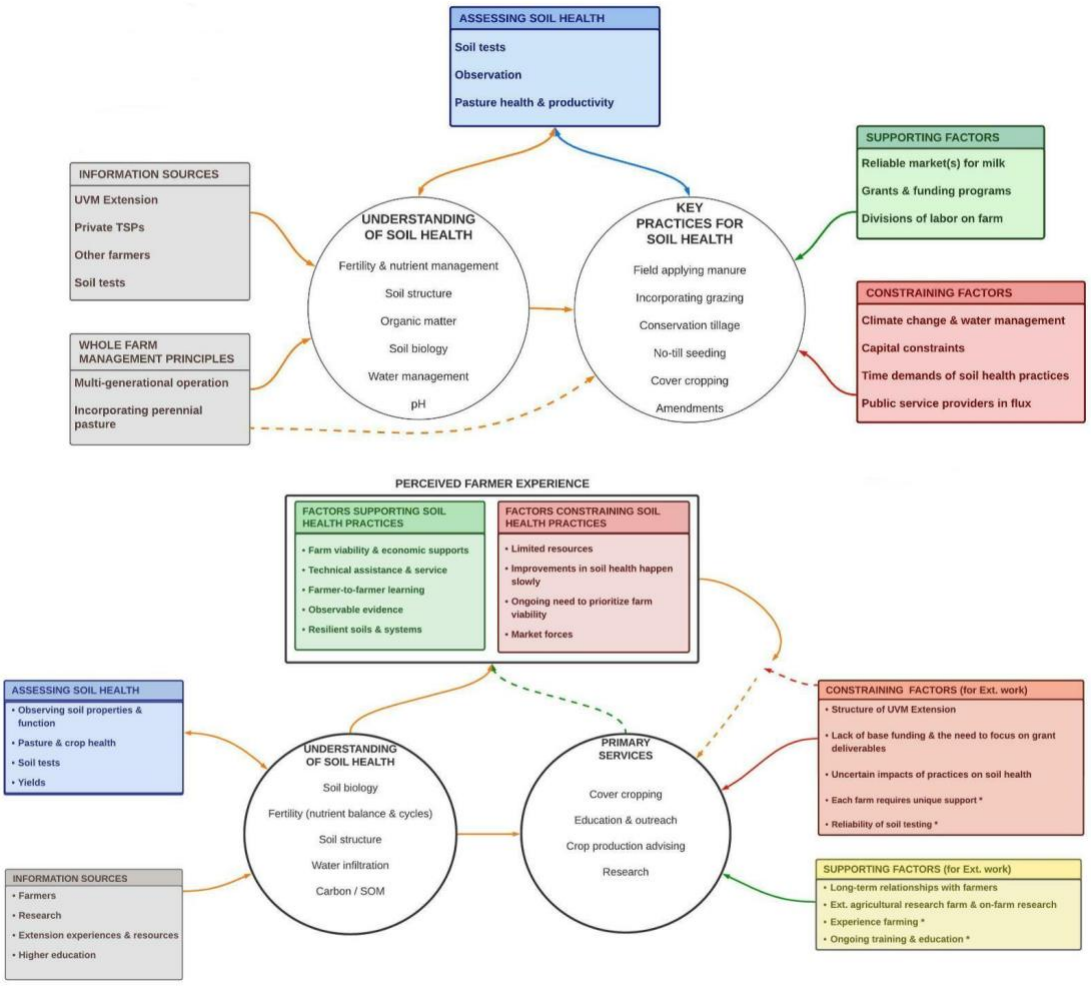


Figure 2.9 This is a comparison of the grouped mental models of soil health for non-organic dairy farmers and Extension professionals. These comparative images were presented to farmers during focus groups for feedback and participatory analysis. Each focus group of farmers saw a comparison of their group's mental model juxtaposed with the Extension professionals' mental model to enable comparisons between the two regarding similar and differing perceptions of soil health.

**Interview Protocol A - Farmers**

1. **Can you please describe your farm for me? (~5)**

- What are the main items your farm produces?
  - How many acres of land do you manage?
  - Do you own or lease the land you manage?
- What labels do you use to describe your farm (like organic, conventional, sustainable, etc.)?
- How many years have you been farming in total? and at your current location?

2. **What does 'soil health' mean to you? (~10)**

- How did you come to this understanding?
- How has your understanding of soil health changed over time?
- What resources do you rely on for information about soil health?
  - Who are the people that influence your soil health management decisions?

3. **Can you talk me through how you manage your soil health? (~25)**

- What practices do you employ to promote soil health?
  - What do you consider your most effective soil health practices?
    - Where did you learn about these practices?
    - How do you know if they're working?
  - Are there practices you want to try but can't? why not?
  - What are the primary ways you assess soil health?
    - Can you walk me through how you use that information?
    - How do you utilize soil testing, if at all?
- Do you face challenges implementing soil health practices on your farm?
- What could help you overcome those challenges?

4. CONCEPT SORTING (~20)

- *Group physical, chemical, biological dimensions of soil health*
- *Group practices, policies, norms, challenges, support tools…*
- ***Identify relationships / connections between grouped concepts***
- ***"How does X relate to Y"***

**Interview Protocol B – Extension Professionals**

1) **Briefly, can you describe your job for me? (3-5)**

- What are the main items produced by the farms you work with?
- What's the range of acreage that typifies the farms you work with?
- What are the most common labels that farmers you work with use to describe their farms?
- How many years have you been working with farmers in total, and in your current position?

2) **What does 'soil health' mean to you? (5)**

- How did you come to this understanding?
    - In what ways has your understanding of soil health changed over time?
- What information do you rely on when promoting soil health practices?
- Who are the people that influence your soil health recommendations to farmers?
- What aspects of soil health are of the most interest to you going forward?
- What do you think are the most important benefits associated with soil health?

3) **Can you talk me through how you support farmers in managing their soil health? (10)**

- What are the key practices you promote to farmers with regard to soil health?
    - What are the best ways to assess soil health?
    - What role do you think soil testing plays in soil health management?
- What do you consider the most effective soil health practices, and why?
- How do you help farmers adopt those practices?
- What would help you better support farmers?

4) **What do you see as the biggest challenges farmers face in prioritizing soil health? (10)**

- What are key challenges to implementing soil health practices farms you work with?
    - What is needed to help farmers overcome those challenges?
    - What do you think service providers could do to help farmers improve soil health?
- Are there soil health practices you want to educate about but can't? Why not?

5. CONCEPT SORTING (~30)

- *Group physical, chemical, biological dimensions of soil health*
- *Group practices, policies, norms, challenges, support tools…*
- Then, "How does X relate to Y?"
- ***Identify relationships / connections between grouped concepts***

**Focus Group Protocol – Farmers**

Part One – Grouped mental map analysis (30 min)

1. **Does this mental map reflect how you and your farmer peers discuss soil health?**
    a. What do we need to change so that this visual reflects your groups' understanding of soil health?
2. **What knowledge gaps do you see when you look at this visual?**
    a. What questions do you have when you look at this?
3. **What could shift some of the constraining factors?**
    a. What would the impact of those shifts be?
    b. What would a more robust support network for soil health look like?

Part Two – Comparing mental maps with Extension (30 min)

1. **How well does this visual align with your experiences working with Extension on issues related to soil health**?
    a. Do you see room for ways Extension could better support you and other farmers?
2. **What do you see as key similarities with your groups' mental map of soil health?**
    a. Do they understand soil health in a similar way to your group?
    b. Do they focus on similar key practices as your group does?
    c. Can you share an example of an interaction with Extension around soil health that went really well? Why do you think it went well?
3. **What do you see as key differences with your groups' mental map of soil health?**
    a. Can you share any examples that demonstrate how differences have come up in your interactions with Extension?
4. **What influences your motivation to collaborate with Extension around soil health?**

## APPENDIX B – Chapter 3

### Interview Protocol A - Farmers already engaged in ALAMs

*(Questions in bold, potential prompts below)*

1. **Can you please describe where you farm for me? (10 min)**
    - How many years have you been farming in total? and at your current location?
    - Who else is involved with the farm?
    - What legal structure or land use agreement are you operating under?
    - How many acres of land do you steward in total? And acres in ag?
        - Can you describe the composition of this place in terms of ecological systems (like wetlands) and land use?
    - What do you know about the history of the land?
    - What's special about the land you're on?
    - What drew you to farming?

2. **Can you tell me about the process you went through to be on this land? (10 min)**
    - What kind of land access model are you engaging with? (**for models besides AC)*
    - What drew you to this model?
        - How did you learn about it?
    - How long was the process?
    - How did the process feel for you?

3. **Why did you seek out an alternative to private land ownership? (15 min)**
    - What have your past experiences with land access been?
    - Why do you think alternatives are necessary?
    - Who do you think benefits from alternatives?
    - How would you describe your access to capital?
    - How do alternatives relate to your broader values or worldview?

**4. How has this model of land access impacted your approach to farming? (10 min)**

- What practices are different from what you did previously?

- How has your relationship with the land changed?
- How has your relationship with farming changed?
- How has your relationship with your partners changed?
- How has your relationship with your community changed?

**5. Can you describe some of the challenges you've experienced implementing this model? (~8 min)**

- What makes the challenges you mentioned stand out? (recent, particularly difficult, surprising…?)
- How are you navigating those challenges?
- What people or resources have you turned to for support?

**6. What are the most significant benefits you've experienced from engaging in this model? (~8)**

- Were you surprised by these benefits?
- How are you feeling about the future?

**Interview Protocol B: Land seekers (landless farmers and farmworkers)**

1. **Can you please describe your experiences working in food or agriculture? (5-8 min)**
    - How many years have you been doing this type of work? Where and for whom?
    - What drew you to farming?

2. **Can you tell me about the process of looking for land? (15-20 min)**
    - What made you want to find land // move away from existing work arrangement(s)?

- How long have you been engaged in the search process?
- Who else is involved - Do you have partners in your search?
- What barriers have you encountered?
- What people or resources have you turned to for support?

- What kind of land access models are you considering? (**for models besides AC)*

- What draws you to this model? *(*for AC)*
    - How did you learn about the commons model?

- How does going through this process feel for you?

**3. Why are you seeking an alternative to private land ownership? (15 min)**

- What have your past experiences with land access been?
- Why do you think alternatives are necessary?
- Who do you think benefits from alternatives?
- How do alternatives relate to your broader values?

**4. How would alternative land access impact your future farm plans? (5-8 min)**

- What practices might be different from what you're doing now?
- How do ownership structures impact your relationship with land?
    - …your relationship with your partners?
    - …your relationship with your community?

**5. How are you feeling about your future in agriculture? (5-8 min)**