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## EDITED BY

Carol Williams,  
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## REVIEWED BY

Anne Elise Stratton,  
University of Hohenheim, Germany  
R. Eugene Turner,  
Louisiana State University, United States

## \*CORRESPONDENCE

Tara Maireid Conway  
✉ conwa304@umn.edu

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# An agroecological turn in intermediating sustainability transitions with continuous living cover

Tara Maireid Conway\*

Forever Green Initiative, Department of Agronomy and Plant Genetics, University of Minnesota, Saint Paul, MN, United States

Continuous living cover's (CLC) perennial and winter annual crop varieties present a novel opportunity to increase the diversity and resiliency of agroecological systems in the Mid-Continent of North America. However, transforming the predominant agri-food regime remains a complex and daunting undertaking. In the face of such complexity, a recent body of literature highlights the particular importance of intermediaries in facilitating sustainability transition processes, which CLC agriculture's proponents can draw upon. Intermediaries can be defined as actors or organizations that positively influence sustainability transition processes by linking diverse entities, networks, institutions, activities and their related skills, knowledges, and resources. Simultaneously, agroecology, in the more political understanding of the term, can serve as an evaluative framework for agri-food transition processes to augment our understanding of intermediaries in sustainability transitions. This mini-review presents an overview of the emerging sustainability transition intermediary literature, an introduction to CLC agriculture's transition intermediaries, and the research gaps highlighted from an agroecological perspective. Integrating an agroecological lens attentive to the science, practice, and politics of intermediating agricultural transitions, this review proposes an adapted framework to understand and assess CLC agriculture's intermediaries. Thus, CLC agriculture presents a unique opportunity to iteratively draw upon and advance the sustainability transition intermediary literature.

## KEYWORDS

sustainability transitions, intermediaries, agroecology, continuous living cover, food systems

## 1. Introduction

Continuous living cover (CLC) agriculture offers a compelling alternative agricultural paradigm amidst our food system's compounding ecological and socio-cultural crises. The dominant summer annual cropping systems of the Mid-Continent of North America are highly productive, yet leave soil exposed for the majority of the year, resulting in an array of environmental disservices (Crews et al., 2018). In response, the University of Minnesota's Forever Green Initiative, Green Lands Blue Waters (GLBW), and partners are working to develop a suite of perennial and winter annual crops to augment the prevailing summer annual system to enhance soil coverage and deliver additional income streams to farmers, providing sustainable water management and other critical socio-ecological benefits. This modified agronomic system is aptly referred to as continuous living cover, due to its premise of providing consistent plant cover to the soils of the Upper Midwest, described elsewhere as "plant cover on the soil and roots in the ground all year long" (Jewett and Schroeder, 2015).

The emergence of the term “Continuous living cover” is most readily tied to the formation of Green Lands Blue Waters, an organization with a singular focus on advancing CLC, in 2004 ([greenlandsbluewater.org](http://greenlandsbluewater.org)). However, continuous ground cover has long been practiced as an Indigenous agricultural technique (Citizen Potawatomi Nation, 2020), and thus the premise of continuously covering soil with plant matter extends far beyond GLBW’s inception. GLBW describes CLC as five strategies: agroforestry, perennial biomass, perennial forage, perennial grains, and cover crops/winter annuals, and emphasizes the on-farm integration and stacking of these strategies (Green Lands Blue Waters, 2021). CLC’s inclusion of a suite of strategies to achieve on-farm diversity, and particularly CLC’s incorporation of marketable winter annual crops such as winter camelina (*Camelina sativa*) and pennycress (*Thlaspi arvense*), differentiates the approach from a singular focus on perennialization or cover cropping. CLC has been invoked as an example of multifunctional agriculture, or the simultaneous production of both ecosystem services and agricultural commodities (Jordan and Warner, 2010), and as a pathway to landscape level change toward more resilient agricultural systems (Runck et al., 2013). However, novel crops and cropping systems alone do not change food systems nor do they guarantee a more just and equitable system (Streit Krug and Tesdell, 2020). As such, CLC, as a suite of crops and cropping systems, must be distinguished from the approaches taken to move CLC into the landscape and the resulting socio-ecological systems.

For example, the Forever Green Initiative, a primary driver of CLC crop domestication and improvement [in the U.S. Mid-Continent], understands change to be driven in part by market pull, or the profitability of CLC crops for farmers. In practice, this means devising entirely new supply chains for novel grain and oilseed crops such as Kernza™ (*Thinopyrum intermedium*) and winter camelina (Forever Green Initiative, 2020) alongside robust research and development that must span plant breeding, agronomy, food science, and more. This crop system scaling process has elsewhere been conceptualized as sustainable commercialization (Jordan et al., 2016) and new food crop domestication (Van Tassel et al., 2020), both of which call for an integrated attentiveness to a crop’s genetics, agronomics, and socio-cultural infrastructure, including markets, policies, educational practices, and values. Proponents of CLC agriculture must contend with the “wicked problem” (Rittel and Webber, 1973; Peterson, 2009) of the dominant agri-food regime, specifically the complex interdependencies, uncertainty, and contestation inherent to altering the prevailing system.

In the face of such complexity and uncertainty, there is a growing body of literature that highlights the particular importance of intermediary actors in facilitating many aspects of sustainability transition processes (Kivimaa et al., 2019a; Kanda et al., 2020; Sovacool et al., 2020). Sustainability transitions have been defined as radical shifts to new kinds of socio-technical systems away from unsustainable consumption and production patterns (Köhler et al., 2019). The concept of transition intermediaries has strong ties with Geels’s multi-level perspective (MLP), which understands sustainability transitions to arise through interactions between three analytical levels: niches, regimes, and socio-technical landscapes (Geels, 2019). Niches are understood to be spaces for

radical innovation that operate outside of the prevailing regime, which is the locus of stability for the dominant socio-technical system, made up of an established web of rules, beliefs, practices, and institutions. Meanwhile the landscape level represents the wider socio-technical context, such as macroeconomic patterns, political ideologies, and material realities like climate (Geels, 2011). The MLP theorizes that rare “windows of opportunity” for transformation of entrenched regimes (e.g., industrial agriculture) can arise when bottom-up momentum from the niche level is met with landscape level pressure. Intermediaries are considered to be significant actors in orchestrating this niche-regime-landscape alignment and thus may prove critical to the advancement of CLC agriculture. However, both the MLP and the associated field of transition intermediaries have been critiqued for their (1) assumption that green innovations are inherently positive, (2) lack of interrogation of the outcomes or consequences of a socio-technical shift toward “more sustainable” innovations, and (3) their disregard for distributional consequences (Avelino and Rotmans, 2009; Lawhon and Murphy, 2012; Geels, 2019; Magda et al., 2021). Therefore, the study of CLC transition intermediaries can benefit from an additional lens that is attentive to such shortcomings.

CLC agriculture’s proponents in Minnesota aspire toward, “healthy soils, clean water, and a more resilient and equitable agricultural economy” (Forever Green Partnership, 2022) and claim that “CLC, implemented equitably with people and communities at the center, can bring about both environmental and social changes sorely needed in agriculture” (Green Lands Blue Waters, 2021). CLC crops must scale both widely across the landscape and deeply into culture, values, and mindsets (Lam et al., 2020) in order to realize these aspirations. This gap between CLC as a suite of scientific enterprises and CLC as a driver of regional agricultural, environmental, and social transformation is perhaps best assessed through the lens of agroecology, which seeks systemic transformation to build just food system futures (Nicklay et al., 2023). Agroecology can be understood as the integration of sciences, practices, and politics (Wezel et al., 2009; Bell and Bellon, 2021) where things like plant breeding, relationship-building, and food justice activism can intermingle to seek transformation. Agroecology is a participatory, action-oriented, and transdisciplinary framework (Méndez et al., 2013) with a political orientation toward supporting transformations led through community self-organization and participatory governance processes (Anderson et al., 2019). Currently, CLC agriculture can be described as agroecological only in the narrowest understanding of agroecology as a scientific approach of applying ecological principles to agriculture (Wezel et al., 2009). It remains undetermined as to whether CLC agriculture can be described as agroecological in the more political understanding of the term as a transformative process that centers power, governance, and democracy (Anderson et al., 2019). Thus, agroecology presents itself as an evaluative framework to assess the process of transformation to CLC agriculture, where intermediaries ostensibly function as potent agents of transformation in regional agri-food systems. This mini-review presents an overview of the emerging sustainability transition intermediary literature, an introduction to CLC agriculture’s transition intermediaries, and the prospective advancements highlighted from an agroecological perspective.

## 2. Sustainability transition intermediaries

Intermediary is a general term that refers to any individual, organization, or thing that serves as a link between multiple entities. The term has been employed in diverse fields from finance (Boyd and Prescott, 1986) to social networking applications (Sylvain, 2018), and in the case of this mini-review, sustainability transitions. Sustainability transition intermediaries are more specifically defined as, “actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources, or by connecting transition visions and demands of networks of actors with existing regimes in order to create momentum for socio-technical system change, to create new collaborations within and across niche technologies, ideas and markets, and to disrupt dominant unsustainable socio-technical configurations” (Kivimaa et al., 2019a). Noteworthy in the definition is the intrinsically positive understanding of transition intermediaries’ role in facilitating change, which warrants skepticism given that intermediaries are understood to have detrimental impacts in other fields ranging from agri-food supply chains (Huria and Pathania, 2018) to cultural taste-making (Edwards, 2012). This critique will be elaborated upon later in the mini-review, following an overview of the current literature on transition intermediaries.

Sustainability transition intermediaries are currently understood to advance transitions through bridging and brokering knowledge (Goodrich et al., 2020), transferring technology (Howells, 2006), enabling learning processes (Klerkx and Leeuwis, 2009), facilitating dialogue and social interaction among diverse stakeholders (Steyaert et al., 2016), creating new markets (Kivimaa et al., 2020a) mobilizing resources (Polzin et al., 2016), and political maneuvering (Kivimaa et al., 2020b). Their capacity to balance objectivity and subjectivity through clarifying and coordinating, while also eliciting diverse perspectives to inform their evolving understanding of complex situations is thought to be particularly important in the tackling of sustainability’s “wicked problems” (Steyaert et al., 2016). It remains contested whether transition intermediaries should strive for neutrality (Pielke, 2007; Klerkx and Leeuwis, 2009; Parag and Janda, 2014; Kant and Kanda, 2019) or if remaining neutral is possible given their inherent orientation toward change (Moss, 2009; Kivimaa, 2014). Despite the varying roles ascribed to intermediaries across the literature, they are consistently defined by *what they do* (Bergek, 2020), which is acting in-between networks, actors, institutions, scales, and/or spatial extents.

Although there is recognition that intermediaries can be formal or informal (Kivimaa et al., 2019a; Kanda et al., 2020) and range from individual actors to organizations (Köhler et al., 2019), the transition intermediary literature is primarily based on analyses of formal intermediary organizations in Europe. Representative examples include the Berlin Center of Competence for Water, which funds and coordinates regional water research and technology development (Moss, 2009); Doarpswurk, a semi-governmental organization that supports Frisian villages in resilient transition processes (Warbroek et al., 2018), and Malmo Cleantech

City, which supports the creation of jobs and employment in the clean technology sector (Kanda et al., 2020).

Kivimaa et al.’s (2019a) seminal systematic review of the sustainability transition intermediary literature resulted in a distillation of five types of intermediaries: systemic, which operate on all levels of a system and promote a change agenda; regime-based, which are tied to the prevailing regime but with a mandate to promote a transition; niche/grassroots, which attempt to experiment and advance a particular niche outside the predominant regime; process, which help facilitate a transition process in its day-to-day machinations; and user, which connect niche technologies to users and help articulate future demand to the broader socio-technical system. They found that while systemic and niche intermediaries hold particular importance, a robust ecology of all intermediary types is needed to support the multifaceted and dynamic process of a sustainability transition. Other research has indicated that intermediaries can have diverse and conflicting agendas (Kanda et al., 2020; Vihemäki et al., 2020) and that intermediary ecologies shift over time (van Lente et al., 2011; Kivimaa et al., 2019b). As such, interaction and coordination amongst various intermediaries is deemed essential (Mignon and Kanda, 2018). Additionally, transition processes are thought to have distinct phases, as in Kivimaa et al.’s (2019b) predevelopment, acceleration, and stabilization. Accordingly, intermediaries have particular roles in these phases, from supporting experimentation and making space for niche technologies in predevelopment (Kivimaa et al., 2019b) to creating markets, managing conflicts, and increasing cohesion during acceleration (Kivimaa et al., 2020a). The same intermediary may not be able to fulfill all these functions, potentially enabling excessive redundancy and competition amongst intermediaries as a transition process evolves (Kanda et al., 2020; van Boxtael et al., 2020). These diverse findings from the transition intermediary literature can be both drawn upon and advanced through applications to CLC agriculture.

## 3. Advancing the transition intermediary literature through CLC

Establishment of CLC crops and systems onto the landscape is a current, ongoing effort and as such, research related to CLC’s intermediaries is only recently emerging. For example, Muckey (2019) analysis of the viability of continuous living cover crop Kernza in Southern Minnesota cited effective communication and supply chain linkages as significant barriers to commercialization, while Ray’s (2020) research into CLC crop winter camelina’s supply chain development indicated a need for coordinated systems for research dissemination, collaboration with policy-makers, and general personnel capacity for systemic coordination. These early results indicated synergies between intermediaries and CLC supply chain development, specifically citing the lack of personnel to carry out intermediary functions as a significant barrier. Additionally, research on CLC crop technical service providers, who provide intermediary functions, indicates the critical importance of empathy, rapport, emotional intelligence, and relatability (Peters et al., 2021); elements that are mostly overlooked in the current sustainability transition intermediary literature.

More recently, emerging literature highlights that actors involved in the commercialization, adoption, and scaling of CLC agriculture actively identify as intermediaries (Cureton et al., *in review*) and that an intentional polycentric governance network is being built to systemically advance CLC agriculture (Jordan et al., *in review*). These contributions to the transition intermediary literature are novel, due to their reflexivity from an intermediary perspective and U.S. agri-food context.

Regarding reflexivity, Cureton et al. actively engage with Kivimaa et al. (2019a) intermediary typology and situate themselves, as CLC crop Kernza™ commercialization staff, as simultaneously operating within the systemic, niche, user, and niche-regime categories (Cureton et al., *in review*). Their contribution to the literature is rich with examples of CLC intermediary functions, with some examples including: brokering technology and technical resources to growers, cleaners, dehullers, millers, brewers, bakers, and more; observing and articulating innovation rhythms and trajectories to stakeholders; navigating tweaks to dominant policy regimes; incorporating novel crop varieties into cultural institutions; and systemically aligning niche-regime-landscape interactions to promote systemic transformation. While the authors consider Kernza™ to still be in early phases of commercial development, it is noteworthy that this group of CLC commercialization staff claims to transcend the boundaries of formerly established intermediary typologies. Additionally, Cureton et al.'s collective reflexivity is a welcome contribution to the literature, as there have been calls to intentionally introduce collective intermediary activities in research (Vilas-Boas et al., 2022), given the alleged importance of intermediary coordination. Relatedly, Jordan et al. (*in review*) cite the transition intermediary literature in their description of a “Learning and Experimentation Network” composed of individuals from various institutions working in the commercialization and scaling of CLC crops. This network convenes to share their experiences and learnings from sustainable supply chain development to help inform collective scaling efforts. However, Jordan et al. share reflections on the slow and difficult process of establishing the group as self-governing and self-directed, indicating that CLC intermediaries might not find much value in the group. Reflections on the complex, uncertain, and difficult work of scaling CLC crops is a worthwhile addition to transition intermediary literature, given the field's current focus on longitudinal, retrospective analyses that might flatten the lived complexity of sustainability transition processes (Murto et al., 2020).

### 3.1. CLC intermediaries as political actors

In addition to the ecological benefits of continuous living cover, such as improved soil health, water quality, and pollinator habitat, Jordan et al. (*in review*) underscore the importance of equity and social sustainability in their vision of diverse, regional CLC systems. Similarly, Cureton et al. highlight the incorporation of social sustainability research as a core approach to legitimacy-building for the novel perennial grain crop Kernza™ (Cureton et al., *in review*). Attentiveness to multiple aspects of sustainability has been mostly lacking in the current intermediary literature,

highlighted in Sovacool et al.'s findings that European transitions toward renewable energy systems have furthered injustice and intensified pre-existing vulnerabilities (Sovacool et al., 2021).

It should be noted that intermediaries, in their focus on linking diverse entities, are imminently concerned with building relations, and not all relationships are positive. For instance, food justice scholars point to racial capitalism and settler colonialism as defining sets of agri-food relations (Slocum and Cadieux, 2015; Black, 2022), indicating that our current system is not merely defined by an absence of connectivity but rather an undesirable set of relationships. Another prescient example lies in agricultural supply chain intermediaries, who have been charged with inflating food prices (Huria and Pathania, 2018), accumulating power through market consolidation, and exploiting farmers and farmworkers (De Fazio, 2016; Lakhani et al., 2021). Although supply chain intermediaries are distinct from transition intermediaries, the potential for negative outcomes through more connectivity in these examples warrants deeper consideration.

Instead, sustainability transition intermediaries are near-universally spoken of as inherently good despite the literature's occasional acknowledgment of intermediaries' diverse, conflicting agendas, competition, and potential for excessive redundancy. The seminal papers in the young field assert that intermediaries positively affect transition processes (Kivimaa et al., 2019a), are paramount during all phases of the transition process (Kivimaa et al., 2019b), and have a catalyzing effect on the processes they engage with (Klerkx and Leeuwis, 2009; Kanda et al., 2020). While there has been recognition that intermediaries can theoretically enable and disable transitions in equal measure (Janda and Parag, 2013; Kivimaa et al., 2020b) and calls to consider the negative impacts of intermediaries (Moss, 2009; Mignon, 2017), these suggestions remain mostly hypothetical and lacking in empirical engagement. This overly simplistic description of intermediaries is at odds with the complex nature of sustainability transitions, which understands change-making to be inherently political, defined by disagreements regarding the direction and steering of transition processes (Köhler et al., 2019), and always resulting in both winners and losers (Wigboldus et al., 2016). Cureton et al. acknowledge this dimension, citing their agency in potentially shaping CLC innovation trajectories and role in intervening when others attempt to change innovation trajectories in ways that are perceived to be at odds with more broadly shared values (Cureton et al., *in review*). Thus, Jordan et al. and Cureton et al.'s attentiveness to multiple and potentially conflicting aspects of sustainability transitions appears to be an important dimension to integrate in the transition intermediary literature. CLC agriculture provides an opportunity to further this area of inquiry, taking seriously the political agency of transition intermediaries.

### 3.2. CLC intermediaries as practitioners

Current findings are not yet robust enough to propose an alternative typology for CLC's transition intermediaries, primarily because the main findings to-date (Cureton et al., *in review*) are based on one CLC perennial grain crop Kernza™, which might not be representative of the much broader suite of

CLC crops, cropping systems, and stacking of these strategies. However, although [Cureton et al. \(in review\)](#) both draw upon the sustainability transition intermediary literature and self-identify as intermediaries in their practical theory of CLC crop commercialization, they cite the lack of conceptual and practical intermediary guidance as the impetus for their contribution to the literature. This observation is perhaps an inadvertent criticism of the current scope of the sustainability transition intermediary literature, which prioritizes systemic, retrospective analyses at the expense of actor-level perspectives on a transition in the making ([Murto et al., 2020](#)).

Similarly, [Zolfagharian et al. \(2019\)](#) critique the transitions literature for its lack of paradigmatic and methodological diversity, while [Steyaert et al. \(2016\)](#) call for increased attention to the assumed relationship between knowledge and action in the study of intermediaries. Conclusions in the transition intermediary literature are often directed toward policy-makers and researchers (e.g., [Mignon and Kanda, 2018](#); [Kant and Kanda, 2019](#); [Kivimaa et al., 2019a](#)) suggesting a paradigm that assumes policy-makers and researchers both can and will design effective intermediary bodies and their broader ecologies. This approach to knowledge production is somewhat incompatible with research findings, which indicate that intermediaries often arise naturally in response to gaps in coordination and knowledge ([Moss, 2009](#); [Kivimaa et al., 2019a](#); [Kanda et al., 2020](#)). These critiques, paired with [Cureton et al.](#)'s assertion that the literature is lacking in practical intermediary guidance, suggest that the transition intermediary literature should give consideration to intermediaries as action-research practitioners. Such a paradigmatic reframe would call for more diverse research artifacts that are attuned to application in sustainability transition processes, rather than merely describing transitions *post-hoc*. A practitioner-researcher positioning might be unique to intermediaries in U.S. agri-food contexts, where there is a history of Cooperative Extension providing some intermediary functions as an integral part of the Land Grant University system ([Peters, 2014](#)). This remains merely speculative but worthy of future inquiry. Summarily, the nascent research in CLC transition intermediaries indicates the need to bring more concerted attention to the practice and politics of transition intermediaries in future research, which finds great familiarity with agroecology's framework of science, practice, and politics.

#### 4. An agroecological framework for intermediaries in CLC transitions

An understanding of agroecology as a triad of sciences, practices, and politics that align to achieve pragmatic goals ([Bell and Bellon, 2021](#)) can help advance the transition intermediary research in an agri-food context. Of course, the boundaries between these three categories are not strict, as science also has political and practical elements, just as practitioners are informed by science and politics. However, agroecology's triad remains a useful heuristic and, in this framing, the study of transition intermediaries can be understood as one of the many sciences that supports agroecological transformation. The framing also highlights the lack of attention to the politics and pragmatic practice of agroecological transition intermediaries within the current literature. While there

is a robust field of research devoted to agroecological transitions that remains outside the scope of this mini-review (e.g., [Duru et al., 2015](#); [Montenegro de Wit and Iles, 2016](#); [Ollivier et al., 2018](#); [Anderson et al., 2019](#); [El Bilali, 2020](#)), there is relatively less research that concertedly investigates intermediaries in such transitions. The emerging research that does investigate both agroecological transitions and intermediaries (e.g., [Contesse et al., 2021](#); [Iyabano et al., 2021](#); [Groot-Kormelinck et al., 2022](#); [Vilas-Boas et al., 2022](#)) brings novel perspectives to the importance of non-human agency and farmer organizations in intermediary transition processes. However, there still remains a lack of attention to intermediaries as practitioners with political agency that could actively integrate frameworks to help guide their work. Such frameworks could address calls for more process-oriented approaches to sustainability transitions that acknowledge limits to scientific knowledge in complex problem solving ([Bulten et al., 2021](#)).

In that vein, this mini-review proposes a framework based on an adaptation of [Anderson et al.'s \(2019\)](#) notion of six "domains of transformation" in agroecology to understand and evaluate the role of intermediaries in CLC transitions ([Table 1](#)). [Anderson](#) proposes six primary, overlapping interfaces between the predominant agri-food regime and agroecological niches: knowledge and culture; systems of exchange; networks; discourse; equity; and access to farmland, plant material, and natural resources. Four of these categories (systems of exchange, networks, knowledge and culture, and discourse) fall directly within the purview of CLC transition intermediaries, who are tasked with building sustainable supply chains, forming networks, translating diverse knowledges, and continually framing CLC through their interactions with various stakeholders, from growers to policy-makers. Issues related to equity and access to natural ecosystems have important intersections with their work but do not currently define CLC intermediaries' role. The proposed framework augments [Anderson et al.'s](#) understanding of enabling and disabling conditions for transformation to reflect the three core functions of intermediaries based on [Kivimaa et al.'s](#) definition ([Kivimaa et al., 2019a](#)): (1) linking actors, activities, skills, and resources; (2) connecting transition visions with existing regimes to create momentum for socio-technical system change; and (3) disrupting dominant socio-technical configurations. The framework appreciatively builds off of the growing understanding of intermediaries in sustainability transitions, while explicitly adding a political dimension based on an agroecological understanding of what constitutes transformative change.

The resulting framework can serve as a starting point for CLC intermediaries attempting to make sense of their work, as well as a reflective, evaluative tool for ongoing transition efforts. The six core domains, adapted from [Anderson et al. \(2019\)](#), include:

- Construction, production, sharing, and mobilization of CLC knowledge.
- Profitable, fulfilling, accessible, and fair supply chains for CLC producers.
- Multi-stakeholder CLC networks that enable inclusive development of knowledge, markets, and discourse.
- CLC discourse, or the way in which language is used to frame CLC debates, policy, and action.

TABLE 1 Domains of transformation and associated practices for CLC transition intermediaries.

| Domain  | Definition  | Enabling transition   |  | Disabling transitions  |
|---|---|---|--|--|
|   |   | Practices linking actors, activities, skills, and resources   | Practices creating momentum for socio-technical system change  | Dominant socio-technical configurations to disrupt   |
| Knowledge and culture                                     | Construction, production, sharing, and mobilization of CLC knowledge  | <ul style="list-style-type: none"> <li>Promote horizontal processes of CLC food producer learning</li> <li>Invite diverse participation in CLC research processes</li> </ul>                                | <ul style="list-style-type: none"> <li>Respect and employ knowledge from diverse stakeholders</li> <li>Solicit needs and aspirations of local food producers to inform CLC transition</li> </ul>   | Disrupt: <ul style="list-style-type: none"> <li>Promotion of centralized, researcher-produced knowledge</li> <li>Prioritization of knowledge from profit-led research agendas</li> </ul> |
| Systems of exchange                                       | Profitable, fulfilling, accessible, and fair supply chains for CLC producers  | <ul style="list-style-type: none"> <li>Embed CLC markets in local territories that allow for self-determination</li> </ul>  | <ul style="list-style-type: none"> <li>Construct CLC markets that value the ecological, social, economic, cultural, and political outputs of CLC agriculture</li> <li>Base CLC markets in democratic social relations</li> </ul>                       | Disrupt: <ul style="list-style-type: none"> <li>Concentration of agricultural input markets</li> <li>Singular focus on economies of scale</li> </ul>                                     |
| Networks  | Multi-stakeholder CLC networks that enable inclusive development of knowledge, markets, and discourse   | <ul style="list-style-type: none"> <li>Weave together networks driven by civil society actors</li> </ul>  | <ul style="list-style-type: none"> <li>Develop high-functioning polycentric, decentralized, governance models</li> <li>Develop policies that reach across constituencies to address agriculture, health, environment, and rural livelihoods</li> </ul> | Disrupt: <ul style="list-style-type: none"> <li>Dominant regime that undermines local organization</li> <li>Research networks disconnected from food producers</li> </ul>                |
| Discourse   | The way in which language is used to frame CLC debates, policy, and action  | <ul style="list-style-type: none"> <li>Employ discourse that promotes participation of local communities in shaping transitions</li> </ul>  | <ul style="list-style-type: none"> <li>Frame CLC agriculture holistically to include environmental, economic, and social goods</li> </ul>  | Disrupt: <ul style="list-style-type: none"> <li>Agricultural discourse with a singular focus on productivity</li> </ul>  |
| Equity  | Dismantling dynamics of marginalization and inequality in multiple CLC-related arenas   | <ul style="list-style-type: none"> <li>Promote BIPOC and diverse gender participation in CLC decision making</li> <li>Promote participation by those historically excluded from U.S. agriculture</li> </ul> | <ul style="list-style-type: none"> <li>Emphasize people-centered development of CLC systems</li> </ul>   | Disrupt: <ul style="list-style-type: none"> <li>Crop/ cropping system development models blind to existing inequalities</li> <li>Persistent inequity</li> </ul>                          |
| Access to farmland, plant material, and natural resources | Food producer's access to CLC plant material, the ways in which CLC enables farmers to steward land, and how CLC actors align themselves with other land access initiatives | <ul style="list-style-type: none"> <li>Enable food producer access to CLC crops and plants</li> </ul>   | <ul style="list-style-type: none"> <li>Promote synergies between CLC crop production and ecosystem services</li> </ul>   | Disrupt: <ul style="list-style-type: none"> <li>Unequal land access</li> <li>Farm consolidation</li> <li>Excessive private control of seeds and other aspects of biodiversity</li> </ul> |

Adapted from Anderson et al. (2019), integrating Kivimaa et al.'s (2019a) understanding of key intermediary functions.

- Dismantling dynamics of marginalization and inequality in multiple CLC-related arenas.
- Food producer's access to CLC plant material, the ways in which CLC enables farmers to steward land, and how CLC actors align themselves with other land access initiatives.

Critical reflection amongst these six domains and, specifically, the degree to which these six domains can be integrated for a given CLC crop or cropping system transition process can inform an understanding of how transformative or reinforcing a given CLC crop or system is to the predominant agronomic regime. The six domains and their associated intermediary practices remain suggestive and far from exhaustive. This framework welcomes modifications, additions, and

future iterations informed by the ongoing practice of CLC transition intermediaries.

## 5. Conclusion

CLC agriculture presents an exciting opportunity to iteratively draw upon and advance the burgeoning transition intermediary literature in an agroecological context. Agroecology's triad of science, practice, and movement provides a useful heuristic to expand current research approaches in the transition intermediary literature, while its explicitly political orientation can provide a framework to assess agri-food systems undergoing concerted transition efforts. More generally, such a framework can inform

the study of transition intermediaries in other contexts, spurring increased attention to the politics of transition intermediaries.

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The author confirms being the sole contributor of this work and has approved it for publication.

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The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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