



Learning communities and new farmer knowledge in Canada

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ABSTRACT

This research examines the agroecological learning processes of new farmers in Canada in order to understand the role of learning communities in transforming food systems. We consider how these learning communities represent new farmer engagement with agroecology and community-based economies as part of a global movement building alternatives to dominant capitalist and productivist food systems. In particular, we examine how the lack of formal education in agroecological alternatives in Canada is being overcome by these new farmers. Our results arise from interviews conducted in the Canadian provinces of Ontario and Manitoba with new and aspiring farmers, mentors, and farmer trainers. Farmer learning networks were described and compared according to factors that include region, gender, years of experience, and production practices. These networks showed remarkable similarities across these categories, indicating the importance of informal networks and the relevance of relationships that support farmers on their learning journeys. Farmers placed the greatest value on social learning, followed by independent learning, whereas institutional learning had much less value. Farmers who did not know each other were learning in similar ways, indicating that they may be part of a broader agroecological movement which relies on global assemblages of neighbours, peers, online tools, and mentors. Farming knowledge, as a component of a reimagined, sustainable, and just food sovereignty movement, has the potential to change the way farming is practiced and to facilitate the emergence of alternative food systems in Canada and indeed the world.

1. Introduction

New agroecological and alternative farmers are developing informal networks and learning communities to address knowledge gaps in the face of powerful corporate, institutional, and government actors that otherwise reinforce ideologies of neoliberal, productivist, and industrial agriculture (Sachs et al., 2016; Ekers and Levkoe, 2016; MacAuley and Niewolny, 2015; Levkoe, 2014; Hassanein, 1999; Guthman, 2008; Laforge et al., 2018). These farmers are positioning themselves in opposition to the dominant food system that is environmentally destructive due to pollution, over-exploitation of resources, and climate change (Altieri et al., 2012; Cushon, 2003), exploitative of farmers and farm workers (Weiler et al., 2016; Gouveia and Juska, 2002), contributes to poor health and food insecurity (Weiler et al., 2015; Wiebe and Wipf, 2011; Koc et al., 2008), contributes to the decline of rural communities (Qualman, 2011), and contributes to the decline of local farmer knowledge (Warner, 2008; Kuyek, 2007; Morgan and Murdoch, 2000; Hassanein, 1997). Current models of university and government extension services are built on a hierarchical, one-way transfer of knowledge with a focus on corporate profitability through the

marketing of techno-fixes, despite the fact that public extension services once supported farmers through learning and research including sustainable farm management (Milburn et al., 2010; Warner, 2008; Kuyek, 2007). Agroecological approaches to farming, including permaculture, organic, biodynamic, ecological, and holistic management, to name some more common practices, lack adequate research and training resources (Kuyek, 2007; Hassanein, 1999). We suggest that today's agroecological farmers function as a metaphorical canary in the coal mine of the contemporary food system, with the undermining of their local knowledge highlighting a threat to all farmer knowledge, including that of more conventional farmers. As such, understanding the ways that new agroecological farmers develop informal and peer-to-peer networks to facilitate learning of agroecological practices and community-based markets is critical to the sustainability of farming and support for farmer knowledge in Canada.

Neoliberalization has resulted in the privatization of agricultural knowledge as corporations have become increasingly implicated in the funding of university research and emphasize studies on chemical inputs and ag-biotechnology because of their profitability (Argue et al., 2003; Kneen, 1990). Such approaches are generally science-based and

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both the formation of the network and the creation and dissemination of knowledge since learning is limited by the socio-cultural, and political contexts in which it occurs (Thompson and Lockie, 2013). While networks or learning communities may be a useful way to describe knowledge sharing, the concept of rhizomes represents a metaphor to explore possible outcomes and impacts of these networks (Haynes, 2011; Deleuze and Guattari, 1987). Rhizomes, and the related concept of assemblages, describe the ways that the connections between actors, including non-humans, behave and are shaped (Deleuze and Guattari, 1987). Using this concept, LeGreco and Leonard (2011) describe how a movement made up of an intentional network of ideas and values can creatively, organically, and collectively respond to challenges. In the case the food sovereignty and agroecology movements, rhizomes can provide a lens to examine changing discursive imaginaries, including how knowledge is produced, transformed and circulated in complex cultural-political interfaces (Ferreira and Devine, 2011; Escobar and Osterweil, 2010). In food movements, new imaginaries and alternative knowledges are often ruminating within farmers' learning communities.

As a metaphor rhizomes, or in this case mycorrhizal networks, are a useful way to examine the movement of ideas, resources, or practices within a food system because they have no beginning or end and are open to multiple points of entry and understanding (Ferreira and Devine, 2011; Le Grange, 2007). Mycorrhizae facilitate the uptake of nutrients in vascular plants from the soil and the atmosphere that allows them to become established in challenging environments, and in this analogy, they represent the connections that facilitate energy, ideas, opportunities, and other resources to move to areas where they are needed. Meanwhile, the development of new farmers is the fruit of the vascular plant of the coalescing work of the agroecological learning communities. In an era of digital technologies, mycorrhizal connections and associated learning communities need not be situated in place; they can be fluid, diversified, and self-organized and may create the impression of unseen, subterranean connections among actors within a global food and farming movement (Cadger et al., 2016; Levkoe, 2015; Levkoe and Wakefield, 2014). As ideas are shared and new projects undertaken as a result of these interactions, the nature of the food system changes since energy is moving along mycorrhizal pathways that are otherwise invisible (Funke, 2012; Leake et al., 2004; LeGreco and Leonard, 2011). We argue that when new farmers resist the hegemony of corporate agricultural knowledge by sharing their local and experiential knowledge through these connections, they are also challenging the assumptions of capitalist food systems.

3. Methodology: qualitative and network analyses

In 2014, interviews were conducted with new and aspiring farmers, mentors, and farmer trainers in southern Manitoba and eastern Ontario to explore the role and importance of learning communities. We chose these two regions since they have relatively similar population sizes and rely primarily on the business of two urban markets: Brandon and Winnipeg in southern Manitoba, and Kingston and Ottawa in eastern Ontario. Eastern Ontario is situated in a transition zone from the St. Laurent lowlands to the Canadian Shield, resulting in rockier soil whereas southern Manitoba is limited by its longer and more severe winters. With respect to farmer learning, several incubator farms are accessible in eastern Ontario, but these do not exist in Manitoba. Both southern Manitoba and eastern Ontario were served by highly successful farmer learning projects funded by Heifer Canada until 2011 when funding ended abruptly; the Manitoba Farm Mentorship program matched aspiring farmers with mentors and internship opportunities while a similar program in Kingston called the NFU New Farm acted as a meeting place to share ideas between new and experienced farmers. Manitoba does not currently have a program to support farmer training, although Food Matters Manitoba and the Harvest Moon Society support local food systems through public education and advocacy work. Eastern Ontario maintains an informal training program called CRAFT

(Collaborative Regional Alliance for Farmer Training), which encourages partnerships among mentor farms including farm tours with interns. In Eastern Ontario, Just Food also supports local food systems and provides farmer training and manages an incubator farm project. Finally, these two regions have differences in terms of provincial government supports for farmers, including eligible grants for new farmers and extension services for organic production (Wilson and Martorell, 2017). With respect to institutional programs, the former satellite campuses of the University of Guelph at Kemptville College and the francophone Collège Alfred in Eastern Ontario (both agriculture programs have since been discontinued) and the current programs available at the University of Manitoba have all provided training in these regions.

This research uses both quantitative and qualitative data analysis to build the analysis iteratively. Sampling was done through both convenience and snowballing by interviewing representatives from organizations in both regions who work on new farmer training to find mentors and aspiring farmers and then soliciting participants themselves for other potential participants. Interviews provided data from open-ended questions as well as quantitative data arising from a related mapping exercise. A total of 26 farmer participants were interviewed, representing both regions (Manitoba = 14, Ontario = 12), genders (males = 12, females = 13), production types (livestock = 8, vegetables and field crops = 10, mixed = 8), and years of experience (new and aspiring = 18, mentors = 8). Interviews focused on farm histories, farming practices, how learning took place, and the challenges encountered when seeking out different farming approaches. Interviews were transcribed in their entirety. Transcripts were then coded using Dedoose (www.dedoose.com), an online tool for mixed methods data analysis, to highlight discussions of the challenges in accessing learning and building networks, including any political and economic barriers, farmer successes in accessing learning, and the types of learning processes used. Coding was done using an iterative approach to allow themes to emerge during the analysis (Corbin and Strauss, 2008; Charmaz, 2005).

In the mapping exercise, participants were asked to comprehensively list the sources and destinations of knowledge in their learning network, including all of the people, organizations, reference material, conferences, workshops, etc. that they engaged with during their learning journeys. These sources and destinations were listed on small pieces of paper, which were then arranged on a larger piece of paper. Since participants could list anything as a source or destination of knowledge, some categories were assigned during the analysis, such as 'mentors' or 'neighbours' instead of naming the individuals who had been identified. However, some sources of knowledge were specifically highlighted because of their relative importance, for example, the book 'The Market Gardener' by Jean-Martin Fortier was especially important to many participants so it was left as its own resource rather than being placed in the print publication category (see Table 1). Participants then connected each item using directional and weighted lines. Connections that were more significant had thicker lines than those that may have been more important in the past or which are only used occasionally (these were later summarized and ranked on a scale of 1 [least] – 3 [most] important). We then categorized farmer learning as either: (i) *independent* learning, where participants reflected on their own trial-and-error and personal experiences or consulted websites, books/periodicals/magazines, and online courses; (ii) *social* learning, where participants engaged in formal and informal experiential learning that included farmer-to-farmer interactions, incubator farms or farm schools, and on-farm training and internships; or (iii) *institutional* learning, where learning was initiated and facilitated by organizations including workshops and conferences, university and college programs, or government extension services. These categories were chosen in response to the types of sources and destinations of knowledge that participants had listed and by consulting literature on social and transformational learning (see Reed et al., 2010; Percy, 2005).

Table 1
Ten most important learning sources (N = 26).

Learning activity	Value	Learning type	Notes	Nature of impact
Farmers/Neighbours	1.81	Social learning	Some participants listed more than one of these people in their learning map to highlight the individual role that each of these played in their farm's success	Direct
Internet	1.42	Independent learning	This includes consulting official websites, personal blogs, and online videos	Direct
Print Publications	1.38	Independent learning	In some circumstances, specific books were identified separately to highlight their individual importance	Direct
Mentors	1.04	Social learning	Some of these relationships were ongoing, but for more experienced farmers they were often no longer active relationships	Direct
Volunteers (also includes customers and interns)	0.96	Social learning	This was usually an expression of learning going away from the farmers towards these sources although there was sometimes a two-way transfer of knowledge	Indirect
Parents	0.77	Social learning	These relationships were helpful in providing not only knowledge, but also social, emotional, and financial support	Direct / Indirect
Personal Experience	0.65	Independent learning	Self-directed, trial-and-error processes	Direct
Non-farming friends and family	0.58	Social learning	These were helpful in providing not only knowledge, but also social, emotional, and financial support	Indirect
"The Market Gardener" by Jean-Martin Fortier	0.54*	Independent learning	Those who had read this book indicated that this book contributed significantly to their farm's success and their own learning on practical techniques	Direct
Just Food	0.54*	Social learning	This regional food organization is based in Ottawa and has offered farmer training workshops in the past and currently runs an incubator farm project in Ottawa	Direct / Indirect
Government	0.54*	Institutional Learning	Typically refers to provincial, rather than federal, programs and supports. Includes some programs that have since been discontinued	Direct / Indirect

* Indicates a tie.

Next, we summarized these maps to enable comparison according to region, gender, production type, and years of experience. This was done by inputting the sources and destinations of knowledge into Excel along with their weighted value and then graphing them using Gephi (Bastian et al., 2009), an open access social network analysis (SNA) software. SNA visually represents and quantifies the relationships among actors in any network by charting each participant and source and destination of learning as a node and then mapping lines to show connections between nodes (Kimmerle et al., 2012). Our research uses a variation of this technique to explore the composition and dynamics of learning communities that farmers are using for their knowledge sharing and acquisition (Cadger et al., 2016). In most SNA research, a quantitative survey is used to create a sociogram that is meant to approximate the entire network (Cadger et al., 2016); however, our approach was more exploratory and did not attempt to reach network saturation. Rather, we looked for a variety of different types of learning networks (see Borgatti and Lopez-Kidwell, 2011). In addition, most SNA research examines relationships among individuals within the same network, whereas our approach examined farmers who may not have actually interacted with one other, but rather asked about the mutual use of learning resources (see Mailfert, 2007). Therefore, a common SNA comparison of 'betweenness centrality,' the measure of centrality based on the shortest path, was not appropriate to compare our learning maps, rather average weighted degrees were used instead (Opsahl et al., 2010). The average weighted degree calculates the average number and weight of the lines that connect resources in our learning maps (Σlearning type/N) and was used below to compare the level of connectivity in the learning networks.

4. Findings: exploring similarities and differences

Overall, the average weighted degree for social learning was the highest (9.27 = 241/26), these values double those of independent learning (4.81 = 125/26) and triple those of institutional learning (3.08 = 80/26). Table 1 showcases the ten most important learning sources overall. Social learning from farmers and neighbours was ranked highest, followed by independent learning derived from the Internet (including websites and blogs) and print publications (Table 1). In contrast, government (0.54) and university (0.27) were ranked much lower as forms of institutional learning. In addition, we compared how learning activities represented a direct contribution to a participant's farmer knowledge, as part of their learning community, or whether it represented an indirect, or food system level, impact on access agroecological knowledge. In other words, the nature of the impact reflects whether learning is only for the individual farmer or whether it contributes to broader food system changes.

With respect to social learning, participants often described either formal internships or informal mentorship relationships they had with more established farmers as important. However, farmers were often cautious when describing internship opportunities and discussed some of the difficulties inherent to these practice-based relationships, like this new female farmer in Manitoba,

Internships provide [an] intern with one experience, but they only provide them with one way of doing something and if that person really wants to be a farmer in their life, they're going to have to figure out for themselves their reality and that only comes with actually doing it. [...] But an internship is a really good starting point. You gain knowledge and practical skills. But it can be limiting if you don't get to see different ways in doing something (MB7).

A new male farmer in Manitoba described independent learning, particularly experiential learning as something that is ongoing and is a significant source of continued learning, "No matter what you're studying, if you're not stepping off the edge and doing and failing you're not learning" (MB16). This self-directed learning is both an opportunity to experiment and grow.

Finally, this farming couple in Manitoba highlighted some of the challenges facing the use of institutional learning:

MB12a (female): *I was interested in ecology and [soil science] seemed like a real way to apply the things that I was really interested in. [...] I think once I had that initial interest [in farming], there was of course book learning, I was reading everything and the Internet is an extremely valuable tool. There are networks of people you can meet people through Harvest Moon Society. But not being a farmer I felt self-conscious a lot of the time. And not being a foodie I didn't really feel like a part of that crowd. I think that I actually found a lot of support with grazing club groups. I think that Holistic Management is really fantastic and the people that are on the ground out there grazing and moving their cows, direct marketing, and are interested in soil. And for me, because I think I went through the [university] I have appreciation on how to look through peer reviewed journals and who to talk to in order to get information.*

MB12b (male): *Yeah, your [non-agricultural] education makes you a better farmer than, I would say my education. Rather than going through the agriculture program I should have done something like an MBA and taken environmental studies or geography. I would have been way further ahead.*

MB12a (female): *I think that one of our advantages is that he has the practical skills, he opted out of the institution to farm at 18 which I think a lot of people don't have the support to do.*

Here, MB12a had a diverse set of learning resources including a Master's degree, in comparison to her male counterpart who has lots of practical experience but comparatively less formal training. In fact, MB12b is critical of the agricultural training that he had received. Neither came from farming backgrounds, but MB12b knew early that he wanted to farm and sought out formal training options including internships, whereas MB12a made a career switch, which resulted in a need to convert her existing skill set and knowledge to a new livelihood. A key part in this transition was her participation in social learning networks like the Harvest Moon Society, grazing clubs, and Holistic Management groups that provided technical support as well as reassurance and inspiration.

Surprisingly, given the diversity of learning experiences, the learning maps were remarkably similar in their composition and connectedness (Table 2). For example, when comparing gender, both men and women had the same average weighted degree (Table 2). When comparing provinces, Manitoba and Ontario had similar values as did production types. Only when comparing the average weighted degree of years of experience was there a significant difference with new and aspiring farmers (7.08), who appeared more interconnected than mentor farmers (4.89) (Table 2).

However, when considering the details of these network maps

Table 2

Comparing learning maps: Average weighted degree, standard error, and number of resources according to region, gender, production, and years of experience.

Comparison	Learning maps	Average weighted degree	Standard error	Number of resources
Region	Manitoba	7.79	1.08	34
	Ontario	6.03	0.85	31
Gender	Men	5.77	0.86	36
	Women	5.77	0.83	39
Production	Livestock	4.30	0.70	30
	Vegetables and	5.70	0.74	37
	Crops			
	Mixed	4.31	0.69	26
Years of experience	New and	7.08	1.11	39
	Aspiring Mentors	4.89	0.65	36

below, it is apparent that the average weighted degree may not give the whole story of connectedness of these learning maps.

4.1. Region

In Manitoba, the top three knowledge sources were other farmers and neighbours (2.07), print publications (1.50), and then the Internet (1.36). Within Ontario, there was equal weight given to the Internet and farmers and neighbours (1.50), which were followed by print publications (1.25) (Fig. 1). With respect to average weighted network connections, social learning was rated highest for both Manitoba and Ontario (Table 3). However, institutional learning was rated much higher in Manitoba (4.50) than in Ontario (1.66). In addition, the learning map of Manitoba farmers was more complex and diverse than that of farmers from Ontario, as reflected by the greater overall number of resources (Table 3) and the larger and more connected map in comparison to the closeness and fewer lines of connection in the Ontario map (Fig. 1) (see Fig. 2).

The shape of the maps in Fig. 1 can be explained by the number and value of secondary knowledge resources. In Manitoba, mentors (1.36) and customers/volunteers/interns (1.14) emerged as the fourth and fifth most significant network component whereas in Ontario it was Just Food (1.17). This indicates a more direct type of learning provided by Just Food in Ontario compared to the more indirect impact from organizations in Manitoba, including the Harvest Moon Society/Harvest Moon Local Food Initiative (0.71) and Food Matters Manitoba (0.43). The importance of Just Food was highlighted by a male farmer from Ontario as a nexus of knowledge and information sharing among farmers and a key component to many learning communities,

Perhaps one of the most important and positive experience with the Just Food Farm is that all the farmers, especially first-year farmers, are so generous in sharing knowledge. We learn new stuff each day. And it's not as if we are talking that purpose, it just comes naturally (ON10).

This practical knowledge emerged from a wide diversity of sources including workshops, tours, internships and experiential learning. A female farmer highlighted the value of the training itself, “*Just Food workshops were a main source of education for us as well as our internship and the farm tours because that gave us the more hands-on look at how to do things*” (ON3).

In Manitoba, rather than organizations, many new farmers mentioned mentors as being important, but these relationships were often much more informal and episodic in nature. It involved periodically phoning mentors to ask for advice rather than spending sustained working with these farmers or participating in internships. It is likely that internships have become less formal and structured in Manitoba since the demise of the Manitoba Farm Mentorship program. However, a common attitude amongst mentors in Manitoba remains that informal internships were easy to access, as indicated by this mentor, “*If somebody was really interested in internship or incubator they should be able to find that relatively easily and then how they source it and where it goes from there is really up to them or the farm*” (MB13b). In contrast, many new farmers indicated that they faced ongoing challenges in finding mentors, as this new female farmer describes in her trials over the previous few seasons:

“Then the following year, I found a woman who'd been running a market garden at her place and she was looking for partners. [...] That didn't go very well for interpersonal reasons. It was a frustrating and disappointing summer. [...] Anyway, so sort of back to the drawing board. This winter I kept asking around. [...] At the last minute, I decided on [my current] place and this has worked out really well [so far]” (MB3).

Finally, the significant difference between institutional learning in Manitoba and Ontario is likely due to several factors. Farmers in Manitoba named more institutional learning types and rated them higher and included both direct support for learning communities and

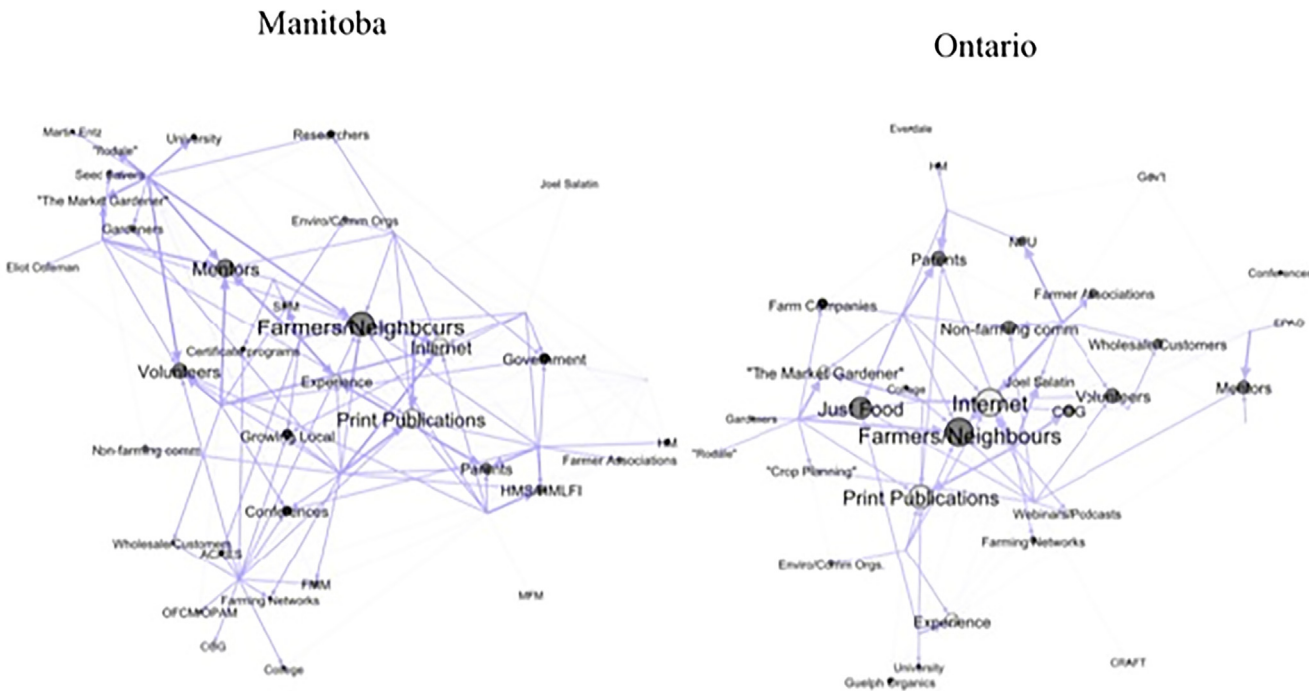


Fig. 1. Regional learning maps: Comparing Manitoba (n = 14) and Ontario (n = 12). Nodes of the learning maps that are further away from the centre are less important than those located more centrally. Unlabelled nodal points between resources indicate participants in the learning map. Independent learning categories are shown with white circles, social leaning as grey circles, and institutional learning as black circles. The size of these circles is relative to the value (1–3) respondents assigned that resource.

Table 3
Learning type average weighted values by region: Manitoba (n = 14) and Ontario (n = 12).

Learning Type	Manitoba	Standard Error	Number of Resources	Ontario	Standard Error	Number of Resources
Social Learning	9.86	1.74	17	8.58	1.18	16
Independent Learning	4.57	2.94	7	5.33	2.01	8
Institutional Learning	4.50	0.96	10	1.66	0.55	7

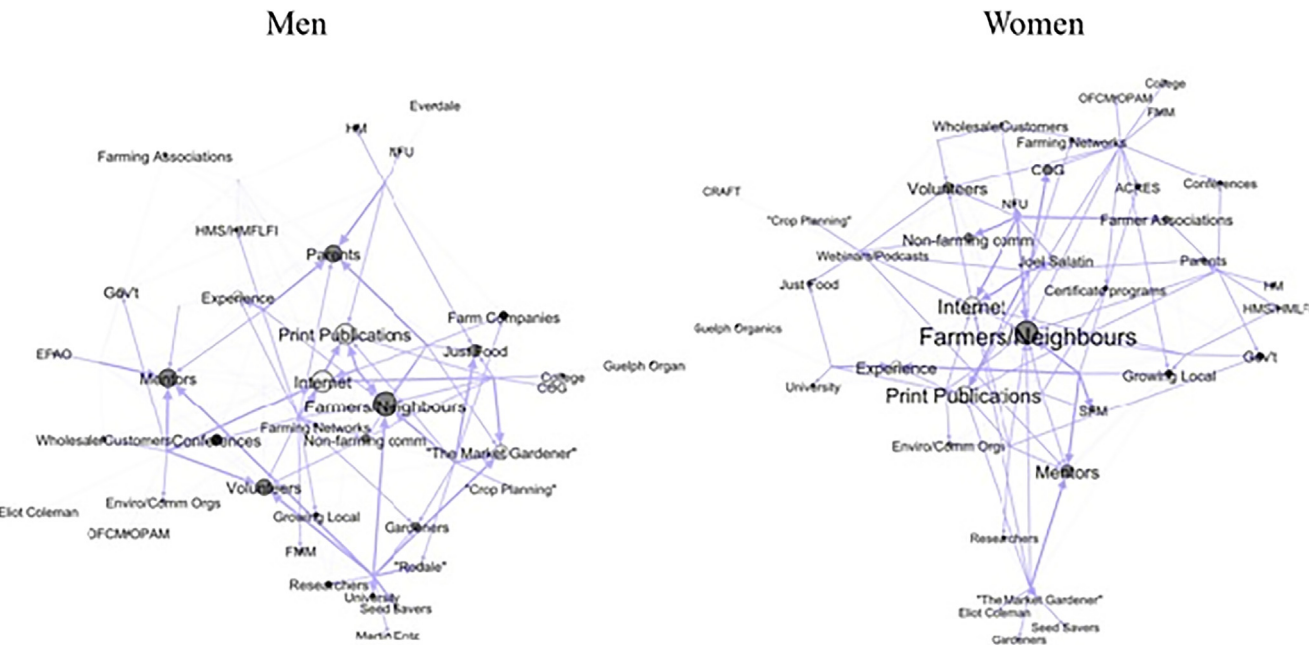


Fig. 2. Gender learning maps: Comparing men (n = 12) and women (n = 13). Nodes of the learning maps that are further away from the center are less important than those located more centrally. Unlabeled nodal points between resources indicate participants in the learning map. Independent learning categories are shown with white circles, social leaning as grey circles, and institutional learning as black circles. The size of these circles is relative to the value (1–3) respondents assigned that resource.

indirect support for alternative food systems. In particular, provincial government programs and loans in Manitoba received an average weighted degree of 0.79 while in Ontario the value was 0.25. Similarly, universities in Manitoba had an average weighted degree of 0.36, with an additional 0.50 for specific researchers, while in Ontario the value was only 0.17. A new female farmer in Manitoba mentioned accessing government funding to participate in training with both the federal and provincial government agriculture departments, among other supports,

“The Prairies East Sustainable Agriculture Initiative receives funding through the [federal] Growing Forward Programs and they do their own test plots and test different innovative ideas. They provided some funding for the development of a permaculture demonstration and education site and particularly as it pertained to experimenting with poly-culture orchards. [...] And the East Interlake Conservation District has also been extremely supportive in providing help with planting and also lending us equipment and funding” (MB9).

4.2. Gender

The learning networks of men and women were remarkably similar, with the same average weighted degree of 5.77. Quantitatively, men and women had similar values in independent, social and institutional learning (Table 4). Women rated farmers and neighbours (1.92) in a similar way to men (1.67). The Internet was given similar weighting by both women (1.38) and men (1.42). Print publications were listed as equivalent by both women (1.38) and men (1.33). However, women place greater significance on more ‘peripheral’ learning that comes from social learning and networked sources such as farmer associations (0.54 women vs. 0.25 men). The only exception to this was that men placed a much higher emphasis on their parents (1.08) than women (0.38), likely due to the larger number of men who had inherited inter-generational farms.

Yet the qualitative data suggested that some subtle gender differences did exist. For example, a male farmer in Manitoba observed how women are less likely to be perceived as farmers by both consumers and their colleagues since farming is seen as men’s work while gardening is seen as women’s work:

The general disposition would call this a garden before they would call it a farm. I think this is representative of the entire politics [regarding] food; how we understand food as a commodity, as something that’s distant, something that’s produced with machines, by men on big farms. That conversation gets opened a lot, because three of the four of us on the collective are women and the primary labour is women. And if it’s a garden it’s fine, but as soon as you start calling it a farm, and then these women are farmers, there are sparks. You can see them, sometimes subtle and nuanced, but other times they’re just right there (MB8).

While the majority (61%) of new farmers in this research were women, many of them were often considered ‘gardeners’ or ‘hobby farmers’ by their male peers, especially if those male peers practiced large-scale cash cropping (see also Sachs et al., 2016). This

Table 4
Learning type average weighted values by gender: Men (n = 12) and women (n = 13).

Learning type	Men	Standard error	Number of resources	Women	Standard error	Number of resources
Social learning	9.25	1.21	19	9.15	1.27	19
Independent learning	4.92	2.43	7	5.00	2.24	9
Institutional learning	3.17	0.70	10	3.15	0.59	11

demonstrates the additional cultural barriers that women farmers face, which can make it difficult to access farmer knowledge and learning communities. For example, popular reference books cited in this research such as those written by Eliot Coleman and Joel Salatin, as well as Canadian books including “The Market Gardener” by Jean-Martin Fortier and “Crop Planning for Organic Vegetable Growers” by Frédéric Thériault and Daniel Brisebois were often listed by name by participants. It is notable that all of these books were written by men, indicating an ongoing gender and power dynamic when it comes to the ways that some voices and forms of knowledge are privileged over others (Andersson and Lundqvist, 2014; Liepins and Schick, 1998).

4.3. Production practices

Three types of production were compared: vegetable and crop, livestock, and mixed farming. Overall social learning was much higher for vegetable and crop farmers (12.10) compared to livestock (9.00) and mixed farmers (6.00) (Table 5). The highest weighted learning resources for vegetable and crop growers were all social learning types including, farmers and neighbours (2.00), customers/volunteers/interns (1.70), and mentors (1.30). Meanwhile there was little difference between independent and institutional learning by production type. The relative closeness and lack of diversity was evident in the learning networks of mixed farmers compared to a higher number of lines and nodes in the network of vegetable and crop farmers, whereas those of livestock farmers were located between these two extremes (Fig. 3 and Table 5).

A female vegetable farmer in Ontario discussed how social learning, such as internships provided direct learning opportunities, but also helped build her support network, including allowing her to meet a future business partner and become involved with the Just Food Farm,

“I interviewed with a farm and landed there for a full season. And that was where I met [my business partner]. She was interning for another farm, but she was friends with a couple folks at the farm I was at so she came over to visit a few times and they all came over the visit a few times as a farm. We just became acquaintances and eventually friends. And then I heard about this Just Food project through a totally different place, a girl at the greenhouse I was working for wanted to join forces and [start an incubator project] and I decided to invite [my business partner] along and it turned out that she had also been planning to go for her own reasons” (MB13).

There are often fewer social learning resources for aspiring farmers interested in mixed or livestock farming, particularly internships and incubator farms, which may explain why these farmers rated social learning lower.

4.4. Years of experience

Mentors seemed to place more importance on all learning types compared to new and aspiring farmers, likely reflecting the time required to develop complex learning networks (Table 6). Yet, the learning maps of new and aspiring farmers were much more diverse than those of mentors and featured more lines and nodes and more resources (Fig. 4 and Table 6). This may be the result of new and aspiring farmers trying to build their learning communities and reaching out to any and all learning types, while also having weaker connections to these learning resources. Meanwhile mentors have refined and evolved their learning networks over time to focus on the most important sources and destinations of knowledge and letting other connections dissolve over time.

Once again other farmers and neighbours, print publications, and the Internet were most important to all participants (Fig. 4). Mentors were more likely to list their parents as important (1.13) than new and aspiring farmers (0.61). This is likely due to the high number of mentors who came from farming backgrounds and who had grown up with

Table 5
Learning type weighted values by production practices: Livestock (n = 8), vegetables and crops (n = 10), and mixed (n = 8) production practices.

Learning type	Livestock	Standard error	Number of resources	Vegetables and crops	Standard error	Number of resources	Mixed	Standard error	Number of resources
Social Learning	9.00	1.01	16	12.10	1.27	18	6.00	0.79	12
Independent Learning	4.13	2.02	4	5.20	1.48	8	5.25	2.27	6
Institutional Learning	3.00	0.54	10	3.80	0.530	11	2.75	0.37	8

parents who farmed, especially since these mentors were mostly men (67%). In contrast, very few new and aspiring farmers had had this resource available to them since they often came from non-farm backgrounds (72% in this research). In terms of organizational support, new farmers rated Just Food relatively high (0.67 new and aspiring vs. 0.25 mentors), but the similar organizations in Manitoba saw a higher positive response from mentors with Harvest Moon Society (0.28 new and aspiring vs. 0.63 mentors) and Food Matters Manitoba (0.00 new and aspiring vs. 0.75 mentors). This difference is likely due to the training provided by Just Food which is highly relevant to new farmers, while the organizations in Manitoba do not provide new farmer training, rather they provide indirect support through public education and advocacy.

A male mentor from Manitoba described the role his father and his grandfather had on the development of his farm: “When I would have a management issue, I would ask dad “do you remember what grandpa did?”

Table 6
Learning type weighted values by years of experience: New and aspiring farmers (n = 18) and mentors (n = 8).

Learning type	NEW and aspiring	Standard error	Number of resources	Mentors	Standard error	Number of resources
Social learning	8.17	1.73	19	11.75	1.00	17
Independent learning	4.56	2.89	9	5.75	1.77	7
Institutional learning	2.61	0.82	11	4.50	0.62	12

And it’s been wonderful because I’ve heard so many stories about grandpa from the 1950s when they were on the farm” (MB16). These stories were particularly helpful since this farmer was using ecological practices on

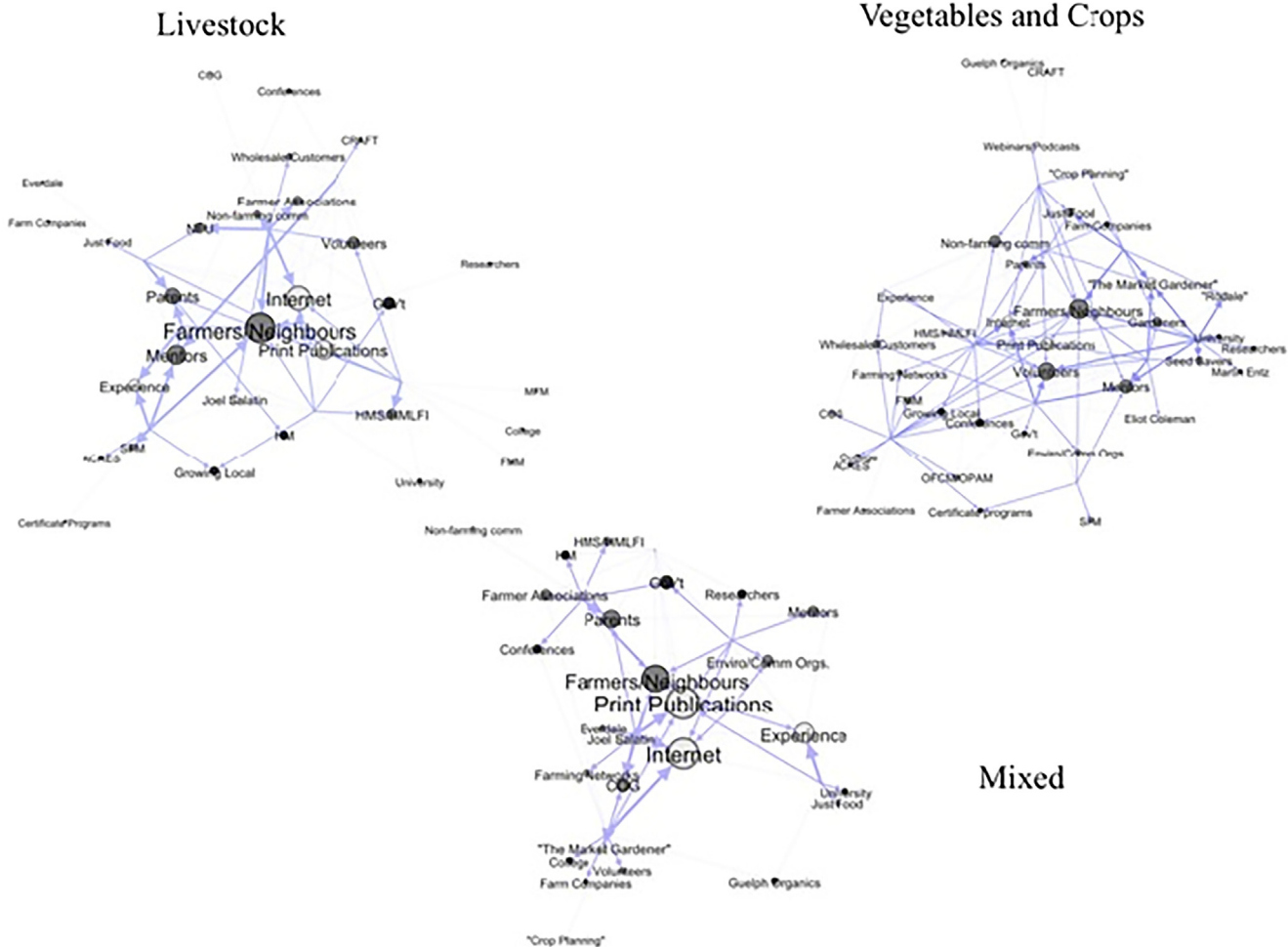


Fig. 3. Production practices learning maps: Comparing livestock (n = 8), vegetables and crops (n = 10), and mixed (n = 8) production practices. Nodes of the learning maps that are further away from the centre are less important than those located more centrally. Unlabelled nodal points between resources indicate participants in the learning map. Independent learning categories are shown with white circles, social learning as grey circles, and institutional learning as black circles. The size of these circles is relative to the value (1–3) respondents assigned that resource.

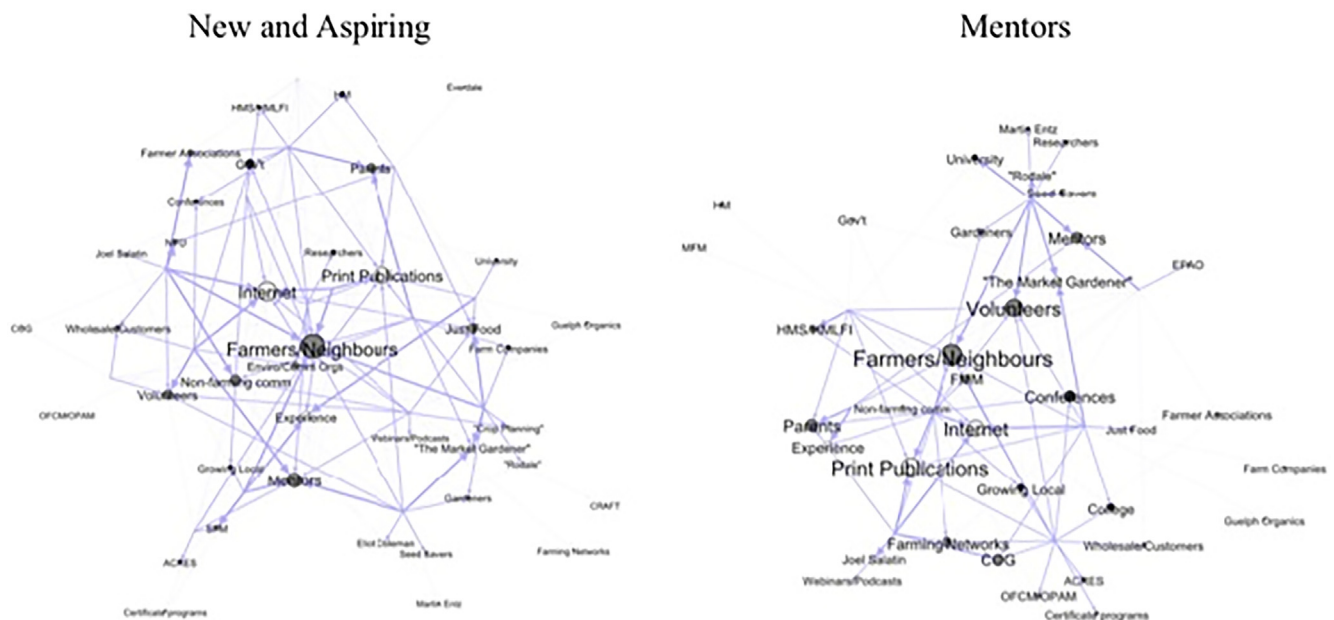


Fig. 4. Years of experience learning maps: Comparing new and aspiring farmers ($n = 18$) and mentors ($n = 8$). Nodes of the learning maps that are further away from the centre are less important than those located more centrally. Unlabelled nodal points between resources indicate participants in the learning map. Independent learning categories are shown with white circles, social learning as grey circles, and institutional learning as black circles. The size of these circles is relative to the value (1–3) respondents assigned that resource.

his own farm, practices that are not that dissimilar from those used in the 1950s.

Unsurprisingly, mentors listed volunteers (which included both interns and customers) as a key component of their learning networks because of the significant learning shared with interns. At the same time, a new female farmer in Ontario described the kinds of production-related knowledge she provided to her urban customers, “I do a lot of educating of potential customers too, which is a marketing opportunity. People hear things and they toss out categories and words and they don’t necessarily know what they’re talking about” (ON8). In this way, farmer knowledge is shared not just with farmers, but with the general public as well, something that has the potential to transform food systems. Volunteers, interns, and customers also shared learning with farmers, although this more often had to do with food systems issues rather than contributing directly to their farmer learning.

4.5. Learning communities as food system change

Participants were also asked to describe their how their learning communities interacted with and reflected broader food system issues, that is, how the indirect effects of the food system determined the learning they were able to access. These questions were important to understand both the personal and systemic resistances of agroecological farming including both how farmers are resisting dominant narratives of farming as productivist through learning about alternatives, and also how these understand this as part of a political process of food system change. These questions also highlighted the mycorrhizal connections between farmers who had never met, but who demonstrated similar experiences and farming cultures. For example, participants highlighted the relevance of gardeners and seed savers as providing both direct support on practical knowledge on growing and saving seeds as well as indirect influence at a food systems level in terms of the politics of seed ownership. Farmer-gardener relationships contributed to a sense of community and connection to the broader agroecological food movement. This male farmer spoke to the cross-cultural knowledge sharing that took place among gardeners, seed savers, and farmers of different nationalities and backgrounds:

The specific knowledge about the crops, days to maturity, what to pay attention to, came from the community garden conversations. [...] We live in a relatively low-income neighbourhood and a very multicultural one, so the gardeners are practically coming from all over the world and they are bringing different experiences. Again, not very professional experiences, but they have an eagerness to share knowledge and learn (ON10).

While some might consider gardeners to have a lower level of skill compared to farmers, many respected the knowledge shared between gardeners and farmers, despite the differences of scale of production and economics. This same farmer discussed of the difficulties he found with engaging in the capitalist, market-based transactions in farming, which may also be connected to his respect and appreciation of gardeners who do not grow for profit:

I have a problematic relation with the market in general. I’m not very fond of buying things or selling things. That whole mindset is very alien to me. I realize that is something that is part of farming. There is a market aspect involved, both in terms of looking for areas to sell, the timing, the pricing, the whole package. The practice of farming is more rewarding than the selling (ON10).

Similarly, a male farmer from Manitoba had close relationships with gardeners and seed savers and expressed related political and economic tensions. Here he described the links to the loss of practical food skills and the adverse capitalist and political pressures on the food system:

I think the deskilling around food, not just what to eat but how to prepare it, that’s a huge piece that has to be built and we’re always doing that every week in our newsletters and stuff. [...] The political pressures of the corporate understanding of agriculture and sustainability, so that people will question our work on seeds, because they have no idea what the issues of seeds are and why on earth would you not be using something that is a modern variety, or that is a hybrid, or that is a GMO (MB8).

This farmer made connections between corporatization and the loss of both farmer knowledge as well as knowledge around the food system more broadly, including the loss of food preparation skills.

Advocacy organizations like the Canadian Organic Growers and the

National Farmers Union were mentioned five and two times respectively, indicating these organizations have limited direct relevance for farmer learning. However, many of these organizations are recognized as having an indirect impact on food systems by connecting the Canadian food system to global food movements, particularly as the National Farmers Union is a member of *La Via Campesina*, an international peasant movement that is affecting social change around the world. A male farmer in Manitoba pointed out the importance of farmer organizations in changing the situation for farmers at multiple scales,

I think it becomes even more important to listen to international discussions. [...] I think there's so much in terms of analysis about this blanket smothering local food systems, and realizing that it's a global struggle. We can better understand what's going on globally, and that we're not alone (MB2).

Thus, while these organizations may not directly affect farmer learning, they are important actors in food system change. This same farmer went on to highlight importance of diversifying food organizations by grounding settler-farmer experiences within Indigenous food systems that they had come to colonize and undermine, and that they still largely ignore:

I find that in most organizations I'm part of, the Aboriginal partnership is an afterthought. To actually begin by saying 'What was the food system here and what can we learn from that?' To bring out the best of that and make it part of the discussion at the beginning (MB2).

These farmers recognize the role that corporatization has played in changing our relationships with food and the people who grow it, whether they are growing for profit or not. They also demonstrate the complex narratives with the alternative food movement and the ongoing challenges in making this movement more inclusive while continuing to resist capitalist ideologies. Here, mycorrhizal connections are demonstrated in the similarity in attitudes of farmers in Canada, particularly the common political, economic, and cultural narratives shared by agroecological farmers.

Finally, while government extension and university research was not an important source of learning to participants, one participant did have an extremely positive experience with university researchers. The University of Manitoba has partnered with *The Bauta Initiative on Canadian Seed Security* (2013) to work with farmers on a participatory plant breeding project for potato and wheat varieties using open-pollination processes and selective breeding to find crops varieties that are adaptive to changing climatic conditions on organic farms. The male farmer described the level of respect he received from the researchers, Gary Martens and Martin Entz, when he first met them and asked for help finding heritage seed,

And then Martin is like "Maybe you're interested? We're doing a farmer participatory plant breeding project and we're doing oats, wheat, and potatoes?" and then at the end of the conversation he says "I'm ready to say, I want you to be our potato grower" and I said "I think you misunderstood, we're really small and we're not potato farmers and it sounds like you're pretty serious about that. And Gary steps right in front of me and he says "You don't understand! That's exactly why we want you doing it!" [...] So now we're in the second year of doing those potatoes. And what was so great about them was that I went into the university prepared to be laughed at, honestly, for what we do and from the moment that they stood in front of me and shook my hand, I felt respect from these guys who I think deserve a ridiculous amount of respect for what they are doing in a place like that, which is heavily funded [from agriculture corporations]. I think it's amazing what they have done in the milieu that they have done it in (MB16).

Here, researchers, farmers, and a national organization alike are interested in diverse agroecological farming systems, which opened up opportunities for research. This difference in approach, while limited at the University of Manitoba, may also explain why participants in

Manitoba ranked universities higher than those in Ontario (Table 3).

5. Discussion: learning communities and food systems

When it came to direct contributions to participants' agroecological learning communities, social and independent learning resources were the most significant. Overwhelmingly participants preferred using social learning networks and resources provided by peers and neighbours, regardless of age, gender, region, or type of farming (Table 1). The importance of informal social networks was well known to new farmers, but they also faced challenges in establishing their social and learning networks, particularly if they came from non-farming and urban backgrounds (Laforge et al., 2018). Many new and aspiring farmers found it difficult to initially identify agroecological farmers when building their learning communities. Meanwhile, formal social learning facilitated by organizations including formal internships and incubator farms were able to help address this early challenge for new and aspiring farmers by providing both training and coordinated networking opportunities. As such, organizations that support farmer learning and do advocacy work were important in the development of both learning communities and alternative food systems.

As new and aspiring farmers built their networks, they also relied on independent learning resources, such as print and online publications. Independent learning is changing as Internet resources decrease the constraints of physical space and allow for connections to be built virtually more easily and quickly than ever before, while also highlighting the similarities between gender and other identities (Baumann, 2016; Lockie, 2006). As information and knowledge can be shared more quickly and across larger distances, the online and real-life networks of farmers have come to hold greater significance and independent and social learning networks begin to merge. This process also facilitates the sharing of agroecological farming identities and knowledges beyond learning communities which has the potential to change food systems as a critical mass is achieved.

Participatory approaches to institutional learning and research have the potential to bring together both learning communities and food system change. Participatory plant breeding, such as the research taking place at the University of Manitoba, could help expand agroecological science in Canada as researchers can work with farmers to identify key research questions and concerns, while also respecting and nurturing the local knowledge of farmers themselves. The advantage of these types of scientific research projects is that they combine social and institutional learning and have the potential to be more inclusive and may result in improved farm management and production conditions (Percy, 2005; Nerbonne and Lentz, 2003). Unfortunately, this participatory research is very limited in Canada, which is why social and independent learning remain critical to both farmer learning and food system change through resistance.

At a food systems level, personal experiences and backgrounds of farmers affects the kinds of learning they pursue and this is often a gendered and gendering process (Hassanein, 1999). For example, women rely on a diversity of learning resources with the exception of university agriculture programs, which have traditionally been more oriented towards men who are more likely to be part of large-scale, multi-generational farms. Researchers have found that women play a key role in transforming farmer knowledge and creating sustainable and healthy food systems by transforming farming cultures (Sachs et al., 2016; Hassanein, 1999). In addition, other researchers have demonstrated how through challenging gendered farming stereotypes, women farmers can make space for a variety of non-traditional farmer identities such as new immigrants, LGBTQ, and inner city youth (Sbicca, 2015; Slocum, 2007). This approach requires careful reflexivity to ensure that voices are being heard, but the value is that promoting more diversity of farmers, promotes a greater wealth of farmer knowledge, much of which has been marginalized (Goodman et al., 2012).

Building relational networks among farmers, eaters, and advocates,

within and across regions, redistributes and provides resources and energy to parts of the food movement that need it most. These mycorrhizal formations have no centralized organization or planning, simply reflecting the organic spreading of ideas, energy, and resources. We can understand the similarities in the learning communities of farmers as being the result of a metaphorical mycorrhizae that connects these farmers to each other in hidden, underground ways. In this research, the mycorrhizal network facilitated the ability of new farmers to gain agroecological knowledge. Mycorrhizal connections may be formed through virtual or online communities where farmers can share resources and values without ever meeting each other. These connections also provide important social and emotional support for agroecological farmers who are often marginalized and have little direct access to government or institutional support and who may be ostracized by their more conventional farmer peers (see Laforge et al., 2018). By providing an opportunity to share knowledge, learning communities are contributing to food system change by dismantling the cultural barriers facing new farmers. Taken collectively, the cultivation of agroecological farming knowledge could potentially challenge the dominant food system, as this energy is shared and built through mycorrhizal connections among farmers but also through larger networks that connect with consumers and food activists. This kind of pervasive and persistent network is critical to the success of ongoing resistance to the erosion of farmer knowledge, while also maintaining multiple points of entry for the inclusion of a diversity of marginalized voices.

6. Conclusion

The similarities of farmers' learning communities are likely due to the nature of the challenges experienced by agroecological farmers across Canada including the privatization of agricultural research, the undermining of agroecological farmer knowledge, and the corporatization of food. These issues within the food system are resulting in similar forms of resistance within food movements across this country (Levkoe and Wakefield, 2014, Laforge et al., 2018). As a result, by sharing alternative knowledge through local and regional agroecological learning communities, farmers are acting together to resist and transform the Canadian food system. This resistance comes from putting local farmer knowledge back into the centre of farmer learning as demonstrated by the importance placed on social and independent learning. Meanwhile, agroecological farmers recognize how corporations have coopted and conventionalized knowledge in many institutional venues and are therefore more critical of these sources of knowledge. That many of these agroecological farmers are women with urban backgrounds and existing diverse networks, facilitates the indirect influence on the food system while also amplifying their voices as farmers.

Many of the farmers interviewed in this research saw it as their role to not just provide food, but to contribute to wider socio-political change. Farmers who are re-imagining the food system as agroecological and socially just are part of a global food movement, whether they are explicitly politically engaged or not. This work fits within what Escobar and Osterweil (2010) describe as attempting "to re-imagine the world's geographies of power and knowledge by social movements that operate from the epistemic borders of modern colonial world system" (p. 207). By engaging in community-based economies and agroecological practices, farmers are not only re-imagining, they are also rebuilding the food system in a prefigurative process. This allows for the expansion of farmer identities to include agroecological farmer knowledge and a shift that could result in greater social and economic justice in the food system by working to democratize knowledge in agriculture. The mycorrhizal metaphor acknowledges the importance of both individuals and communities in food and farming systems. In particular, the transfer of knowledge along pathways that would otherwise not have been available to farmers is both personally and collectively empowering, and demonstrates the co-creation of food systems through these

increasingly diverse learning communities.

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References

- Altieri, M., 1997. *Agroecology: The Science of Sustainable Agriculture*, second ed. Westview Press, Boulder, CO.
- Altieri, M.A., Funes-Monzote, F.R., Petersen, P., 2012. Agroecologically efficient agricultural systems for smallholder farmers: contributions to food sovereignty. *Agron. Sustainable Dev.* 32 (1), 1–13. <https://doi.org/10.1007/s13593-011-0065-6>.
- Andersson, E., Lundqvist, P., 2014. Gendered agricultural space and safety: towards embodied, situated knowledge. *J. Agromed.* 19 (3), 303–315. <https://doi.org/10.1080/1059924X.2014.916644>.
- Argue, G., Stirling, B., Diaz, P., 2003. Agricultural chemicals and agri-business. In: Diaz, H.P., Jaffe, J., Stirling, R. (Eds.), *Farm Communities at the Crossroads: Challenge and Resistance*. University of Regina: Canadian Plains Research Centre, Regina, pp. 207–235.
- Bastian, M., Heymann, S., Jacomy, M., 2009. In: *Proceedings of the Third International Conference on Weblogs and Social*, pp. 361–362.
- Baumann, T., 2016. Connected farmers: the world of the tech-savvy agriculturalist. Retrieved October 12, 2017, from <<http://modernagriculture.ca/connected-farmers-world-tech-savvy-agriculturist/>>.
- Bodin, Ö., Crona, B.I., 2009. The role of social networks in natural resource governance: What relational patterns make a difference? *Global Environ. Change* 19 (3), 366–374. <https://doi.org/10.1016/j.gloenvcha.2009.05.002>.
- Borgatti, S.P., Lopez-Kidwell, V., 2011. Chapter 4: network theory. In: Scott, J., Carrington, P.J. (Eds.), *The SAGE Handbook of Social Network Analysis*. SAGE, London, pp. 40–54.
- Burton, R.J.F., 2004. Seeing through the "good farmer's" eyes: towards developing an understanding of the social symbolic value of "productivist" behaviour. *Sociologia Ruralis* 44 (2), 195–215. <https://doi.org/10.1111/j.1467-9523.2004.00270.x>.
- Cadger, K., Quaicoo, A., Dawoe, E., Isaac, M., 2016. Development interventions and agriculture adaptation: a social network analysis of farmer knowledge transfer in Ghana. *Agriculture* 6 (3), 32. <https://doi.org/10.3390/agriculture6030032>.
- Carr, A., Wilkinson, R., 2005. Beyond participation: boundary organizations as a new space for farmers and scientists to interact. *Soc. Nat. Resour.* 18 (3), 255–265. <https://doi.org/10.1080/08941920590908123>.
- CÉGEP de Victoriaville, 2017. Production légumière et fruitière biologique. Retrieved October 6, 2017, from <<http://www.cegepvicto.ca/formation-collegiale/programmes-detudes/techniques/gtea—production-legumiere-biologique.aspx>>.
- Charmaz, K., 2005. Grounded theory in the 21st Century. In: Denzin, Norman K., Lincoln, Yvonna S. (Eds.), *The SAGE Handbook of Qualitative Research*. Sage, Thousand Oaks, pp. 507–535.
- Cushion, I., 2003. Sustainable alternatives for Saskatchewan agriculture: a farmer's perspective. In: Diaz, H.P., Jaffe, J., Stirling, R. (Eds.), *Farm Communities at the Crossroads: Challenge and Resistance*. University of Regina: Canadian Plains Research Centre, Regina, pp. 223–235.
- Corbin, J., Strauss, A., 2008. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Sage, Thousand Oaks.
- Deleuze, G., Guattari, F., 1987. *A Thousand Plateaus: Capitalism and Schizophrenia*. (B. Massumi (Ed.), Trans.). University of Minnesota Press, Minneapolis and London.
- Ekers, M., Levkoe, C.Z., 2016. Transformations in agricultural non-waged work: from kinship to intern and volunteer labor. *J. Agric. Food Syst. Commun. Dev.* 2, 179–183.
- Escobar, A., Osterweil, M., 2010. Social movements and the politics of the virtual: Deleuzian strategies. In: Jensen, C.B., Rödje, K. (Eds.), *Deleuzian Intersections*. Berghahn Books, New York.
- Faysses, N., Sraïri, M.T., Errahj, M., 2012. Local farmers' organisations: a space for peer-to-peer learning? The case of milk collection cooperatives in Morocco. *J. Agric. Educ. Extension* 18 (3), 285–299.
- Ferreira, M.L., Devine, D., 2011. Theater of the oppressed as a rhizome: acting for the rights of indigenous peoples today. *Latin Am. Perspect.* 39 (2), 11–26. <https://doi.org/10.1177/0094582X11427888>.
- Funke, P.N., 2012. The Rhizomatic Left, neoliberal capitalism and class: theoretical interventions on contemporary social movements in the global north. *Int. Crit. Thought* 2 (1), 30–41. <https://doi.org/10.1080/21598282.2012.660040>.
- Goodman, D., DuPuis, E.M., Goodman, M.K., 2012. *Alternative Food Networks: Knowledge, Practice, and Politics*. Routledge, London and New York.
- Gouveia, L., Juska, A., 2002. Taming nature, taming workers: constructing the separation between meat consumption and meat production in the U.S. *Sociologia Ruralis* 42 (4), 370–390. <https://doi.org/10.1111/1467-9523.00222>.
- Guthman, J., 2008. Neoliberalism and the making of food politics in California. *Geoforum* 39 (3), 1171–1183. <https://doi.org/10.1016/j.geoforum.2006.09.002>.

- Hassanein, N., 1997. Networking knowledge in the sustainable agriculture movement: some implications of the gender dimension. *Soc. Nat. Resour.* 10 (3), 251–257. <https://doi.org/10.1080/08941929709381024>.
- Hassanein, N., 1999. *Changing the Way America Farms: Knowledge and Community in the Sustainable Agriculture Movement*. University of Nebraska Press, Lincoln and London.
- Haynes, P., 2011. Conceptualizing networks as assemblages: a case study from the Spanish ceramics sector. *Revista Internacional de Sociología* 69 (2), 417–437. <https://doi.org/10.3989/ris.2009.06.29>.
- Katchova, A.L., Ahearn, M.C., 2015. Dynamics of farmland ownership and leasing: implications for young and beginning farmers. *Appl. Econ. Perspect. Policy* 38 (2), 334–350. <https://doi.org/10.1093/aep/pvp024>.
- Kimmerle, J., Thiel, A., Gerbing, K.K., Bientzle, M., Halatchliyski, I., Cress, U., 2012. Knowledge construction in an outsider community: Extending the communities of practice concept. *Comput. Hum. Behav.* 29 (3), 1078–1090. <https://doi.org/10.1016/j.chb.2012.09.010>.
- Kneen, B., 1990. *Trading Up: How Cargill, the World's Largest Grain Company, is Changing Canadian Agriculture*. New Canada Publications, Toronto.
- Koc, M., Macrae, R., Desjardins, E., Roberts, W., 2008. Getting civil about food: the inter-connections between civil society and the state to advance sustainable food systems in Canada. *J. Hunger Environ. Nutr.* 3 (2–3), 122–144.
- Kuyek, D., 2007. *Good Crop/Bad Crop: Seed Politics and the Future of Food in Canada. Between the Lines*, Toronto.
- Laforge, J.M.L., Fenton, A., Lavallée-Picard, V., McLachlan, S.M., 2018. New farmers and a national food policy in Canada. In: *Canadian Food Studies*, forthcoming.
- Le Grange, L., 2007. The “theoretical foundations” of community service-learning: from taproots to rhizomes. *Educ. Change* 11 (3), 3–13. <https://doi.org/10.1080/16823200709487174>.
- Leake, J., Johnson, D., Donnelly, D., Muckle, G., Boddy, L., Read, D., 2004. Networks of power and influence: the role of mycorrhizal mycelium in controlling plant communities and agroecosystem functioning. *Can. J. Bot.* 82, 1016–1045. <https://doi.org/10.1139/B04-060>.
- LeGreco, M., Leonard, D., 2011. Building Sustainable Community-Based Food Programs: Cautionary Tales from The Garden. *Environmental Communication: A Journal of Nature and Culture* 5 (3), 356–362. <https://doi.org/10.1080/17524032.2011.593639>.
- Levkoe, C.Z., 2014. The food movement in Canada: a social movement network perspective. *Journal of Peasant Studies* 41 (January 2015), 385–403. <https://doi.org/10.1080/03066150.2014.910766>.
- Levkoe, C.Z., 2015. Strategies for forging and sustaining social movement networks: A case study of provincial food networking organizations in Canada. *Geoforum* 58, 174–183. <https://doi.org/10.1016/j.geoforum.2014.11.013>.
- Levkoe, C.Z., Wakefield, S., 2014. Understanding contemporary networks of environmental and social change: complex assemblages within Canada's “food movement”. *Environmental Politics* 23 (2), 302–320. <https://doi.org/10.1080/09644016.2013.818302>.
- Liepins, R., Schick, R., 1998. Gender and education: towards a framework for a critical analysis of agricultural training. *Sociol. Ruralis* 38 (3), 285–302. <https://doi.org/10.1111/1467-9523.00079>.
- Lockie, S., 2006. Networks of agri-environmental action: Temporality, spatiality and identity in agricultural environments. *Sociologia Ruralis* 46 (1), 22–39. <https://doi.org/10.1111/j.1467-9523.2006.00400.x>.
- MacAuley, L.E., Niewolny, K.L., 2015. In: *In Adult Education Research Conference*, pp. 1–7.
- Mailfert, K., 2007. *New Farmers and Networks: How Beginning Farmers Build Social Connections in France*. Royal Dutch Geographical Society 98 (1), 21–31. <https://doi.org/10.1111/j.1467-9663.2007.00373.x>.
- McLachlan, S.M., 2012. Relative Importance of Agroecological and Other Alternative Agricultural Research in Western Canadian Universities, Report for the UN Special Rapporteur on the Right to Food.
- Milburn, L.S., Mulley, S.J., Kline, C., 2010. The End of the Beginning and the Beginning of the End: The Decline of Public Agricultural Extension in Ontario. *Journal of Extension* 48 (6), 1–11.
- Monllor, N., 2012. *Farm Entry: A Comparative Analysis of Young Farmers. Their Pathways, Attitudes and Practices in Ontario (Canada) and Catalunya (Spain)*, pp. 31.
- Morgan, K., Murdoch, J., 2000. Organic vs. conventional agriculture: Knowledge, power and innovation in the food chain. *Geoforum* 31 (2), 159–173. [https://doi.org/10.1016/S0016-7185\(99\)00029-9](https://doi.org/10.1016/S0016-7185(99)00029-9).
- Morgan, S.L., 2011. Social Learning among Organic Farmers and the Application of the Communities of Practice Framework. *The Journal of Agricultural Education and Extension* 17 (1), 99–112. <https://doi.org/10.1080/1389224X.2011.536362>.
- Nerbonne, J.F., Lentz, R., 2003. Rooted in grass: Challenging patterns of knowledge exchange as a means of fostering social change in a southeast Minnesota farm community. *Agric. Hum. Values* 20 (1), 65–78.
- Niewolny, K.L., Lillard, P.T., 2010. Expanding the boundaries of beginning farmer training and program development: a review of contemporary initiatives to cultivate a new generation of American farmers. *J. Agric. Food Sys. Community Dev.* 1 (1).
- OACC (Organic Agriculture Centre in Canada) (n.d.). Canada's Organic Science Cluster II: Science with Impact for Profitability, Sustainability, and Competitiveness. Retrieved September 30, 2017, from < <https://www.dal.ca/content/dam/dalhousie/pdf/faculty/agriculture/oacc/en/osc2/oacc-osc2-activity-map-4-page-2016.pdf> > .
- Opsahl, T., Agneessens, F., Skvoretz, J., 2010. Node centrality in weighted networks: generalizing degree and shortest paths. *Soc. Netw.* 32 (3), 245–251. <https://doi.org/10.1016/j.socnet.2010.03.006>.
- Oreszczyn, S., Lane, A., Carr, S., 2010. The role of networks of practice and webs of influencers on farmers' engagement with and learning about agricultural innovations. *J. Rural Stud.* 26 (4), 404–417. <https://doi.org/10.1016/j.jrurstud.2010.03.003>.
- People's Knowledge Editorial Collective, 2017. How people's knowledge can transform the food system. (People's Knowledge Editorial Collective, Ed.). Centre for Agroecology, Water and Resilience (CAWR) at Coventry University, Coventry, UK. Retrieved from < [http://www.coventry.ac.uk/Global/08 New Research Section/Signposts/Everyday-Experts-complete.pdf](http://www.coventry.ac.uk/Global/08%20New%20Research%20Section/Signposts/Everyday-Experts-complete.pdf) > .
- Percy, R., 2005. The contribution of transformative learning theory to the practice of participatory research and extension: theoretical reflections. *Agric. Hum. Values* 22 (2), 127–136. <https://doi.org/10.1007/s10460-004-8273-1>.
- Qualman, D., 2011. Advancing agriculture by destroying farms? The state of agriculture in Canada. In: Wittman, H., Desmarais, A.A., Wiebe, N. (Eds.), *Food Sovereignty in Canada: Creating Just and Sustainable Food Systems*. Fernwood Publishing, Halifax & Winnipeg, pp. 20–42.
- Reed, M., Evelyn, A., Cundill, G., Fazey, I., Glass, J., Laing, A., Stringer, L., 2010. What is social learning? *Ecol. Soc.* 15 (4). <http://doi.org/Article>.
- Robinson, G.M., 2006. Ontario's environmental farm plan: evaluation and research agenda. *Geoforum* 37 (5), 859–873. <https://doi.org/10.1016/j.geoforum.2005.05.002>.
- Sachs, C.E., Barbercheck, M.E., Brasier, K., Kiernan, N.E., Terman, A.R., 2016. *The Rise of Women Farmers and Sustainable Agriculture*. University of Iowa Press, Iowa City.
- Sbicca, J., 2015. Farming while confronting the other: the production and maintenance of boundaries in the borderlands. *J. Rural Stud.* 39, 1–10. <https://doi.org/10.1016/j.jrurstud.2015.03.004>.
- Schneider, F., Fry, P., Ledermann, T., Rist, S., 2009. Social learning processes in Swiss soil protection—the “From Farmer - To Farmer” project. *Hum. Ecol.* 37 (4), 475–489. <https://doi.org/10.1007/s10745-009-9262-1>.
- Slocum, R., 2007. Whiteness, space and alternative food practice. *Geoforum* 38 (3), 520–533. <https://doi.org/10.1016/j.geoforum.2006.10.006>.
- Stuiver, M., 2006. Highlighting the retro side of innovation and its potential for regime change in agriculture. In: Marsden, T., Murdoch, J. (Eds.), *Between the Local and the Global: Confronting Complexity in the Contemporary Agri-Food Sector*. and San Diego: Elsevier, Oxford, Amsterdam.
- The Bauta Family Initiative on Canada Seed Security, 2013. *Participatory Plant Breeding Projects*. Retrieved September 30, 2017, from < <http://www.seedsecurity.ca/en/126-participatory-plant-breeding-project> > .
- Thompson, L.-J., Lockie, S., 2013. Private standards, grower networks, and power in a food supply system. *Agric. Hum. Values* 30 (3), 379–388. <https://doi.org/10.1007/s10460-012-9404-8>.
- Tovey, H., 2009. ‘Local Food’ as a contested concept: networks, knowledges and power in food-based strategies for rural development. *Int. J. Soc. Agric. Food* 16 (2), 21–35.
- Trauger, A., 2009. Social agency and networked spatial relations in sustainable agriculture. *Area* 41 (2), 117–128. <https://doi.org/10.1111/j.1475-4762.2008.00866.x>.
- Warner, K.D., 2008. Agroecology as participatory science: emerging alternatives to technology transfer extension practice. *Sci. Technol. Hum. Values* 33 (6), 754–777.
- Weiler, A.M., Hergesheimer, C., Brisbois, B., Wittman, H., Yassi, A., Spiegel, J.M., 2015. Food sovereignty, food security and health equity: a meta-narrative mapping exercise. *Health Policy Plan.* 30 (8), 1078–1092. <https://doi.org/10.1093/heapol/czu109>.
- Weiler, A.M., Otero, G., Wittman, H., 2016. Rock stars and bad apples: moral economies of alternative food networks and precarious farm work regimes. *Antipode* 48 (4), 1140–1162. <https://doi.org/10.1111/anti.12221>.
- Wiebe, N., Wipf, K., 2011. Nurturing food sovereignty in Canada. In: Wittman, H., Desmarais, A.A., Wiebe, N. (Eds.), *Food Sovereignty in Canada: Creating Just and Sustainable Food Systems*. Fernwood Publishing, Halifax & Winnipeg, pp. 1–19.
- Wilson, A., Martorell, H., 2017. Supporting New Farmers through Agricultural Policy.