

Linking Regional Food Networks to Ecological Resilience

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JEL Classifications: Q13, Q15, Q56, R11, O13

Keywords: Ecology, Environment, Entrepreneurship, Public Policy, Regional food networks, Resilience, Scale

While the agricultural practices used to create the food we eat depend on natural systems, they are also key drivers of many pressing environmental threats (Foley et al., 2011). Consumers and policy makers attempt to influence the environmental impacts of food production through food labeling programs, local food sales, or payments for conservation practices, but each of these options has limited ability to provide systematic improvements to production agriculture's ecological impacts (e.g., Tuck et al., 2014; Batáry et al., 2011; King et al., 2010; Weber and Matthews, 2008; Born and Purcell, 2006; Bengtsson, Ahnström, and Weibull, 2005; Pirog et al., 2001). A fuller understanding of producers' motivations for environmentally sensitive production practices and the structural dynamics of the food system suggest other policy approaches for improving agriculture's environmental impact. Ensuring global food security will require a reimagined food system that is more sustainable and resilient.

Recognizing that scale is a key structural aspect of the food system, we focus on regional food production and consumption to consider both ecological and food security concerns (Clancy and Ruhf, 2010). Regional food networks (RFNs) comprise local and mid-size food systems that encompass a larger land base, broader natural resources, more diverse production capacity, and larger markets than local food systems. RFNs are defined by fixed, region-specific characteristics such as soil types, climate conditions, and water availability. Primary food products typically flow through processing facilities that operate at a regional scale with a fixed location and capital expenditure and that interact with global and national markets through imports and exports (Clancy and Ruhf, 2010). While consumer interest in "local" food has grown in recent decades, direct sales to consumers have recently plateaued in the United States and more "local" food moves through retail outlets, distributed through intermediated regional marketing channels (Low et al., 2015). For both producers and consumers, volume, variety, supply chains, and markets may make "regional" an advantageous scale for enhancing food security and mitigating the environmental impacts of agriculture.

To understand the connection between producers' participation in RFNs and environmental outcomes, we construct a framework based on marketing theory to identify five characteristics that influence the environmental impact of production agriculture: ownership and control, personal values and social embeddedness, entrepreneurship and multifunctionality, scale, and spatial and temporal distribution. We use this framework to analyze results from our 2016 Oregon RFN producer survey ($N = 193$) and consumer survey ($N = 614$), which probed RFN participants' environmental motivations and practices (Brekken, Parks, and Lundgren, 2017). We conducted both surveys using convenience samples due to practical limitations in reaching RFN participants. In addition, interviews with producers along Oregon's Willamette Valley, a survey and interviews of multifunctional Vermont farmers, and the established literature inform our analysis (Parks and Brekken, 2018; Brown, 2016). Although the results cannot be generalized to the entire population of Oregon or U.S. producers and consumers, the surveys and interviews provide a window into the RFN and multifunctional farm sector. We conclude that marketing through RFNs has an influence on ecological farm practices, while farmers who choose ecological farm practices may be uniquely situated to participate in RFNs. Policy that supports RFN development and the farms that participate in RFNs can support ecological resilience in the food system.

Regional Food Networks and Environmental Outcomes

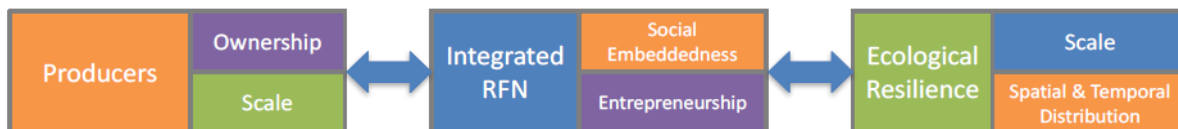
Food system outcomes arise from the relationships between food supply chain actors. Producers, processors, wholesalers, retailers, marketers, and consumers communicate through supply and demand signals regarding food quality, quantity, and other attributes. Other actors—government regulators, input providers, investors, advocacy groups, universities, and transportation services—interact with the supply chain through the market and public policy. The natural environment—including soil, water, and weather—is an active member of the system, responding to farming practices via natural processes and reflecting impacts through feedback loops. The signals run in all directions and are influenced by the forces acting on each system actor through their relationships in the supply chain.

Agricultural producers are directly connected to environmental outcomes through their choice of production practices, which are influenced by policy and market conditions. Our empirical work suggests that the farmers who participate in Oregon’s RFN also use environmentally sensitive farm practices. Nearly all producer respondents participated in at least one RFN marketing channel (agritourism, direct to consumer, local retail or restaurant, local/regional institutions, local/regional distributors). Most also reported environmentally sensitive production methods: 59% used organic practices but were not certified, 13% reported certified organic production, and 28% used conventional methods. Over half of producers, including many who indicated conventional methods, also reported other conservation practices such as conservation tillage, cover crops, or integrated pest management (Brekken, Parks, and Lundgren, 2017). We hypothesize that farm characteristics link production practices and RFN participation (Figure 1).

Figure 1. Connections between Producers, RFN, and Ecological Resilience

HYPOTHESIS

We hypothesize that RFNs are connected to ecological resilience through the market mechanisms connecting regional consumers with entrepreneurial small and mid-scale producers. Marketing through RFNs may have a strong influence on farm practices; conversely, farmers who choose ecological farm management practices are uniquely poised to participate in RFNs.



Producer Characteristics such as ownership and control of land and scale of production influence whether a farmer chooses ecologically sensitive production practices and markets through integrated RFNs.

Integrated RFN refers to the connectedness of the actors in the regional food network (RFN); the levels of connection and interaction of people, place, and prosperity. Social embeddedness of the actors and entrepreneurship opportunities arising from integrated RFNs facilitates market signals that reward producers for ecologically sensitive production practices attuned to local and regional impacts.

Ecological Resilience refers to the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks. Scale of production itself impacts ecological outcomes and matches to market scale within the RFN. Spatial and temporal distribution of on-farm activities and production resources across the regional landscape impact ecological resilience.

Production and marketing choices are intertwined; both are informed by producers’ functional, emotional, social, conditional, and epistemic values (Brown, 2016; Sheth, Newman, and Gross, 1991). We operationalize these values by identifying five key characteristics that connect environmentally sensitive production practices and RFN marketing: ownership and control (functional and emotional values), personal values and social embeddedness (social and emotional values), entrepreneurship and multifunctionality (functional and epistemic values), scale (conditional value), and spatial and temporal distribution (conditional value) (Table 1). Although many of these characteristics are intertwined, we attempt to separate their independent relationships to production and

marketing practices that influence the environmental impacts of farming, which may then give rise to improved ecological resilience for regional food production.

Table 1. Endogenous Values Measured

	Definition (Sheth, Newman, and Gross, 1991)	Brown (2016)	RFN Framework
Functional	The perceived utility acquired from an alternative's capacity for functional, utilitarian, or physical performance.	Using pro-environmental practices improves the overall quality of my food/product; increases my income	Ownership and control, entrepreneurship and multifunctionality
Social	The perceived utility acquired from an alternative's association with one or more specific social group.	Using pro-environmental practices on my farm helps the way I'm perceived in the community	Personal values and social embeddedness
Emotional	The perceived utility acquired from an alternative's capacity to arouse feelings or affective states.	Farming using pro-environmental practices does feel like making a personal contribution to something better	Ownership and control, personal values and social embeddedness
Epistemic	The perceived utility acquired from an alternative's capacity to arouse curiosity, provide novelty, and/or satisfy a desire for knowledge.	I farm to connect with the community	Entrepreneurship and multifunctionality
Conditional	The perceived utility acquired by an alternative as the result of the specific situation or set of circumstances facing the choice maker.	We can gain more watershed benefits if we can restrict pollution from farm production; Farm-level indicators of run-off	Scale, spatial and temporal distribution

Ownership and Control

Farm owner–operators and multigenerational family farms have present and future connections to their land, prompting both emotional and functional values that influence responsible natural resource management. They may be willing to take short-term losses that contribute to long-term economic and environmental sustainability and recognize that the market often fails to reflect the long-run costs of natural resource use (Lyson, Stevenson, and Welsh, 2008; USDA National Commission on Small Farms, 1998; Hamilton, 1994; Strange, 1988).

For this reason, absentee ownership of U.S. agricultural lands has caused growing concern as the farming population ages. Absentee landowners are more likely to live in urban areas and lack personal knowledge of the land or production; many have purchased rather than inherited the land, severing a family history of stewardship (Petrzelka, 2012; Mendham and Curtis, 2010). Absentee landowners may be unwilling to make investments in environmental practices that are costly up front but may pay off in long-term productivity or contribute positive environmental benefits to the region. On the other hand, farms owned by absentee owners or investment firms

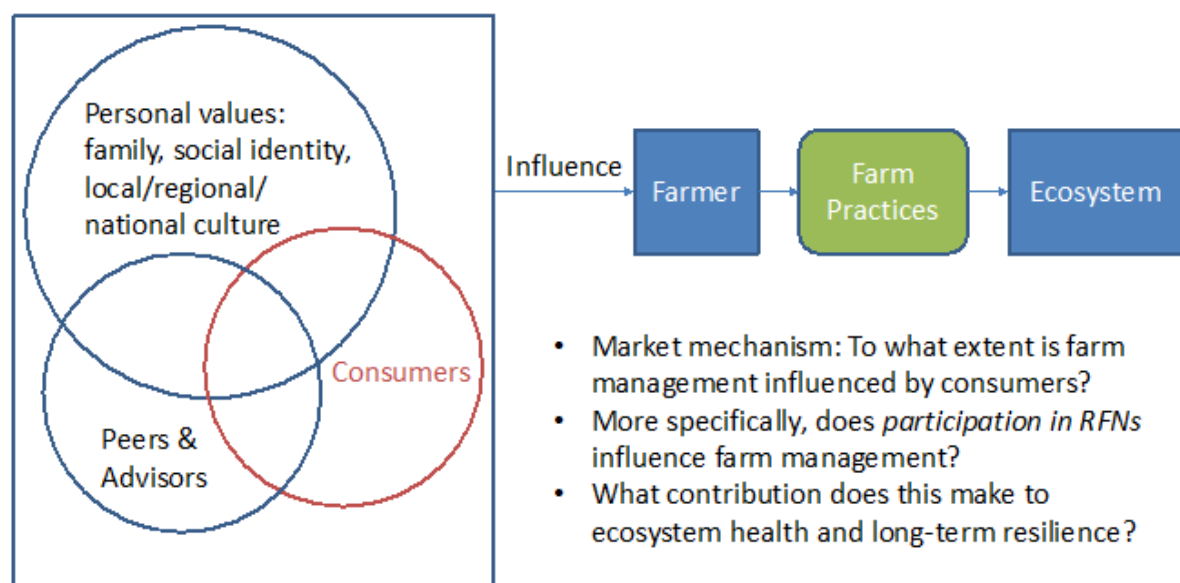
may make the decision to become USDA-certified organic for marketing purposes but have no motivation for choosing practices attuned to regional environmental conditions (Parks and Brekken, 2018).

In Oregon, almost 80% of principal farm operators currently own their land, compared to 61% nationwide. However, farm and ranch operators over the age of 55 control 64% of agricultural land, 10.45 million acres, which could change hands in the next 20 years. With growing interest from investment companies and absentee landowners, states can use public policy to support owner-operated agricultural enterprises to facilitate environmental stewardship of agricultural land (Brekken et al., 2016).

Personal Values and Social Embeddedness

Personal values arise from farmers' experience and worldview (Parks and Brekken, 2018); at least three communities influence producer values and practices: the community of peers and other advisors, the community of consumers, and the family and society in which the farmer lives. Farmers are embedded in their communities, with smaller farms creating a greater diversity of ownership and social capital, while participation in local and regional markets leads to familiarity, transparency, and accountability (USDA National Commission on Small Farms, 1998).

Figure 2. Personal Influences on Farmer Production Practices



The personal values that lead agricultural landowners and operators to choose environmentally sensitive farming practices start with the owner/operator (Parks and Brekken, 2018). A previous focus group of mid-size regional producers in Oregon found that all chose production practices based on personal values; they also used a variety of local and regional marketing options (McAdams, 2015). In our 2016 Oregon RFN survey, 80% of producers chose "aligns with my environmental values" as the top motivator for production practices, highly correlated with environmentally sensitive practices, regional marketing channels, and status as beginning farmers (under 10 years of experience; no correlation with age). Respondents could choose multiple motivations: 32% chose "more profitable," 29% chose "local or regional support and infrastructure," and 25% chose "access to established markets," far behind values but demonstrating that respondents' choice of production practices is also intertwined with their choice of RFN marketing channels, fulfilling emotional and functional values (Brekken, Parks, and Lundgren, 2017). While we cannot generalize our results due to our convenience sampling methods, the strong correlation between personal motivations, production practices, and marketing channels in our RFN survey respondents is consistent with other studies of similarly situated farmers and indicates that the personal values and farm characteristics of RFN participants, small to mid-size farmers, and beginning farmers differ from the farm population at large.

The community of peers and local advisors has a large influence on whether producers translate stated environmental values into actual production practices on their land. Neighboring landowners with similar landscape, soil, and climate watch the success and struggles of those who adopt new farm or marketing practices and learn from one another (Iles and Marsh, 2012). Peers and local advisors share many social, economic, and environmental conditions and have strong influences on farm practices. Our RFN producer survey showed that nearly all farmers, regardless of production practices, most often rely on other farmers for advice, training, education, and technical support, while interviews in Oregon’s Willamette Valley showed that farmers tend to associate with farm organizations and other farmers who share similar production practices and worldviews (Brekken, Parks, and Lundgren, 2017; Parks and Brekken, 2018).

The community of consumers influences producers in RFNs through market mechanisms. Within the confines of a region, producers and consumers in RFNs are “closer” to the environmental impacts of food production, not just physically but also figuratively closer to social norms and values, market conditions such as wages and prices, and environmental conditions such as landscape and weather. Consumer demand signals concern for the environmental impact of food production through a higher willingness to pay for food produced using environmentally sensitive production practices (Pullman and Wu, 2012). In our RFN consumer survey, 45% of respondents stated that environmental concerns motivated them to buy local foods, with some consumer segments expressing significantly higher environmental motivation. Importantly, those who were willing to pay more for local foods were much more likely to be motivated by environmental concerns, rewarding producers who used and communicated their environmentally sensitive production practices (Brekken, Parks, and Lundgren, 2017).

Producers in RFNs also communicate with consumers by telling the story of their food through labeling or face-to-face interactions with consumers: They are engaging in environmental farming practices *here*, to improve a river that the consumer may visit, landscapes that they enjoy, wildlife that they encounter. The connection through regional identification imputes transparency and accountability that contributes to environmental stewardship. Policy that supports RFN marketing channel development, such as appropriate infrastructure and investment, can create market structures that support ecologically minded RFN farm operations.

Entrepreneurship and Multifunctionality

Entrepreneurship and multifunctionality describe the ways that farmers try new things and diversify their operations to enhance profitability. Multifunctional agriculture encompasses a mix of market and non-market uses, such as conservation and provision of ecosystem services (Hibbard and Lurie, 2013). Economically multifunctional activities such as agritourism, value-added, and organic certification can include environmental management practices that differentiate the product in the marketplace and command a higher price (Brown, 2016; Liang, 2012; Liang and Su, 2013; Liang et al., 2012). Entrepreneurship and innovation reflect functional values related to price and quality of products but can also be expressed in epistemic values such as a willingness to try new products, markets, or practices.

The characteristics of farms that choose ecological farm practices and RFN marketing may be the same characteristics that make them entrepreneurial: They may be more risk tolerant and adaptable to environmental and market conditions. Characteristics of entrepreneurship also overlap with characteristics of resilience: Flexibility and intentional adaptation allow a producer to take advantage of new information and opportunities as they arise, while adapting in the face of adversity (Ecotrust, 2012; Clancy and Ruhf, 2010). Entrepreneurial, multifunctional farms manage diverse goals—such as biodiversity and food production—while maintaining economic profitability.

The respondents to our Oregon RFN survey scored high on entrepreneurial attitudes and showed signs of multifunctional operations, averaging 3.2 broadly defined product categories at each farm (for example, “vegetables,” “grains,” “poultry products,” etc., rather than individual crops or varieties) and two marketing channels per farm. Nearly all farms participated in at least one RFN channel, which are often in development stages, along with their environmentally conscious production practices. Beginning farmers in their first 10 years of operation (regardless of age) were significantly more likely to use direct marketing and environmentally sensitive production practices, offering further insights into the entrepreneurial period of new farm operations. Combined with the data on personal values and social embeddedness, it appears that people entering agriculture choose

their practices and marketing to fulfill their personal vision for the operation, mediated by the physical characteristics of their farm, connecting to the markets that will provide the economic returns necessary to support the operation. RFN channels are useful because they allow these values-driven entrepreneurial farms to capture price premiums for their products that are differentiated in the marketplace by their connection to place and environmental practices.

Scale

Scale is related to conditional values because changing practices for the sake of environmental impacts is conditioned on the ease of changing the operation. The characteristics that link entrepreneurship to environmentally sensitive farm practices are often found in small-to-mid-size operations, which have the diversity, adaptability, and self-reliance required to respond to environmental and market conditions. The size of smaller farms may simply make it easier to manage natural resources (USDA National Commission on Small Farms, 1998). For example, self-reliant farms may use soil building and nutrient cycling, relying on farm-generated inputs (Kremen, Iles, and Bacon, 2012; Pearson, 2007; Shennan, 2008), which is both ecologically sensitive and provides some insulation from external economic shocks. Self-reliance, flexibility, and adaptability may result from lower financial and information barriers. Small and mid-size farms may also have lower sunk costs in equipment and training than large farms, allowing them to adopt new practices as cash flow allows rather than taking on large debts and becoming “locked in” to specialized equipment (McAdams, 2015).

Economic viability for small and mid-size farms requires matching production and market scales. Local food systems have emerged in recent years to support small-scale local production, but RFNs provide a mid-size market to match the volume and cost structure for mid-size farms, also known as the “Agriculture of the Middle” (Lyson, Stevenson, and Welsh, 2008; McAdams, 2015). Research on the Agriculture of the Middle has focused on “short” supply chains for differentiated products to connect to consumers who are willing to pay for food imbued with producer and consumer values (Lyson, Stevenson, and Welsh, 2008). Supply chain partners bolster the resilience of the RFN by adding capital and marketing expertise that producers themselves may not be able to provide and are crucial to supporting mid-size farms (Lyson, Stevenson, and Welsh, 2008).

In our RFN survey results, small operations tended to use direct marketing channels, with strong correlations between direct sales and organic practices (but not certified), grazing/free range, and antibiotic- and hormone-free animal husbandry. Large operations used wholesale channels, with certified organic products correlated with RFN retail and wholesale channels, while sales to national or international distributors are correlated with conventional practices. For mid-size farms, barriers to local/regional retail, restaurant, and distribution channels indicated difficulty in matching motivations and price premiums with supply chain partners. This is an area of entrepreneurial opportunity that could bolster Oregon’s mid-size farms and may warrant some public or private policy support (Brekken, Parks, and Lundgren, 2017).

Spatial and Temporal Distribution

The final step in linking RFNs to ecological resilience is recognizing the spatial and temporal distribution of landscape characteristics and farm practices. The agricultural landscape facing the producer is a conditional value used to make decisions about which management practices could be used to improve environmental outcomes. These are physical conditions that can be measured empirically and can be used by producers and policy makers to target policies linked to farm practices (Brown, 2016).

Ecologically multifunctional farms are diverse with regard to field size, field-to-edge ratio, and amount of uncultivated land (verges, hedgerows, etc.). Temporal diversity—crop rotations, timing of management activities—may also increase the overall heterogeneity of the farm ecosystem and ultimately have a positive impact on biodiversity and, by extension, overall ecological resilience (Kremen, Iles, and Bacon, 2012; Pearson, 2007; Shennan, 2008).

The ultimate goal is to translate farming practices to actual environmental impacts (Millennium Ecosystem Assessment, 2005; Jones-Walters, 2008). Water quality (riparian buffering, habitat connectivity, and groundwater infiltration), pollination, nutrient cycling, soil conservation, carbon sequestration, and biodiversity conservation are important ecosystem services that operate at multiple landscape scales (Dale and Polansky, 2007; Swinton et al.,

2007, Zhang et al., 2007). However, ecosystem services generated by farm practices are widely inferred from farm practices in organic certification, eco-labeling, and government regulatory programs rather than by direct measurement.

While measuring environmental outcomes or indicators is ideal, it may be cost or measurement prohibitive (van der Werf and Petit, 2002). Rapid advances are occurring in “precision agriculture,” using new technology to measure on-the-ground environmental indicators. New self-assessment tools also allow farms and their supply chain partners to assess the environmental impacts of the food supply chain. It is becoming increasingly possible for farms to use the latest technology to manage their farm to reduce their environmental impacts, understand the impact on the bottom line, and communicate their progress up the supply chain and to consumers. “Small brands” that aggregate product from regional producers for regional markets in RFNs often differentiate their products based on environmental attributes as well, spurring innovation and the adoption of new technologies among participating producers.

We can also apply the economic concept of “clustering” to ecological impacts of agriculture. Clustering happens when farm businesses participate in their RFNs, strengthening the market and opportunities for individual farms and amplifying economic and ecological impacts (McAdam et al., 2016; Iles and Marsh, 2012; Gellynk et al., 2007). For example, habitat fragmentation can be more effectively alleviated if neighboring landowners participate in habitat restoration plans. Reducing irrigation needs across multiple farms in a watershed could provide more water for other agricultural uses and migrating fish species. Another take on clustering would protect agricultural landscapes from development to enhance regional food security. Multifunctional landscapes can be intentionally maintained and interacted with the RFN’s social, economic, and ecological characteristics to create greater benefits.

While we do not have specific geographical data to analyze the spatial proximity of the farms in our Oregon RFN survey, future research on ecological impacts should account for the aggregated impacts of clustered farm practices.

Summary

The ecological impacts of agriculture are most directly a product of farm practices. Fundamental farm management decisions—such as what to produce, fertilization, irrigation, pesticides, tillage, harvesting, and processing equipment—have direct consequences for ecological health. These decisions are informed as much by factors in the social and economic environment as much as by those in the physical environment.

We analyzed the results from our Oregon RFN producer and consumer survey using a framework of five characteristics that connect producers who participate in RFNs to improved ecological resilience: ownership and control, personal values and social embeddedness, entrepreneurship and multifunctionality, scale, and spatial and temporal distribution of RFN producers and markets. We conclude that farmers who choose ecological farm management practices may be good candidates for RFNs, while marketing through RFNs may have a strong influence on farm practices: taking advantage of the spatial, temporal, and figurative proximity of food supply chain actors can lead to improved environmental outcomes in the region as messages about food’s environmental impact move among producers, consumers, policy makers, and natural feedback mechanisms are reflected in ecosystem functions. Developing stronger RFNs opens new market opportunities for innovative, entrepreneurial farmers with strong ecological values, which may improve ecological outcomes for soils, water, and climate while building farms’ productive capacity to ensure long-term food security.

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Acknowledgments: This study was funded by the U.S. Department of Agriculture under National Institute for Food and Agriculture grant 2014-68006-21854. We thank our collaborators, graduate students, and anonymous peer reviewers for their efforts and insights.

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