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**Social ecological food systems: Lessons from Maine dairy networks**

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# Social ecological food systems

## Lessons from Maine dairy networks

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In New England, Maine has the highest food insecurity for both children and the elderly (Coleman-Jensen et al., 2011). Understanding ways in which food system networks grow and prosper might provide valuable lessons for sustainability science at large, and social ecological food systems (SEFS) dynamics in particular.

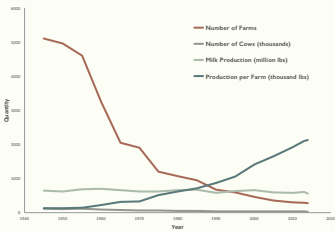
Dairy studied as a food system encompasses all aspects of production from milking to consumption. It is also a social ecological system (SES), which means that throughout the chain of production there are interactions between people and the environment (Azar, Holmberg, and Lindgren, 1996).

I make the assumption that in Maine, it is important for dairy to continue to be a part of our landscape, culture, and economy. I also suggest that lessons for other industries can be learned from the dairy industry viewed as a social-ecological system.

### CONTEXT Why is dairy an important food system?

Milk has played an integral role in the history, culture, and economy of Maine's agriculture. In 2011, dairy products were the second largest agricultural commodity in Maine (USDA ERS, 2013). Annually, dairy contributes more than 570 million dollars to Maine's economy and over 25 million dollars in taxes (Kersbergen et al., 2013). Dairy is a key component of the integrated rural Maine landscape—700,000 acres of open space (Kersbergen et al., 2013). The dairy industry supports not only farmers, but also 4,000 other jobs such as grain suppliers, veterinarians, processors, and scientists (Kersbergen et al., 2013). In 2007, Maine's organic dairy sector made up more than half of the State's revenue from all organic products, but the industry also requires large inputs and is vulnerable to rising organic feed costs (Beach, 2010). Both conventional and organic dairy have systemic challenges, and also opportunities (Fig. 1).

Figure 1. Maine dairy since the Green Revolution



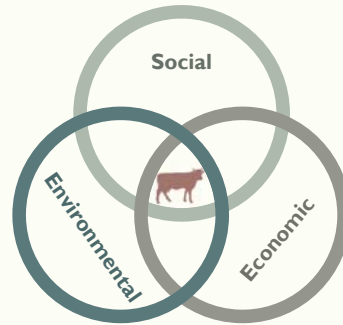
Insulated covered milk collection truck. The Maine Agricultural Experiment Station, Bulletin 374, Sept. 1934.

### MIXED METHODS

I employ a mixed methods research design, which includes network surveys, semi-structured interviews, and network modeling (Bernard, 2011; Tashakkori and Teddlie, 2003). It is necessary to overcome disciplinary boundaries to solve problems in social ecological systems (Miller et al., 2008). It is also critical to maintain an adaptive research process, and to do this my methods will inform one another to allow for iteration. Network analysis and modeling allow a researcher to measure the strength and organization of relationships between members of a network (Henry, Lubell, and McCoy, 2012). Because of Maine dairy's rapidly changing industry structure, it is challenging—if not impossible—to determine the social boundaries of the industry. To address this challenge and potential sources of error, I used a hybrid name generator for the network instrument design (Fig. 4), which is selected when a researcher does not know all of the relevant actors in a system (Henry, Lubell, and McCoy, 2012).

The network survey and long-term viability indicators (Belanger et al., 2012) will provide a framework for the semi-structured interview questions. Conducting the survey first will also provide an opportunity to determine which network actors are the most trusted, and what types of information are shared between individuals. Semi-structured interviews will be conducted with a population sample. Each production size tier will be represented for both organic and conventional dairies.

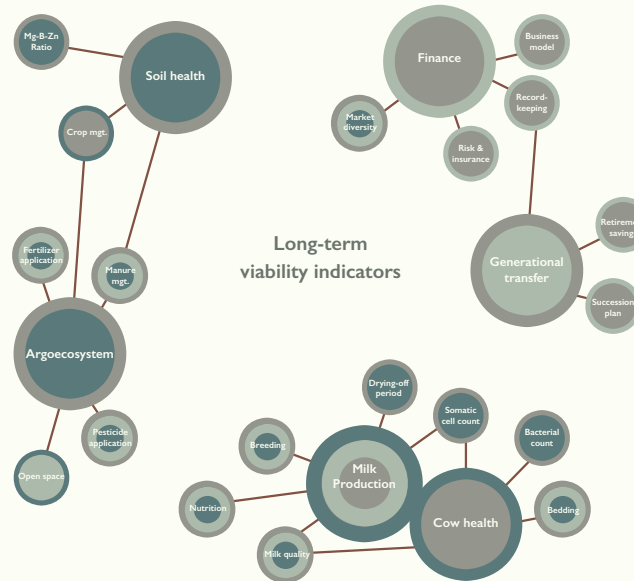
### SUSTAINABILITY What are the indicators of dairy viability?



I ascribe to the three-part model of sustainability—there are economic, environmental, and social indicators that are essential to the long-term viability of a farm

(Belanger et al., 2012; Kastenhofer & Rammel, 2005; Zimmerman, 2005).

I hypothesize that dairy farm sustainability is dependent on industry-specific social, ecological, and economic metrics. These metrics will be aggregated to form an index of sustainability indicators to predict farm viability. I also suggest that network analysis is an important tool to measure and model sustainability of social ecological food systems.



### FOCUS GROUP Input to strengthen experimental design

I conducted a preliminary network survey with a focus group of dairy farmers and industry professionals (n=12). Results suggested that interviews should be conducted after the population-wide network survey to better understand the industry's trusted information networks (Fig. 2) and industry challenges (Fig. 3). The final network survey was adapted with focus group and expert feedback (Fig. 4).

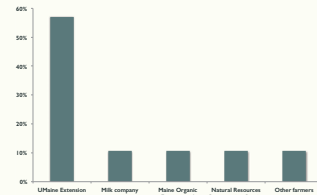


Figure 2. Most trusted sources of information in the Maine Dairy Industry (above).

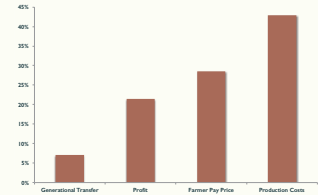


Figure 3. Biggest challenges for long-term viability of the Maine Dairy Industry (above).



Figure 4. Network Survey Instrument (left).

### PROJECTED OUTCOMES

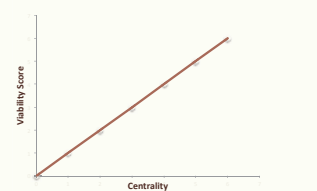


Figure 5. The dependent variable, farm "Viability Score" is an aggregate of the viability metrics to the left. The independent variable, "Centrality," is an index of the strength of a farm's social network connectivity.

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### FEEDBACK

Business cards

Questions?

Comments