CHALLENGES TO AND FROM SCALE IN ALTERNATIVE FOOD SYSTEMS

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ABSTRACT

Sophie L. Kelmenson: Challenges to and from Scale in Alternative Food Systems
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In recent decades, "alternative", "local", "regional", and/or "community focused" food production practices gained support as an opportunity to mitigates or even reverse the barrage of negative impacts on human health and the environment, loss of small farms and food businesses, and the increasing reliance on inequitable labor practices that are associated with industrial agriculture (Dahlberg, 1993; Feenstra, 1997; White, 2020; Low, et al., 2015) However, there is growing recognition that farmers' markets and direct sales alone will not meet the increasing demand for local food, or shift the structure of industrial agriculture (Born & Purcell, 2006; Pirog, 2008). Instead, these interventions may need to be "scaled up" to shift production and consumption practices across the food system. Without attention to how scale may happen, efforts to build something alternative to industrial agriculture may fail.

This dissertation examines challenges *to* and *from* scaling up in for alternative food systems in three ways. Paper I is a case study of innovative pathways for increasing in scale while maintaining and even enhancing many the values associated with alternative food systems. Paper II is a case study of growing pains resulting from scale, specifically how institutions influence sustainable food system development in the context of complex environmental management concerns arising from a larger scale of production. Finally, Paper III explores labor quality in alternative food systems and risks it may pose for innovation and scaling.

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INTRODUCTION

The literature on the U.S. agricultural industry documents consolidation of production, where a few very large farms produce the majority of food, diminishing the opportunity for rural economies to use agriculture as an economic engine (MacDonald, Hoppe, & Newton, 2018). Yet, there is also growing recognition of the negative consequences of this arrangement, and in recent decades "alternative", "local", "regional", and/or "community focused" food production practices have gained support as an opportunity for production that mitigates or even reverses these impacts (Alkon & Agyeman, 2011; Janssen, 2010). The local food literature analyzes systems of production and distribution of local foods as an opportunity for sustainable economic development that combats the barrage of negative impacts on human health and the environment, loss of small farms and food businesses, and the increasingly reliance on inequitable labor practices that are associated with industrial agriculture (Dahlberg, 1993; Feenstra, 1997; Fryar, Carroll, & Ogden, 2012; White, 2020; Thilmany, Bond, & Bond, 2008; Low, et al., 2015)

Food systems also have a big role to play in addressing climate change. Food production is a major driver of greenhouse gas emissions contributing to climate change (Carlsson-Kanyama & González, 2009). Food production is also likely to be seriously impacted by climate change. As shifting fisheries, declining soil quality, and heightening temperatures threaten more recognized food production methods, not only will food security be threated, so will the economic security of those who produce our food.

Shifting the food system away from industrial agriculture and towards alternatives that are more socially and environmentally just and sustainable then, is an opportunity for sustainable development. Born and Purcell (2006) encourage an understanding of local food that connects ecological sustainability with social and economic justice – almost exactly in line with Campbell's (1996) articulation of sustainable development. Other local food and environmental advocates concur that food systems offers an interdisciplinary opportunity to bring about sustainable development on several levels (Feenstra, 1997; Donald, 2008).

Consistent with planning debates elsewhere, there is no clear path to achieve Campbell's (1996) articulation of sustainable development in alternative food systems (AFS). While this new sector receives much attention, at the small scale it is currently at, representing as little as 1.5% of US GDP in 2012 (Low et al., 2015), there is debate about the potential benefits from investing in this sector, how to measure these benefits, how the sector should be understood and organized, and whether and how the sector can become a viable alternative to industrial agriculture, or whether it may be destined to be a niche product for wealthy consumers.

However, there is growing recognition that farmers' markets and direct sales alone will not meet the increasing demand for local food, or shift the structure of industrial agriculture (Born & Purcell, 2006; Pirog, 2008). A literature on the importance of larger scaled, "local" food systems emerged to document the strategic opportunity of intermediated supply chains for more broadscale change in the food system (Hardesty, et al., 2014; Gwin & Thiboumery, 2014; Lyson, Stevenson, & Welsh, 2008). While showing a promising shift in the 2012 USDA data toward intermediated supply chains (Low et al., 2015), when small producers scale up, they confront new challenges (Tewari et al. 2018). Increasing the scale of alternative food systems requires changes for both businesses seeking to scale up and institutions supporting this nascent industry.

Without attention to how scale happens, efforts to build something alternative to industrial agriculture may fail.

To better understand are the underlying processes of change that contribute to scaled up food systems, I focus on aquaculture, an avenue for alternative food system development heralded as particularly useful for growing healthy food in climate conscious ways. Paper I is a case study of shellfish aquaculture farm development of innovative pathways for increasing in scale while maintaining and even enhancing many of the values associated with alternative food systems. This case reveals important lessons regarding how successful scale happens and the role of firm partnership and product "story telling."

Next, I use a case study of a regulatory institution, the California Coastal Commission, to understand the ways in which institutional mechanisms deal with growing pains when firms begin to achieve scale – the challenges that arise with competing uses of marine systems and understanding complex and evolving environmental conditions – and how institutions ultimately influence sustainable food system development in the context of complex environmental management concerns arising from a larger scale of production.

Finally, although there is research on farm workers, and related industries such as the food service industry or the tourism industry, there is no research on the suite of occupations that make up the alternative food systems industry, particularly those jobs that are necessary to design, set up, and orchestrate systems that are by definition alternative to the status quo. Using national level job-posting data, I examine which jobs constitute the alternative food systems industry, and whether the jobs in this industry of good quality, compared to similar occupations in other industries. It more specifically begins to answer the question of whether under-paying job opportunities may be holding back alternative food systems. This research creates a set of

occupations that make up an alternative food system so that future researchers examine trends in the industry.

The dissertation will conclude with commentary on several through lines across these papers. Most prominently are the ways in which alternative food systems may or may not take advantage of scale – geographically and economically – and the reciprocal benefits and challenges that arise. I will discuss how scale within alternative food systems is evolving; strategies for (re)-organization to overcome potential obstacles; and the potential for emergent alternative food regions. Second are the ways in which the future of food and environmental protection are increasingly and intimately intertwined. Any type of food production, but especially those alternative systems in the process of scaling up, increasingly will need to deal with climate change. This will involve instability in business models, require incorporating complex scientific information and regulation to deal with a changing climate, and engaging stakeholders who are concerned about the environment. These papers together examine how different economic and institutional actors struggle to meet this challenge. Third are the ways in which equity, power, and agenda setting manifest in a relatively new and emergent economy. This manifests itself in the ways in which alternative food infrastructures are developed, who develops them, and who will benefit from this work. Finally, I will identify opportunities for future research.

CHAPTER I: WHAT ARE THE UNDERLYING PROCESSES OF CHANGE THAT CONTRIBUTE TO SCALED-UP FOOD SYSTEMS?

Introduction

Industrial agriculture intentionally obscures how and what it produces to its benefit. When those details come to light, they create a defining moment in which consumers must contend with their values around food and what they choose to eat. This reflection may include considering on how animals get treated, how land is managed, and more existentially, how our planetary environment is affected, itself a factor in the future of humanity.

For producers of alternative foods, establishing a values-based connection through increased consumer awareness and engagement is thus critical for advancing the goal of sustainability. It is also necessary if we want alternative foods to replace industrial agriculture on a level that will have a real impact. But there is an inherent paradox in this push to replace industrial foods with those that are good quality and earth-friendly: the processes of scaling that are necessary for this transition to occur can also undermine the ability of alternative food producers to keep consumers interested in how and why quality, sustainable food gets made.

Resorting to standard labels such as "local" or "organic" is rarely sufficient. They place too much pressure on individual behaviors to create change, and further, often leave consumers confused about what those generic and commonly used categories mean. Worse, these go-to labels can result in product homogenization, not only obscuring localized variation in environmental, economic, and social impact but also risking the misclassification of products

known as "greenwashing." This challenge means that better branding of alternative food is not enough: more encompassing strategies are needed to create economies of scale while also deepening commitments to sustainable and equitable food production by expanding mutual producer and consumer understanding and appreciation of the specific practices and obligations involved in producing alternative foods.

This paper highlights a promising strategy for achieving value-based scale within aquaculture farming. It focuses on two vertically and horizontally integrated shellfish farms, one on the east coast and one on the west coast, which have successfully grown into multimillion-dollar enterprises that maintain their "small farm" feel and values. It describes a new model for scalable, place-based, sustainable development in alternative food systems that leverages the strengths of VBSCs and direct ownership to create scale while escaping homogenization of alternative food products by instrumentalizing and articulating value in terms of *merroir* rather than traditional VBSC labels. The idea of "merroir," analogous to *terroir* in land-based production systems, reflects the particulars of the people, place, and production methods that create a specific taste. Communicating in terms of *merroir* – more storytelling than branding – embeds a more expansive understanding of, and connection to, the practices and commitments involved in producing alternative food. Not only is this strategy effective at market-making, but it also operationalizes values in alternative food systems in a more nuanced way. By engaging with *merroir*, producers are drawn to deepen their commitments to sustainable place-making to preserve or enhance the taste of their goods. In contrast, consumers are drawn to deepen their understanding of how and why good food is made. This case sheds light on both how to scale and how values are instrumented through processes of scale, with implications for AFS practitioners seeking either or both.

Literature Review

Values-Based Supply Chains

Value-based supply chains (VBSCs) are a strategy that arose in the United States out of recognition of the need to extend the geographic scope and scale of small and medium-sized farms that espoused certain non-industrial values. When demand sparked for locally produced food from farmers markets – an arrangement meant to "reconnect" consumers to their local ecosystems and communities and to support more sustainable and ethical local economies – so did the recognition that sustainably producing goods was possible at multiple scales of production (Born & Purcell, 2006). However, a lack of infrastructure limited market avenues for farms producing these "higher quality, differentiated" goods on larger scales. They grew too much to sell exclusively at farmers' markets, and too little to compete in global commodity markets. A slew of research sought ways to protect market access for "the agriculture of the middle" as a pathway away from reliance on industrial agriculture that was accessible beyond farmers' markets (Lyson, Stevenson, & Welsh, 2008).

Analyses of supply chains (rather than individual firms) identified networks of partners within and across supply chains as a successful strategy to create economies of scale in processing, marketing, and distribution (Gwin & Thiboumery, 2014; Lyson, Stevenson, & Welsh, 2008; Hardesty, et al., 2014). Partnership allowed small and medium-sized producers to aggregate goods without sacrificing their goods' "high quality, differentiated" nature (Feenstra, Allen, Hardesty, Ohmart, & Perez, 2011; Hardesty, et al., 2014). Partnership created a novel form of vertical integration, in contrast to "direct ownership and competition, as is the case in

traditional vertical integration" (Clark & Inwood, 2016, p. 504). These networks also became pathways for small producers to scale up to medium-sized (Clark & Inwood, 2016; Tewari, Kelmenson, Guinn, Cumming, & Colloredo-Mansfeld, 2018).

Partners in a VBSC rely on fair pricing that prioritizes stability and reliability to create longer-term partnerships and business strategies. Stability supports participants' ability to work together by providing more market certainty and planning for market fluctuations (Cumming, Kelmenson, & Norwood, 2019; Clark & Inwood, 2016; Lev & Stevenson, 2011) (Feenstra & Hardesty, 2016). Given a commitment to fair and reliable pricing, the third feature of success is a willingness to experiment with new products and strategies that fosters the creation of market niches and innovation (Feenstra, Allen, Hardesty, Ohmart, & Perez, 2011; Clark & Inwood, 2016; Angelo, Jablonski, & Thilmany, 2016). To make these commitments, firms need production *and* business skills (Cumming, Kelmenson, & Norwood, 2019; Hardesty, et al., 2014).

The VBSC strategy was economic initially, with "values" initially being about partnership and trust in the supply chain (Lev & Stevenson, 2011; Hardesty, et al., 2014; Feenstra, Allen, Hardesty, Ohmart, & Perez, 2011; Clark & Inwood, 2016; Feenstra & Hardesty, 2016). The VBSC approach to values deepened through its application to the local foods space. Members of VBSCs screen potential partners based on their ability to match supply and demand, "culture fit," and "values" (Lev & Stevenson, 2011; Angelo, Jablonski, & Thilmany, 2016; Clark & Inwood, 2016) (Feenstra & Hardesty, 2016). Through the partnership process, "high quality, differentiated" goods translated to "capturing price premiums in the marketplace for the environmental, economic, and social benefits (values) embedded in the products" (Feenstra, et al., 2011, p. 71).

However, the VBSC approach also limits how values can be instrumented in the food system. VBSCs rely on categories such as "local," "organic," "free trade," "biodynamic," "raw," "cage free," "non-GMO," that capture qualities about food in a generic way that is not connected to particular places or the place-making that occurs to produce food. As a result, both VBSCs and local food are defined as "not industrial food." While have some have argued the variability and breadth among categories is a strength for an emerging market, it also opens the industry up to greenwashing and confusion.

Second, VBSCs rely on aggregation and some homogenization to create scale. For some goods (especially processed), the final product is not from a specific farm alone, or that a label identifying the farm is not particularly meaningful when competing against many other "local" products with no further differentiation (Angelo, Jablonski, & Thilmany, 2016). The price premium instead is derived from the branding of less specific values, such as certifications (i.e., Fairtrade), locations (i.e., "local"), or practices (i.e., organic). The vagueness of these attributes may obscure the firms' alignment to customers' values, effectively distancing customers from food information rather than increasing it.

Third and finally, when small producers implement a VBSC, they sell their products to consumers they likely do not interact with directly. Affordable production locations often bring VBSCs to less developed areas, while effective market segmentation and distribution require urban markets (Schrock, Doussard, Wolf-Powers, Marotta, & Eisenburger, 2019). The distance created between the farm and the consumer increases the potential for greenwashing (Wengle, 2016; Colloredo-Mansfeld, 2011; Comaroff & Comaroff, 2009). It becomes more difficult to "know your farmer [and] know your food"[1] and more important. Producers rely on labels to

[1] A common advertising phrase for local food systems.

communicate the values of their goods when they're not present. This challenge contributes to the commodification of food established by industrial food practices because consumers must rely on labels to understand their food.

Smaller producers may be doubly punished by this challenge because it is often costly to complete certification standards (Paxson, 2012; Tewari, Kelmenson, Guinn, Cumming, & Colloredo-Mansfeld, 2018). Many small producers may use practices that are consistent with "local," "organic," or other labels consumers are interested in, but are unable to afford the certification process allowing them to advertise their products as such. Reliance on these labels thus may create distance between the customers and products that the system is meant to bring together.

As a result of these dynamics, case studies highlighted the need to be a good "storyteller" about alternative food products and develop strong branding to portray the values that justify a higher price premium to partners and the public (Feenstra & Hardesty, 2016). However, little distinction is made between retail buyers and foodservice buyers as final "partners" along the supply chain whose responsibility it is to communicate those values (Lev & Stevenson, 2011; Hardesty, et al., 2014; Clark & Inwood, 2016) (Feenstra & Hardesty, 2016). However, Feenstra and Hardesty (2016) note that chefs have recently become more informed about "farm to fork" sourcing strategies. Storytelling among foodservice buyers (restaurants, cafeterias, caterers) and between retail buyers vary significantly.

The VBSC literature, then, would benefit from further investigation into alternative arrangements for scaling up alternative food systems to understand ways to incorporate more specificity about values in alternative foods. To explore this, the *terroir*-based strategy and its approach to place-making in food production is introduced.

From Terroir to Merroir

The idea of *terroir* relays natural factors (i.e., climate, biology) and social conditions (regional economies, production practices, history, culture, and expectations of food) into the taste of a food item produced in that region (Farmer, 2014; Trubek, 2008; Paxson, 2012). It arose because winemakers in France did not want copy-cats of their wines in other regions – essentially an intellectual property regime to create a brand name that would be widely recognized as specific to that place. Because of this, *terroir*-based strategies may also extend the geographic reach of a product. In some ways, it is easier for *terroir*-branded products to travel farther to consumers than VBSC goods because the label's content remains stable. For example, champagne, from Champagne, France, does not rely on "local" to articulate its values. Instead, consumers trust champagne makers negotiated, collective legal commitments to consistent and high-quality production practices (Farmer, 2014). However, *terroir*'s introduction in the US has been more limited. Terroir markets food from individual farms rather than regional production activities (Paxson, 2012). Similar to wine, a region may be apt at producing a type of wine, but individual farms in a region will still have taste variations based on hyper-local conditions. In the United States, *terroir* has been recognized more at this hyper-local level.

Terroir is distinct from "local," "organic," or other VBSC value designations in terms of production and consumption. Bowen and De Master (2014) argue that *terroir* fosters "a process for constructing an alternative food system that has greater potential to be a more nuanced, textured, and situated version of 'local'" (550). *Terroir* connects environmentally sound *production* directly to high-quality, place-specific *taste*, rather than emphasizing the proximity of consumption to production (Paxson, 2012). To describe the *terroir* of a food, you must explain

how the location where it was produced, and the practices that created it, influenced the taste. It requires telling a story.

Terroir runs the risk of co-optation, similar to how VBSC labels have been critiqued (Farmer, 2014; Trubek, 2008; Paxson, 2012; Bowen & De Master, 2014; Guthman, 2004). But others are less cynical, seeing an opportunity, though not guaranteed, to develop *terroir* in the United States to foster ethical economies and sustainable rural development (Bowen & De Master, 2014; Paxson, 2012). For example, in analyzing the use of *terroir* among American cheesemakers, Paxson (2012) argues that farmers laboring to develop a product that represents a particular *terroir* must make ethical, intentional, and forward-looking commitments to specific practices. "Terroir is about what … cheesemakers are trying to be — as rural entrepreneurs, ecological stewards, sustainable developers, and local citizens. Value, then, is not just materially extracted from or discursively inscribed on place; moral values can inspire placemaking practices." As a result, Paxson (2012) finds that the process of building *terroir* can extend to developing industries around the potential of a holistic idea of *terroir.*

Without the historical legacy of what practices contribute to *terroir* (such as in France), American producers are forward-looking with the commitments to certain practices to produce a particular *terroir.* These practices have the effect of differentiating products and becoming place-making activities that alter the physical material used to produce the good and the social understandings about food and among producers and consumers. Producers are not the only actors that contribute to the production of *terroir*; consumers and chefs are equally important. Growing, cooking, and eating practices make and re-make tastes: "people create place as they go about the quotidian tasks of agrarian livelihoods that physically shape landscapes and situate

people's sense of place" (Paxson, 2012, p. 8) – thus taste-making and the use of *terroir* are a form of place-making rather than labeling.

The emphasis on practices as connected to taste specifically allow for much more market differentiation and thus a stronger connection to the places that made them. More than branding, this storytelling provides a "push-pull" that brings producers and consumers together. Terroir gives consumers more to hold on to and is more engaging to them of particular places. A person can appreciate the *terroir* of their favorite vineyard or cheese anywhere in the world if they understand the commitments that contributed to its creation and the specific taste that resulted. By telling the story, producers are pushed to make more substantial commitments to the types of practices that produce their *terroir.* Cultivating product differentiation in this context may garner a higher price point, which is important for producers, but it does more than that. It pushes producers to grow food in ways that jive with local social and environmental conditions, not overcome them to create a homogenized good. Differentiation creates room for a holistic approach to actions that support local ecological conditions and hyper-local community commitments without having to force itself into an eco-certification scheme or an overly romanticized story of agrarian roots. *Terroir* puts the producer and the quality of the food produced, in a place, meaning that they have a responsibility to it. The transparency helps solidify the suitable types of commitments to placemaking through sustainable practices.

Although a good may travel further once cloaked in the story of *terroir*, it may be difficult for the producer to scale up production if *terroir* is limited to a small region. In the United States, *terroir* is more based upon an individual farm than a region, meaning that the ability of a producer to increase the supply of their good may be limited by a small geographic area (Paxson, 2012; Trubek, 2008). This challenge also risks reducing *terroir*-based storytelling

to farm-specific branding if consumers are not connected to an over-arching narrative about the function of *terroir* for food production generally.

The strengths and weaknesses of the VBSC and terroir-based strategies may be complementary. While VBSCs have been shown to offer an avenue to scale up effectively, the values embedded in this approach could use better grounding. Terroir-based strategies offer transparency and depth in how values are constructed, even when food travels farther afield, but little guidance on how to scale.

Here, alternative food systems may benefit from learning from the case of shellfish aquaculture. Recently the term *merroir* has been used to describe the similar layering of many chemical, biological, climate-related, and social factors that influence the taste of farm-raised oysters, acknowledging the influence of the ocean instead of the traditional soil influences for wine-growing regions. While only a handful of analyses examine the use of these larger-scaled supply chains offering high-quality, differentiated seafood products, and even less research examines supply chains for shellfish aquaculture specifically, *s*hellfish aquaculture faces similar challenges to land-based production venues in terms of re-articulating food systems values (Love, et al., 2020). Like land-based farming, small aquaculture farmers also struggle to increase in scale. For shellfish aquaculture farms in some states, including California and Massachusetts, permitting requirements restrict the growth of individual farm size (acreage) and the number of local farms that get permitted. This results in the need for aggregation and scale, much like in land-based systems. Small aquaculture farmers are also pivoting to "direct marketing" that circumvents conventional food supply chains. Articulating sustainability and quality values to garner higher price points, oysters are sold through cooperatives or short intermediated supply chains that sell directly to consumers, restaurants, and wholesale buyers (Stoll, Dubik, &

Campbell, 2015). Stoll et al. (2015) found that networks of cooperating farmers and fishers come together to build these supply chains, offering products to meet "the growing demand for social, ecological, and economic values of foods *and associated terroirs*" (emphasis added) (Love, et al., 2020, p. 40). Given the preliminary evidence that shellfish farmers may use both VBSC and terroir-based strategies, how does vertical integration occur in shellfish aquaculture supply chains that support scalable, sustainable food systems (if at all)?

Methods and Data

Study Areas

The paper presents two cases to show how the phenomena under consideration are not isolated to one case but is a strategy shared across cases. Blending VBSC and *terroir*-based strategies constitutes an emergent and cross-regional model.

Tomales Bay, California, about an hour's drive north of San Francisco, has a history of oyster farming. A nearby town is even called Bivalve. At its peak in the 1800s, it contained 1,100 acres of oyster cultivation. However, water quality issues forced their complete closure by the 1970s. Water quality has recovered, but the industry has recovered more slowly. Today there are 560 acres (5.8% of the bay) leased to a handful of farms for shellfish aquaculture (not just oysters). One of these farms, HIOC, opened in 1983 as a small farm and expanded and vertically integrated. Presently HIOC owns and operates an oyster seed hatchery, nursery, and 160-acre oyster farm that yields 3.5 million oysters, manila clams, and mussels a year. The company also sold (before the pandemic) another 3 million oysters per year grown by many (number undisclosed) farms throughout the Pacific Northwest and the East Coast. Their products are sold through multiple retail, catering, restaurant, and wholesale venues, some of which they own.

Before the pandemic, most of the company's 500 employees reported to one of the company's four oyster bars and restaurants.

Duxbury Bay, Massachusetts, is about an hour's drive south of Boston. Oyster farming is relatively new; there were no farms here in the 1990s. Today, it is home to over 30 farms and 71 acres (1.3% of the bay) of shellfish aquaculture. This relatively small footprint produces the most oysters of any bay in Massachusetts, valued at over $6.5 million in 2018 (Kennedy, McNally, Schillaci, & Silva, 2020). Each shellfish farm can be up to 3 acres. ICOC was the first oyster farm in the bay. Today it is a vertically integrated company that owns and operates an international NGO, shellfish hatchery, nursery, oyster farm, wholesale and distribution company, and purchases additional oysters from over 100 partner farms. Their oysters are sold to over 700 restaurants, including multiple restaurants, retail stores, and online sales platforms owned by ICOC.

Data Collection and Analysis

A qualitative case study approach was used to understand scaling up processes among mid-tier shellfish farmers (Starks & Brown Trinidad, 2007). Purposive sampling at one oyster company and of stakeholders identified by background research led to snowball sampling of shellfish farmers, regulators, environmentalists, and other stakeholders (Ritchie & Lewis, 2003; Carter & Little, 2007), for a total of 28 semi-structured interviews in California and eight interviews in Massachusetts. Interviews were completed in 2017 and 2018 (California only) and 2020 and 2021 (California and Massachusetts).

Interviews were transcribed alongside any notes. Interviews were coded for problem/solution stories concerning decision-making processes that influenced each shellfish farm's growth and vertical integration. These codes were pre-identified themes of interest that

allowed new, more specific themes to emerge relevant to the research question (Miles & Huberman, 1994). These thematic categories were used to examine relationships among actors and firms for enhancing the scale of the businesses.

Data analysis was complemented with content analysis of newspaper coverage, planning documents, public hearings, archival research, and stakeholder surveys. Ethics approval was obtained by IRB (Study 17-0965). Oral consent was given for all interviews; the interview preamble is in Appendix I.

Case study findings: A blended approach to achieving scale

From small beginnings, both farms experimented with ways to circumvent the conventional seafood supply chain. Both farms utilized partnership and direct ownership to achieve scale and vertical integration; storytelling was also an important component of their scaling-up strategy. Their processes of scaling are consistent with the VBSC literature. However, the farms and the shellfish aquaculture industry translated values in ways that are closer to the *terroir*-based strategy. Rather than the typical labeling used by VBSCs, the farms focused on developing customer engagement with taste particularities through the concept of *merroir.* This strategy led to more extensive place-making and community engagement activities in their home regions while extending their impact across the industry and their market reach beyond "local" to consider markets farther afield.

Direct ownership as a scaling strategy that leverages iteration and diversity

In contrast to the VBSC strategy, both farms utilized the direct ownership approach to vertical integration in many parts of the supply chain. Both farms own hatcheries, nurseries, and sales avenues (restaurants, retail, catering). This multi-faceted approach to scale reflects the need

for stability in the supply chain. They achieved this by scaling up slowly and iteratively and establishing diversity in the supply chain for resilience.

Seeking stability in revenue streams, both farms began raising multiple oyster and shellfish species to increase supply chain resiliency and revenues. For example, HIOC began growing different species of oysters with different harvest seasons to supply oysters more consistently, while ICOC began as a clam harvesting business and whose hatchery sells seeds for many species beyond oysters, including algae, scallops, muscles, and different types of clams.

Vertically integrating forward, both companies opened their own sales avenues. Restaurants took center stage in terms of sales, but various sales avenues were important for resilience. For example, HIOC started a traveling oyster bar: "It started as a way to make a living; then it was a great branding tool; then we realized we actually made money. We do over 250 events a year in the bay area, that's over half a million-dollar piece of the company." HIOC also sells oysters "to-go" at the farm directly to consumers and offers farm tours and agri-tourism events. ICOC, by contrast, started first by building a distribution company to serve restaurant accounts better. It took time to build the infrastructure necessary to be profitable, but this investment paid off more than just partnering would: "when we did achieve scale that covered overhead, we … mov[ed] from 3, 5, 8, 10% gross margins to capturing high 30s." Similar to HIOC, ICOC next started direct-to-consumer sales and farm tours and events. This arrangement developed consumer engagement and was essential for surviving the covid-19 pandemic: "having a more balanced revenue mix is definitely appealing. We've been trying for years to create the direct consumer market, to convert people who are restaurant oyster-eaters into at home oyster-eaters, and now 20 or 30,000 people this year [during the pandemic] decided to become home oyster eaters, and I'm hoping they stay home oyster-eaters."

These efforts helped both farms develop the market and capital to open their restaurants. "We realized we don't need to sell volume through wholesale; we have this other way." HIOC opened restaurants in San Francisco and other population hubs, which "really changed the company. … we were in the black from the day we opened. The company doubled in revenue and employees in a year. It was such a vehicle for strengthening the brand as well as being more financially successful."

Both farms integrated backward and forwards, opening nurseries and hatcheries that required substantial financial investment to develop. Hatcheries mate and grow oyster "seeds" until they are big enough to be sold to nurseries (or farms with nurseries). The motivations for investing in an expensive hatchery are multiple. Growing seed reduces seed prices, and any excess can be sold to other farms. HIOC takes this one step further, prioritizing selling seed to farms that supply HIOC with oysters, effectively selling discounted seed to partners to buy discounted finished oysters. In addition, ICOC wanted to ensure that their seed was not at risk to another crop-destroying virus. ICOCs hatchery now produces multiple species and is used to engage customers about the oyster lifecycle. "The hatchery has been really good. … It's not just to grow our species in there. We bring farm tours that we charge for through the hatchery. So it's been a good platform. And recently, it's become a good profit center and a great way to cover the cost of our own seed." Finally, both farms have moved into real estate and apparel types of sales. Owning properties nearby and renting them or developing them for other related business endeavors.

Partnership as a Path to Scaling Up

In conjunction with direct ownership, both farms relied on partnerships and networks of farms to create economies of scale that allowed for non-traditional forms of vertical integration.

One of the major challenges for AFS firms that seek to scale up is generating stability. This style of partnership was significant for developing an adequate and stable supply of oysters. Neither farm could expand to the extent or speed needed due to strict permitting regulations. Instead, they partnered with other farms by either offering to sell other farms' oysters through their established channels or incorporating adjacent farms' oysters under their brand. Expanding supply via networked partnership brings in less margin for each company. However, it still generates a larger scale's efficiencies and provides stability and resilience in the supply chain.

Because partnership occurred within the farms' established channels and under their brand name, they became the "lead farm" within their supply chain. For example, ICOC buys oysters from adjacent partner farms to sell as ICOC oysters – the merroir does not change too much from one three-acre plot next to another in the same bay – and sells oysters branded from other farms. Buying oysters from partner farms in other bays happened when a parasite caused a supply shortage. Not wanting to lose accounts, they realized "there were other pockets of production [of oysters] that were starting to grow, …[that] were getting traction with their farms. And I started calling them because we had all these relationships. … So I started selling other people's oysters also."

Consistent with the VBSC framework, smaller farms benefit from partnering with lead farms' by securing supportive market access. It is often difficult for small farms to find the best end markets because they do not have the branding or marketing capacity, or capability. Both lead farms' oyster bars anchored smaller farms by amplifying their market exposure as vetted, high-quality oysters and by providing a consistent sales avenue: "we love changing the menus. I can work with small growers, and go, 'just tell me what you got, we'll run your oyster for three months, and if you run out, fine.'" The consistency of this end market may allow smaller farms

to better plan for future harvests, which is critical when planning happens in a two to three-year time horizon. In both cases, pricing for smaller farms was an essential and evolving component of a successful partnership. Among small farmers, having a reliable place to sell their oysters at a consistent price was a priority, reflecting the VBSC framework of long-term planning and supply chain stability while allowing the smaller firms to experiment, find their niche, and scale-up.

This partnership style reflects how the farms' incorporation of *merrior,* instead of "local," influences their business model. As one farmer put it, "a good oyster bar has a variety of oysters." The lead farms are forced to aggregate oysters from multiple farms to have enough supply to meet demand. Still, both companies use this to their advantage by advertising the diversity of oysters available. Variety engages consumers to become invested connoisseurs who want to taste (and therefore buy) all of the different flavors and types of oysters available. Developing connoisseurship means helping consumers make the connection between the *merroir* and the place-making that grows an oyster with the taste they experience. Partnership, then, is a resource both for establishing a stable supply and for market-making.

Both lead farms vet their partners for values consistency, consistent with the VBSC strategy. In one case, the founder recruited and taught the other farmers who would eventually be his partners, guaranteeing a values match. For the other case, staff from the lead farm visit potential partner farms before purchasing oysters. Two employees explained, (completing each other's sentences):

> L: [Our farm] does not buy market size oysters from a lot of people because, without sounding pretentious, we don't agree with their practices
> J: it could be with pollution, it could be with how they deal with the environment
> L: it could be how they treat their employees

When this situation arises, the lead farm will communicate with the potential partner. In some circumstances, the potential partner will change their practices to access the lead farm's market.

This practice is consistent with the VBSC approach because it is a form of screening partners and shows open communication, holding partners to value commitments, and a longer-term approach to partnership.

Both lead farms also prioritize working with the right partners on the other end of their supply chain; however, these partnerships reflect a refinement and expansion for the VBSC framework. Both lead farms do not lump food service, retail, and wholesale avenue partners together as "customers." Partnerships with restaurants enabled both to circumvent conventional supply chains. Restaurants offer benefits overlooked in the VBSC literature. First, they provide higher price margins to producers if a distributor is absent or committed to fair profit sharing. Second, they influence their customers' perceptions of quality and taste. Both lead farms used this to their advantage.

For example, when a parasite killed multiple years' worth of oysters in 2009, one lead farm focused on serving high-end restaurant accounts that offered the most margin. "Then we made the decision to cut everybody out [distributors]. And we only did direct to chefs." While the farm sells to other avenues today, anchoring with higher-end, high-margin restaurants allowed the company to subsidize those sales avenues. At the same time, they fine-tuned their business models in other sales avenues.

Partnership with restaurants was similarly essential for market making. In 1984, when "this whole California food movement thing was happening," the HIOC focused on growing "really good oysters" to sell to well-respected restaurants. "That was a big, conscious decision we made in the beginning: not to sell just to anybody." A values-based partnership meant that HIOC sold to restaurants that they counted on to vet their environmental practices and food quality. HIOC's first two accounts were two of the most venerated restaurants in the Bay Area. HIOC

required these restaurants to show the farm's name and address on the menu with their oyster, connecting their place, practice, and quality for the consumer. HIOC did not have a promotional budget between 1983 and 2007 because local food critics consistently provided free advertising. This strategy shows how commitments among growers and purveyors of "good food" to craft production can enhance regional place-making and taste-making connections.

Investing in the company's vertical integration required capital, and both lead farms accepted private investments for different aspects of their growth. Here again, HIOC used principles from the VBSC framework in a new way by offering a private stock offering to friends and colleagues in the sustainable food industry who understood the challenges of a food business - "the long-term nature of the investment" - and who "really believed" in HIOC. The shareholders and fundraising strategy provided some security and connected the company with advocates: "they were emissaries, they were foodies. They would go to restaurants and ask for HIOC oysters." Instead of having one wealthy investor or a bank loan, the company opted for many partner investors.

Story-telling and Merroir-making

Another similarity between the lead farms is the ease of developing their brands and the similarities in their brands. "We were always good at sales and marketing. We like to party, we go out with chefs, and that always came naturally to us. … We were never in it because we were dying to make tons of money. I would have gone and worked on Wall Street if that were the case. We concentrated on having fun and selling oysters." In either case, the resulting reputation or brand identity reflects a lifestyle with a sense of humor, an appreciation for working with ocean elements, and encompasses more than the quality of their product. "The brand is very

much about … the lifestyle. It's the place, it's the people, you know, that it's not just the oysters. So that's pretty important." This approach manifests itself in messaging on their websites such as:

> "We are passionate about good people, good food, and saltwater. We get up every day with something to prove—that with enough hard work, sleepless nights, bloody knuckles, and cold beers we can forge a meaningful livelihood from the sea in the 21st century—and that we can have a damn good time doing it."

This quote connects lifestyle to food that encompasses (potentially aspirational) relational commitments within a place; the relationships among the people and their approach to growing oysters are as crucial as the oysters themselves. In addition, the message is meant to be recruiting. Although their market-making efforts relied substantially on high-end restaurants, this messaging intentionally seeks non-pretentiousness. They hope that connoisseurship of oysters does not lead to status-oriented consumption but rather informed consumption – as long as you know what you like, it does not matter which you like. The lifestyle components of the brand – that hard-working, beer-drinking dudes grow and enjoy oysters – also make oyster-eating available to more people.

The emphasis on the particularity of *merroir* is similarly consistent across farms in the industry, HIOC and ICOC included. They are careful again to help consumers understand the nuances of *merroir* without making their oysters pretentious or exclusionary, as their appeals to merroir must be market building rather than limiting. They are adept at describing the *merroir* of their oysters and their partners' oysters, especially the different aspects to be enjoyed from each oyster's *merroir* in comparison. Each farm develops *merroir* for each type of oyster they grow, based on their individual farm and not a constructed region (like in Europe). HIOC describes theirs like this:

> "Few foods carry the flavor of "place" quite like an oyster. Tomales Bay has the cool, clean water rich in plankton that oysters feed on to grow plump and sweet, and the flavor of the bay is evident in every delicious mouthful. Oyster lovers call this *merroir*; we call

> it delicious. Whether you're a seasoned connoisseur or a newcomer to the world of oysters, you'll find something on our menu that will draw you in and keep you coming back for more. Click here to learn how we farm our oysters."

Whereas ICOC uses the following language to help customers understand how the species, geography, farming method, and 'hand of the grower' unpack components of *merroir*:

> "*Merroir* refers to the unique expression of the ocean on an oyster and provides a handy toolbox of criteria that makes any daunting oyster list easier to navigate. … The next time you saddle up at a raw bar and see a long list of oysters to choose from, ask your shucker a few questions – where the oysters come from, how are they grown – and keep those qualities in mind as you taste each variety. Over time, you'll figure out which aspects of *Merroir* you like best… And you'll be an Oyster Pro for life."

Both messages exhibit many of the features of the *terroir*-based strategy, including a connection to place and production practices, the development of preferences and taste that are individual to the consumer as opposed to ranked or recommended, and the description of how the particular places' natural elements influence the taste the customer experiences. By providing consumers a language to understand the influence of various production techniques and natural effects on *merroir* at the individual oyster and farm level, and by fostering market access within their supply chains for small growers, the use of a *merroir* storytelling practice supports the industry overall, and specifically the introduction of many smaller growers into the market. Although *merroir* is developed at the individual farm level, the business model of offering multiple oysters within the same supply chain supports some of the more regional approaches to oyster farming. For example, ICOC advertises oysters from numerous farms grown in the Damariscotta River, in Maine, because of its unique growing conditions.

The farms are not the only actors teaching customers about *merroir*. Partner restaurants echo the farms when describing their sourcing policies ("Few foods carry the taste of place as well as an oyster" as do restaurant reviewers (The Kitchen Restaurant, n.d.). The New York Times restaurant review recommended trying oysters from ICOC and another farm in Maine

because "both are from the same batch of seed oysters, so tasting the two side by side emphasizes the importance of ‘merroir’ — a term the oyster community uses in place of terroir" (Ryan, 2011). Farms and organizations that support coastal rural communities have also taken up *merroir* as a way to distinguish farms and support economic development efforts; the North Carolina Coastal Federation highlights *merroir* of all of their farmers (The North Carolina Coastal Federation, n.d.).

Both lead farms’ efforts to connect their brand to the story of their farm to the specific taste of their *merroir* point to how this business model creates, reproduces, and structures values in ways that extend beyond the VBSC framework and are parallel to the idea of *terroir*. What both farms do well, especially in linking their branding to *merroir*, is leverage a broader conception of alternative food in their market-making activities and link place-making with the production values and taste of their oysters. For example,

> "We believe in growing oysters for future generations to come. That’s why our day-to-day operations include investing in sustainable farming and business practices; working with leading scientists to measure, understand and share the impacts of changing ocean conditions, and collaborating to help grow a shellfish industry that is sustainable for our coastlines, our communities, and our futures."

These commitments aim to ensure that the communities where the farms are and the ecosystems that sustain the farms are amendable to a long-term continuation of farming practices. Each company strives to make their commitments public; i.e., "Here in our backyard we grow food-the kind that’s good for the people who eat it, for the people who grow it, and for the place where it is raised," or by advertising their B-Corp certification, "ocean friendly restaurant" certification, or another environmentally-friendly vetting. Their use of *merroir* is an act of market-making, but also taste, culture, and place-making that "is elaborated by those who grow, make, and eat food every day [and] allows a more nuanced analysis of the culture of food, and also the larger

cultural assumptions we enact every day" (Paxon, 2012, p.19). Partnering with restaurants to build recognition of oysters and *merroir* as a taste-making process is connected to the ways these companies articulate their environmental and economic place-making values and commitments.

Beyond marketing and certifications, both farms have also invested considerable resources into industry commitments to sustainability. Both companies partner with researchers to analyze the environmental impacts of various production methods, resistance to (oyster) viruses, the interactions between ecosystems and oysters, lifecycle analyses of oyster aquaculture, and ocean acidification. Both companies have also become leaders in industry partnerships with host communities and planning agencies. For ICOC, this means taking a leadership role in a comprehensive review of the industry in Massachusetts facilitated by state and local agencies. The farm also sponsors community events – from fundraisers for their international development non-profit to the local hockey team's jerseys. For HIOC, the co-founders have taken leadership roles at local levels to support the industry and their community in jointly managing natural resource use. For example, by taking leadership roles in the local Dairy Waste Community Meetings, Resource Conservation District, and the local Watershed Council. They organized regular bay-wide cleanups of plastic waste in response to community concerns and worked with local planning agencies on best management practices for sustainable shellfish aquaculture. At a regional level, HIOC uses its leadership in the industry to support the adoption of sustainable practices within their Pacific Coast Shellfish Growers Association.

These commitments reflect a terroir-based strategy that draws together the relationship between practices and taste. Both farms invest in place-making activities as part of their marketing, but also their ability to continue to offer oysters with a *merroir* that reflects good practices to maintain community and environmental quality, such as "cool, clean water." A

"push-pull" dynamic results where the articulation of commitments by farmers endears customers to the place (pull) and pushes farmers to follow through on their commitments.

Conclusion

This paper offers a case study of scale in shellfish aquaculture in the context of values-based supply chains and *terroir*-based strategies for scaling up alternative food systems. Neither strategy has been studied extensively among shellfish aquaculture farms. This paper finds that two farms on opposite sides of the country blended these strategies to create a novel approach for scaling up.

Consistent with the VBSC strategy, both lead farms leveraged partners with similar value commitments to create economies of scale within the supply chain and find end markets that communicate the values of their product. Within their partnerships, these firms espoused the tenets of ethical partnerships identified by the VBSC literature, namely long-term, stable partnerships among actors with similar values, open communication among partners, supply chains with fair pricing, and support for smaller producers to participate.

Partnership was essential in transforming the business model itself, as well as the values embedded in it. Permitting restrictions prevented both farms from expanding, so partnership was crucial to developing supply and creating economies of scale. However, unlike in land-based agriculture, oysters from different bays (or even different parts of bays) produced through different methods taste differently. Both farms embraced the diversity that this introduced, choosing to educate consumers about the different *merroirs* that shone through in the taste of the oyster, reflecting the oysters' growing conditions.

Merroir then became a vehicle for market-making, as the opportunity to sell multiple types of oysters was enticing and engrossing for new and returning consumers. Similar to

VBSCs, this case study affirms the importance of branding even when the oysters travel further from the farm to the consumer. However, they extend this to a form of storytelling that encompasses the people, place, and practices used to grow oysters that take on a particular taste as a result (*merroir). T*elling the story of *merroir* generates a "push-pull" dynamic, where producers, in telling the story of their product, are pushed to make specific place-related commitments that express and protect the uniqueness of the merroir. In hearing this storytelling, consumers are pulled to understand the people, place, and food in more nuanced ways, shifting consumption away from the commodification that certifications such as "local" may come to imply.

Both farms also used direct ownership as a path to vertical integration to create a brand and architecture for smaller partners to participate within, similar to the function of a collectively owned operation in land-based systems. To build this infrastructure, both 'lead farms' prioritized diversity in product offerings and sales avenues to generate layers of resilience in their business model. First, they relied on partnership to diversify their supply further, highlighting oysters with unique *merroir* worldwide. Second, restaurants were used as strategic locations to develop the connection between production and high-quality taste that allowed the industry to emphasize distinction in merroir over homogeneity and aggregation in achieving scale. Third, both farms diversified their sales avenues beyond restaurants to include retail sales, direct-to-consumer sales, and catering, as well as by opening their restaurants. Finally, backward diversification and vertical integration were achieved by developing their hatcheries and nurseries, real estate investments, and merchandising. Questions remain about market power in this model. While small firms gain consistent market access and prices, there are also risks to them relying

exclusively on infrastructure from HIOC or ICOC from an operations and branding perspective. Future research should consider this.

In sum, this paper offers two exemplary cases demonstrating a novel pathway to creating scale in AFS that leverages advantages from the values-based supply chains, direct ownership, and merroir-based strategies. The values framework offers powerful lessons regarding ways to operate AFS businesses and at increased scales ethically. Partnership transformed the business model and the values embedded in it by requiring that both farms embrace the diversity that aggregating oysters with unique merroirs introduced, choosing to educate consumers about each oyster's unique merroir rather than emphasizing homogeneity. However, the VBSC approach to "values" can be shallow. The *terroir*-based strategy has the potential to connect AFS values to place-making efforts and forward-looking commitments more deeply. Where producers, in explaining *merroir*, were pushed to make place-related commitments that expressed and protected the uniqueness of their merroir. In hearing this storytelling, consumers are pulled to understand the people, place, and food in more nuanced ways. These commitments can offer material benefits for the environment, local communities, and food quality in ways that move the strategy beyond the labeling strategies of VBSCs. As a result, this case has implications for achieving scale and how to better articulate the value of food in the process.

These cases lead to several recommendations for food sytems practitioners and scholars. First, articulating value is an important challenge for alternative food systems. *Merroir* and *terroir*-based strategies are one way to increase the transparency about connections between who produces food, how and where they produce it, and what the food tastes like in ways that may be more meaningful to the people consuming the food. A focus on connecting practices to *taste* and

taste differentiation is helpful. Still, it is most beneficial as an industry approach to foster a better consumer understanding of product differentiation and value.

Second, within VBSCs, individual smaller partners should consider ways to preserve their identity because this preserves their option to leave the VBSC should their partnership fail. Having the option to leave may be a good check on unbalanced market power. It may also allow farms to leave more easily when they become big enough, fostering healthy competition and the potential for new innovative business models. Attending to individual identity within a partnership model may develop the groundwork for a more regional approach to food systems and *terroir/merroir* development down the road: consumers will be more used to multiple merroirs and ways of producing food rather than a single narrative around taste.

Third, strict environmental commitments and regulations can be creative material for new business models that still preserve alternative food system values.

CHAPTER II: FRAMING ECOSYSTEMS? THE OPPORTUNITY OF REGIONAL NATURAL RESOURCE MANAGEMENT

Introduction

Adaptive co-management is the gold standard for implementing the social-ecological resilience framework, which links social and ecological systems to better plan for complex environmental challenges like climate change. Complexity and uncertainty arise in natural resource management because of the multitude of social and ecological variables involved. As a result, complex ecosystem management is a form of a wicked problem. Adaptive co-management is a process intended to address this wicked problem. Adaptive co-management brings together stakeholders at multiple scales and institutions to develop and implement governance strategies by treating governance strategies as large-scale experiments. Findings from ongoing "fail-safe" experiments are intended to be incorporated iteratively into resource management plans. According to this approach, adaptive co-management successfully avoids thresholds of ecological importance that will lead to ecosystem failure achieving thresholds that will lead to superior conditions. Unfortunately, the adaptive co-management approach requires that stakeholders first agree on the scope of the resource management concerns at hand to define an experiment or interpret its results, creating a framing challenge that may not be resolved through science alone. In an inter-relational, systems-level framework, the number of ways the natural resource management approach could be framed is endless.

For example, when the goal is something as nebulous as "sustainable development," the potential problem definitions and the solution possibilities are infinite. In this context, the experimentation

approach to learning by doing ignores the process of *framing* that is necessary, at a minimum, for experimentation to begin and for ongoing communication and interpretation regarding decision-making. In the face of "irreducible uncertainty" and complexity, how do planning agencies, local businesses, and community stakeholders deliberate on natural resource management strategies, acknowledging their interconnections with other natural and social systems at multiple geographic and temporal scales, particularly when the stakeholder list is not fixed?

This paper develops a qualitative case study to explore this question, using shellfish aquaculture – an industry touted for its ability to reduce global greenhouse gas emissions, enhance public health, and generate economic growth – with Humboldt, California as its setting. Through the iterative permit application process of a large shellfish aquaculture farm, it analyzes how a permitting agency struggled to understand the environmental impacts of permitting a large-scale project in a state with some of the most stringent environmental protections in the country. Permit applicants proposed treating their large-scale project as an ongoing experiment using adaptive co-management. Data include interviews, public meeting observations, and archival documents, which were deductively and inductively coded to document a wide range of framings of the environmental question at hand over the course of multiple permit applications, rejections, and its eventual approval.

Results show that the permitting agency did not initiate a large-scale experiment using adaptive co-management and instead opted for monitoring requirements for a smaller project with an expanded list of potential environmental impacts. Public comment pushed the permitting agency to deepen its consideration of environmental impacts to acknowledge the interrelated effects of the project on social-ecological systems. The expansion of environmental impacts under consideration prevented agreement about what an adaptive co-management experiment

would use as environmental impacts, how to measure them, and at what scale impacts should be considered. As a result, the permitting agency rejected treating the permit as a large-scale experiment and therefore did not implement adaptive co-management. However, by acknowledging these diverse environmental impacts, it did take on a social-ecological resilience *mindset* that expanded the substance, process, and scale of planning to become more consistent with the social-ecological resilience framework. The resulting permit protected the natural resources in a more acceptable way to stakeholders and allowed the shellfish aquaculture farm to increase its productivity.

This study has several important implications. First, framing contests must be seen as ongoing meaning-making processes. Framing may need to be incorporated into the social-ecological framework for it to function, but the process of framing and monitoring may also operate outside of adaptive co-management processes. Second, rather than viewing environmental and economic activities as trade-offs, it is evidence of the importance of analyzing interdependent, relational activities in planning across space. When there is less of a unifying threat, normative differences about incorporating divergent environmental frames may be more challenging to pull together through experiments.

The literature review will clarify the social-ecological resilience framework and the mechanics of framing. The following sections will describe the methods, followed by the case study context and results.

Literature Review

Social-Ecological Resilience

Traditional natural resources management strategies rely on periods of exploitation followed by conservation to achieve stability and predictability. Social-ecological resilience challenges this idea (Holling, 1978). It critiques the traditional (exploitation and conservation) strategy in two ways. First, for prioritizing short-term economic gains during rapid resource extraction and assuming the system will return to equilibrium during a conservation period. Second, it critiques the linear theorization of these periods. Instead, social-ecological resilience considers ecosystems as parts of broader, linked social and ecological system(s) that adapt to inter-relational dynamics across time and geographic scales. Thus, if a shock to an ecosystem is large enough, the system will not be *resilient* enough to return to equilibrium via conservation. Instead, it may undergo a *regime shift* to another state, which may have vast ripple effects within and across social-ecological systems.

Understanding the relational dynamics of a social-ecological system is an important topic of study for natural resource management and those interested in long-term environmentally sustainable economies. Involved parties wish to identify critical thresholds, historical activity, and important feedback loops to prevent negative regime shifts. Historically, negative regime shifts led to substantial human suffering as over-exploitation of freshwater, adequate food and energy supplies, or building materials led to non-viable cities and settlements (Wilkinson, 2012; Newitz, 2021; Ross, 2013). More recent examples of regime shifts include desertification, species die-offs, and climate change. There are also benefits to understanding these dynamics beyond avoiding mass ecosystem collapse: they may inform ways to improve ecosystems, too, with benefits for the social and ecological components of the system. For example, oysters filter and enhance the quality of water and fix carbon. When produced through shellfish aquaculture,

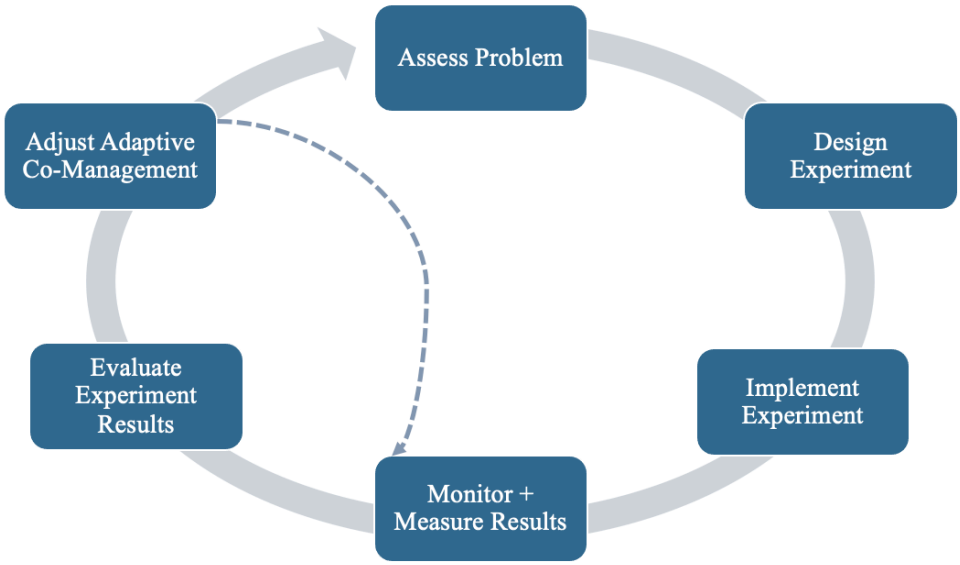
oysters provide a food source, support local economies, and sustain the "social-ecological memory" of food production in the event of a crisis (Barthel, Folke, & Colding, 2010)

The level of complexity involved in social-ecological resilience creates a wicked problem (Horst & Webber, 1973). "Irreducible uncertainty" arises from the many variables and feedback loops within an adaptive and evolving system and how they are "nested within the other across space and time scales" (Gunderson & Holling, 2002, p. 74). Adding to this complexity are social variables such as culture and economies, which are "linked" to the ecological components (Folke, Carpenter, & Walker, 2010). The complexity of social-ecological systems makes identifying thresholds and critical feedback loops very difficult; by the time a particular relationship is understood, it may be too late to intervene.

Adaptive co-management is the proposed governance strategy for social-ecological resilience. This management style is based on the assumption that, given the combination of ecosystem complexity, resource scarcity, potential irreversibility, and growing demands on a resource, decisions must be made even when relevant scientific knowledge is evolving or incomplete (Bormann, Cunningham, Brookes, Manning, & Collopy, 1994). A "learning-by-doing" approach treats environmental management as large-scale (yet "fail-safe") iterative experiments to test out management strategies (Armitage, Berkes, & Doubleday, 2007). The process is: experiment, monitor and measure, synthesize results, and then decide, with the possibility for repeated iterations. Management strategies are treated as large-scale experiments, which is distinct from incorporating the results of pre-existing experiments into more settled natural resource management plans. In the former, the project itself is an experiment. In the latter, natural resource management is informed by established "best available science" identified by completed experiments. For permits, experimentation and science are still considered in

deciding about a permit, but the permit itself is not treated as an experiment. Further, the "best available science" does not represent the holistic approach adaptive co-management strives for.

Figure 1: Adaptive Co-Management Schematic



Adapted from: Williams, B., Brown, E. (2016). "Technical challenges in the application of adaptive management. *Biological Conservation*: 255-263.

Stakeholders "do" this work, which may be housed in several institutional formats, including 'collaboration in a polycentric governance system, public participation, an experimental approach to resource management, and management at the bioregional scale' (Huitema et al., 2009, as summarized by Wilkinson, 2011).

Despite the promise of adaptive management, it has yet to deliver much success (Stankey, et al., 2003; McLain & Lee, 1996; Roe, 1996; Walters, 1997; Lee & Stankey, 1992; Huitema, Mostert, & Egas, 2009). Failure can be attributed to several intersecting themes. First, there are technical challenges to carrying out social-ecological resilience governance, and using an experimental approach in this context relies significantly on technical research. The complexity of modeling ecosystems across multiple scales, which may contain "cross-scale

linkages between physical/chemical and ecological processes," is difficult, with divergence in the appropriate measurement across temporal and spatial scales (Walters, 1997**;** Stankey, et al., 2003, 24**).** The effectiveness of research may be limited further because large-scale ecosystems may exhibit "emergent properties" that are difficult or impossible to detect on smaller scales (Stankey, et al., 2003). Adaptive co-management is also critiqued for failing to effectively monitor outcomes of experiments – arguably the most crucial part of this approach (Allan & Curtis, 2003).

The second set of barriers to success involve an overly optimistic outlook on institutional abilities (Goldstein, 2009). From a procedural perspective, institutions may be too risk-averse, unable to resolve conflicts among stakeholders, unable to incorporate new information and to learn evolving practices, unable to generate credible governance processes, unable to establish long-term implementation, and unable to coordinate with other necessary agencies (Andries, Janssen, & Ostrom, 2004; Danter, Briest, Mullins, & Norland, 2000; Dovers & Mobbs, 1997; Ladson & Argent, 2002; Lee & Stankey, 1992; Mapstone & Curtis, 2003; Walters, 1997; Wilson, 2013; Vandergert, Collier, Kampelmann, & Newport, 2016) (Stankey, Clark, & Bormann, 2005). Institutions may also struggle when the scale of an environmental problem does not match the scale of influence of an institution (Costanza, et al., 2000). Smaller regions may be the only area viable for experiments, despite an eye for regional environmental impacts, thus biasing it towards local results (Wilkinson, 2011).

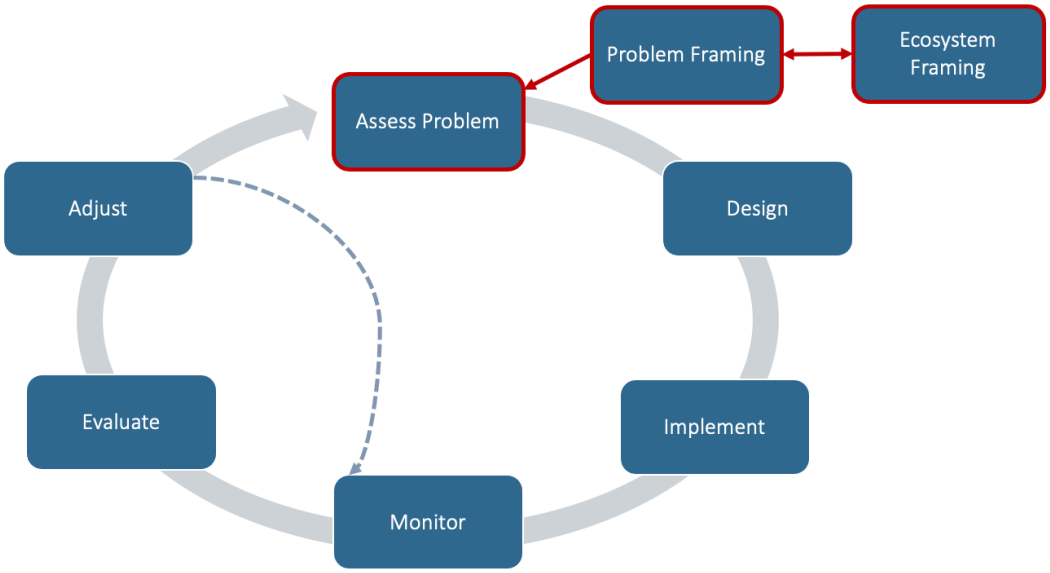
Third, and related to the first two sets of challenges, are the substantive and normative challenges in identifying how inter-relational connections are conceptualized, with implications for how ecosystems are studied/monitored, whose observations are considered legitimate, and how observations are used to make decisions. In particular, Thompson and Tuden (1987) note

that institutions often act is if there is agreement over causation and preferences on outcomes when there is disagreement on both. Institutions may also place too much emphasis on the technical insights that de-politicize governance (Wilkinson 2011). How does the normativity of environmental management itself influence the incorporation of social-ecological resilience into planning? Understanding this will affect how a social-ecological system is defined, which resources are given priority and why, and how environmental management problems and uncertainties are described and interpreted. These parameters will influence the plans for sustainable economic development, especially when the goal is a nebulous concept, like sustainable development.

Framing

Leveraging input from stakeholders to take action on environmental management questions requires that participants be able to "problem set," or "*name* the things to which [they] will attend and *frame* the context in which [they] will attend to them" (Schön, 1983, p. 40). The process of meaning-making has been linked to stakeholder communication within an adaptive co-management process (e.g. (Aldunce, Beilin, Handmer, & Howden, 2014; McEvoy, Fünfgeld, & Bosomworth, 2013; Restemeyer, van den Brink, & Woltjer, 2018). Wilkinson (2011) argued that "one of the most pressing issues for planning theory regarding social-ecological resilience scholarship is to examine its implications for how governance of urban systems is framed" (162). Framing is not part of the social-ecological resilience framework, but it may be essential for an adaptive co-management process to know where to begin and interpret its process.

Figure 2: Framing added to Adaptive Co-Management Framework



Adapted from: Williams, B., Brown, E. (2016). "Technical challenges in the application of adaptive management. *Biological Conservation*: 255-263.

For many, particular understandings of what the environment is and should be, are examples of framing (Whittemore, 2013). This has important implications for defining how natural resources are used. For instance, preservation in national parks has been pointed to as an example of the perception of Marxist and Hegelian theories of "first nature," which exists outside of and before humans, even though the creation and management of the park more closely reflects a "second nature" that involves human interaction and reformation (as summarized by Watts, (2017). The creation of universalized 'natural' objects that confuse the first nature with the second is an example of how framing may fix a landscape and the infrastructures that belong there, obfuscating the work required to produce this frame (Cronon, 1991; Williams, 1973). The social-ecological resilience framework clearly takes the position that humans must be theorized as in relation with natural ecosystems, but this elides that there are many varying normative framings of what role humans can or should play in interfering with these systems.

Different framings of the environment will lead to different preferred uses, raising questions regarding how to manage divergent framings of environmental management options.

For example, the four common natural resources challenges identified by Herrera et al. (2017) – conflicts between the regulator and the regulated; conflicts between affluence and access; conflicts between economic growth and ecological health; and conflicts between current and future benefits – may all be examples of divergent framings of the environment. For understanding sustainable economic development outcomes, it is not just that human behavior influences natural resources, but that framing arguments are made about how to govern those resources such that some people may use some resources to their benefit. These compromises are renegotiated and imagined by users and may lead to new governance structures or processes as environmental frames evolve (Lien, 2015; Haraway, 1988).

Framing also deepens our understanding of how the socio-ecological resilience framework considers natural and social systems at multiple temporal and geographic scales. Efforts to frame an environmental management decision appeal to multiple geographic scales and temporal periods, therefore "re-scaling objects and places of governance" (Bulkeley, 2005, p. 875). Re-scaling, a form of re-framing, can also result in novel management approaches that acknowledge the ability of local practices to operate "across scales" (Sasken, 2003).

This paper uses framing to understand how environmental management problems and their uncertainties are defined and interpreted and how this influences planning when the goal is something as nebulous as sustainable development. To do this, the paper analyzes Coast Seafoods' permit application process at the California Coastal Commission for a large expansion of their shellfish aquaculture farm in Humboldt, California.

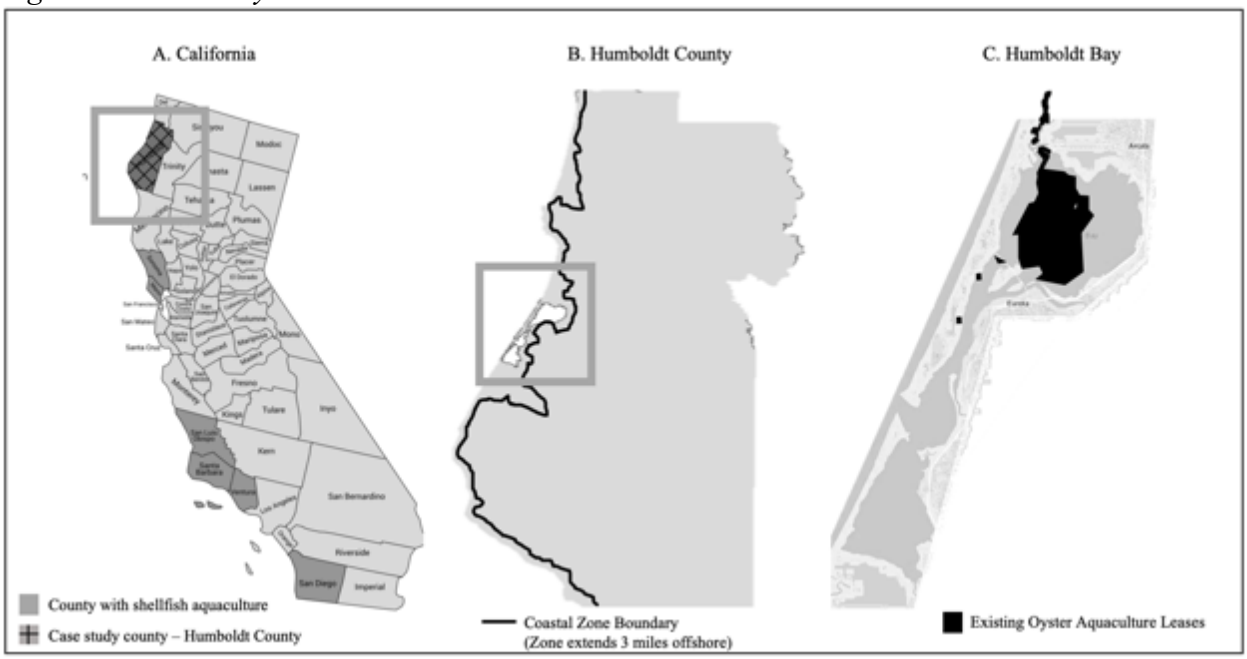
Case Study Background

California Shellfish Aquaculture

Domestically, state and federal governments support expanding the shellfish aquaculture industry as a sustainable economic activity that provides a healthy food source (Dalton, Di, Thompson, & Katzanek, 2017) (O'Connell, 2018). Because most production occurs on public property leased to private producers, shellfish development policies reflect public approaches to natural resource management (California Shellfish Initiative, 2013).

California has a handful of producers (18) located in bays across California, but the vast majority (93% in 2013, Pacific Shellfish Institute, 2013) are in Humboldt and Marin Counties (See Figure 1). Existing and aspiring farmers in California say they cannot expand operations or open new farms due to the difficulty of getting permits. This case study focuses on a permit application to expand the largest shellfish aquaculture farm in California and Humboldt Bay, located in Humboldt County (see Figure 1).

Figure 3. Case Study Context.



Reflecting the diverse potential impacts to social and ecological systems, inter-agency coordination is required from at least fourteen agencies to obtain a permit for shellfish aquaculture farming in sub-tidal or inner-tidal water bottoms in California.[2] This process often requires years to navigate and substantial financial resources. One report estimated hundreds of thousands of dollars were necessary for studies, application fees, environmental impact reviews, and consulting and legal costs (California Shellfish Institute, 2013). Many agencies' purviews overlap and have contradictory mandates or duplicated processes that increase costs. The CCC and another regulating agency, the California Department of Fish and Wildlife (CDFW), have legal mandates to protect natural resources and support aquaculture efforts.

This paper focuses on the stakeholder communication within the California Coastal Commission (CCC) permit process because the organization is the last to issue approval in the form of a coastal development permit (CDP), thus pulling together participation from all other agencies and the public.[3] The twelve voting members of the CCC rely on staff members with marine biology expertise to make recommendations about whether to approve permits. CCC also hears and reads public comments and may question the permit applicant and CCC staff during the permit hearing.

[2] U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service (part of NOAA), National Ocean Service (part of NOAA), U.S. Coast Guard, the California Fish and Game Commission, the California Department of Fish and Wildlife (CDFW), the California Coastal Commission (CCC), regional water quality control boards, the California State Water Resources Control Board, the California Department of Health Services, the California Department of Food and Agriculture, the California State Lands Commission, the California State Historic Preservation Office, as well as any relevant cities, counties, and special districts (California Shellfish Institute 2013)

[3] The CCC is authorized by the California Coastal Act with permit jurisdiction over development proposed on tidelands, submerged lands, and public trust lands in the coastal zone (see Figure 1b.), which are where shellfish aquaculture usually takes place.

The CCC also relies significantly on an environmental impact assessment to decide whether to approve a permit application. The environmental impact assessment is a required evaluation under the California Environmental Quality Act (CEQA) that identifies potentially significant environmental impacts from actions taken by state and local agencies or actions they allow. CEQA requires "significant" environmental impacts to be avoided or mitigated if feasible. Whoever conducts the evaluation is responsible for deciding where and how to look for impacts and what is considered significant. The environmental impact assessment is thus the way that environmental frames are formally recognized in the permitting process. Their quality may be contested as a result of the difficulty of interpreting complex ecosystem dynamics. Other agencies or important stakeholders may also question their scope for failing to look for impacts on a habitat or species. In Humboldt, eelgrass (a seaweed) beds are a protected habitat in California found widely in Humboldt and Arcata Bays.[4] Impacts on eelgrass are central to how the CCC considers issuing coastal development permits.

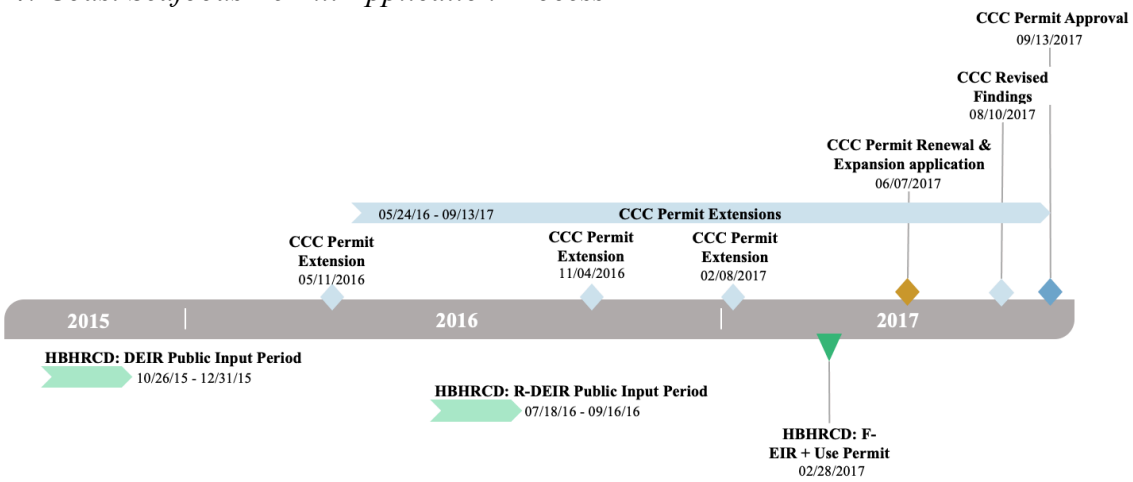
Coast Seafoods' Permit Timeline

Coast Seafoods is a subsidiary of an international seafood company that has been shellfish farming in Humboldt Bay since the 1950s. Formal coastal development permits for shellfish aquaculture were not required until much later, and the company received a 30-year permit for 300 acres of oyster cultivation and related activities in 2006. The largest farm in the area and California by a wide margin, the presence of this farm was not controversial before 2016. Coast Seafoods' initial permit renewal and expansion application proposed expanding oyster cultivation from 300 to 917 acres. The CCC rejected this application due to strong adverse

[4] it hosts important marine animals, including herring, sturgeon, black brant (a migratory sea goose), and salmon.

reactions to its size and potential environmental impacts, but existing operations were allowed to continue.

Figure 4: Coast Seafoods Permit Application Process



Timeline showing Humboldt Bay Harbor Recreation and Conservation District (HBHRCD) and California Coastal Commission (CCC) decisions between October, 2015 and October, 2017 – the two years prior to Coast Seafoods securing a Coastal Development Permit from CCC.

Coast Seafoods re-submitted a modified proposal about nine months later. In addition to re-permitting their existing operations, the company's permit application asked to use adaptive co-management and therefore treat the entire permit as a large-scale experiment to expand by another 256 acres while removing 60 acres of existing cultivation to make up for eelgrass losses. Coast Seafoods' proposed production methods were new, and the proposal relied on new scientific research to argue that the predicted environmental impacts would be negligible. According to one source, Coast Seafoods spent $2.4 million completing research on potential impacts for this permit application. During the first five years, the first experimental phase would allow for 165 new acres of shellfish farming and remove 42 acres of existing shellfish beds. As part of the experiment, Coast Seafoods would monitor eelgrass health impacts compared to pre-established impact thresholds. If impacts surpassed thresholds, mitigation measures or changes in production would be required.

This new proposal was also met with skeptics and enthusiasts, reflected in the public comments submitted through the environmental impact assessment and two legal challenges to the certification. The Humboldt Bay Harbor and Recreation District certified the final environmental impact report, though, and a use permit was issued, thus progressing the permit to the CCC for final approval.

The coastal development permit application came before the CCC in June of 2017. In preparation for the hearing, despite securing the positive recommendation from CCC staff, the commission voted against the proposal 6-5, citing uncertain impacts for the environment, particularly for eelgrass, and a lack of science backing up the experimental approach of adaptive co-management. This decision echoed concerns advocated by opponents in public comments. In its third proposal, Coast Seafoods proposed *decreasing* overall acreage by 21 acres but increasing overall production through a technology change. The CCC approved the proposal unanimously, citing sustainable economic development opportunities. The approved permit did not contain any adaptive co-management measures. Instead, it established the precedent that all shellfish aquaculture farms must submit annual monitoring data on their environmental impacts in coordination with relevant regulating agencies.

Methods and Data

This paper relies on interviews with shellfish farmers, scientists, and regulators. In addition, public comments on the permit application and its environmental impact statements, observations of related marine biology experiments, and the formal environmental impact and permit documentation are used to identify arguments for and against the Coast Seafoods permit. These arguments were connected to changes in the project to identify influential environmental frames.

Data collection started during the summer of 2017 with interviews and observations of stakeholders in Californian shellfish aquaculture. Purposive sampling at one oyster company and of stakeholders identified by background research led to snowball sampling of other relevant people (Ritchie & Lewis, 2003; Carter & Little, 2007) for a total of 28 semi-structured interviews (see Table 1). All interviews except one (due to a poor recording environment) were recorded. All conversations and notes from before, during, and after the interviews were transcribed and analyzed. Individuals are anonymized in this paper if they provided information outside of the public comment process. Instead, they are identified by their employment. In instances with limited access to an important group due to limited outreach responses, perspectives represented in public hearings, archival research, and surveys of their attitudes were used (Smith, 2018; Northern Economics, Inc., 2013; Hudson, 2016).

All of the California Coastal Commission permitting decisions related to aquaculture between 1998 and 2018 were analyzed through access to video recordings of meetings available through the agency's website. Other meeting observations occurred in person between May and August 2017 related to best management practices or planning decisions. Observation of two marine biology research projects over five days to examine the impacts of oyster aquaculture on eelgrass or related species also contributed to this case. Finally, public comments submitted in written formats on the permit applications and environmental impact statements for the Coast Seafoods project were analyzed.

Table 1: Interviews and observations informing this paper

Data	*Number*
Interviews	
Farmers (current or aspiring)	9
Policymakers & regulators	10
Scientists	6 (observation supplemented)
Other Stakeholders (environmentalists, citizens, etc.)	3 (survey supplemented)

Observations	
Research	3 (3-day shellfish aquaculture conference, 2 field studies)
Public meetings and comments	52 (including recordings available on CAL-SPAN)

Analysis and data collection occurred iteratively (Carter & Little, 2007). Transcripts were coded deductively first by coding arguments for/against oyster aquaculture within permitting decisions. Within each stance (for/against), discourse analysis theory provided the foundation to "open code" justifications with descriptive and interpretive inductive codes, which identified active frames used in the Coast Seafoods permit application process (Saldaña, 2009; Starks & Brown Trinidad, 2007). Proponents developed a "sustainable economic development" frame highlighting synergies between sustainable resource extraction, environmental protection, and local economic development. Opponents represented multiple divergent environmental framings highlighting other natural resource use and protection desires, with justifications ranging from economic development to recreation to cultural inheritance. These critiques reveal ways that the Environmental Impact Assessment failed to include certain environmental frames or, according to some stakeholders, inadequately framed them. Preliminary findings were substantiated during a presentation at an industry conference where the results received strong reactions to the idea that concepts of environment and sustainable development have contested definitions.

Case Study Findings

Divergent Environmental Frames

Differences in preferred outcomes and approaches to environmental management stem from differences in the framing of how the environment should be used and protected, in particular concerning the process of environmental protection, recreational use, and sustainable resource extraction. Assessing the documented motivations for CCC actions allows for an

assessment of how various frames impacted the Commission's decision throughout the multiple permitting applications.

Other oyster farmers, economic development practitioners, and some public stakeholders promoted a "sustainable economic development" framing, which advocated an environmental governance process in which sustainable resource extraction was possible in service of local economies without putting natural resources at risk. Here, shellfish aquaculture was seen as a sustainable economic opportunity for the Humboldt Bay area to become an industry leader due to its high-water quality. Becoming an early leader in shellfish aquaculture would allow farms to generate green jobs; an economic impact assessment model was heavily cited for the net benefits of this growth. For proponents, efforts by shellfish aquaculture farmers to protect water quality by helping to clean up oil spills (from other industries) and preventing dumping from pulp mills, for example, established the industry, and Coast Seafoods in particular, as trustworthy stewards of public resources with economic incentives that aligned their business with environmental protection. This frame thus argued that Coast Seafood's, and the industry's, longstanding presence was consistent with environmental protection. The Humboldt landscape includes land uses that are sustainable and profitable for its residents. Further, they argued that shellfish aquaculture provides ecological benefits and that any possible negative impacts were adequately accounted for by the cutting-edge science conducted and relied upon to modify production methods with the environment in mind.

Opponents included environmental groups, some local Tribes, some residents, and boating, birding, and waterfowl hunting enthusiasts. This group was not a coalition; their critiques demonstrate more environmental frames. However, the justifications they point to can

be generalized as either highlighting unaccounted for impacts or impacts for which the process of proposed governance (co-adaptive management) is inadequate for addressing.

The unaccounted-for impacts themselves reflect unique environmental frames. For example, waterfowl hunters wanted to limit shellfish aquaculture expansion because they thought it would interfere with their ability to hunt Black Brant. Their environmental frame prioritized sustainable resource "extraction," but for a different resource and with a different justification: the recreational enjoyment of hunting Black Brant. Birdwatchers were similarly concerned with a destruction of habitat for shorebirds, but their recreational framing of the environment had no intent to justify sustainable resource extraction. Fisher people concerned about herring population decline due to the shellfish farms also implicitly support sustainable resource extraction, but again for a different species. For all of these species, the health and extent of eelgrass beds were essential, and thus eelgrass health was used as a significant impact by all of these groups.

These environmental frames also distinguish themselves concerning the role of human intervention and the idealized "natural state" of environmental resources to which environmental management efforts should aspire. Birdwatchers and kayakers cited concerns about a loss of boating and recreational opportunities and wanted to eliminate all commercial uses of Humboldt Bay so that it could remain "pristine." For the Wiyot Tribe, their cultural resources were considered indivisible from the natural resources in Humboldt Bay, reflecting a much more expansive environmental framing that also supports sustainable resource extraction and does not accept the view that humans are separate from nature. Others focused on the risk of Coast becoming a monopoly actor rather than an economic development opportunity and rejected that expanding Coast Seafoods' farm was necessary for sustainable development overall in the

region. These differences reflect normative differences in how resources should be imagined and therefore used.

Opponents also critiqued the proposed governance process for not credibly considering the extent of impacts on the resources included in the impact assessment by having too few monitoring requirements, enforcement mechanisms, and thresholds, making the process too risky and failing to capture enough information. In addition, certain stakeholder groups cited issues with poor transparency with the decision-making and governance process and concerns about the last-minute changes Coast Seafoods had been asked to make to the permit. Here again, the initial conditions proposed in the Environmental Impact Assessment and by the CCC were too limited in framing the social-ecological impact of the project; by considering these additional social considerations, the system is re-framed.

Table 2. Summary of arguments for and against the Coast permit from the July 2017 hearing.

In Favor	**Example**	**Against**	**Example**
Coast's behavior as a company leads me to trust their environmental decision making	- Good steward of H2O quality - Collaborates with community groups on research in the Bay	There is too much uncertainty about the risks to critical habitat and species	- Threats to Black Brandt, Salmon, Eelgrass, Sturgeon - Tribal resources may not be respected
Coast provides good jobs in a sustainable industry	- Jobs in this sustainable industry are better than other resource extraction jobs - Humboldt should aim to become a leader in an emerging sustainable sector.	The governing and monitoring process for the proposal is inadequate.	- Some species are not included in the monitoring process but should be - The thresholds proposed for impacts are unacceptably high or impossible to assess
Aquaculture is an industry that provides positive environmental benefits	- Water quality improvements - High-quality science to mitigate any negative impacts	Coast's expansion will create a monopoly, effectively limiting the expansion of a sustainable industry in the long term.	- Coast already takes up a vast portion of Humboldt Bay; any more expansion would be too much

Public comment was not the only source of disagreement. Before the Coast Seafoods' application, there were several unsuccessful efforts to coordinate permitting across agencies for the industry that were stymied based on differences in environmental mandates for agencies or individual representatives. These efforts were motivated by a desire for efficiency in the process and an enhanced ability to more coherently shepherd this industry. "Pre-permitting" efforts in Humboldt Bay and near the Port of Ventura garnered sought to permit large area(s) suitable for multiple shellfish aquaculture within a region and sub-leased to small farmers. The California Shellfish Initiative, an extension of the National Oceanic and Atmospheric Administration's National Shellfish Initiative, attempted "to improve regional planning and to permit efficiencies for shellfish aquaculture" through dialogue among stakeholders for the Tomales, Humboldt, and Morro Bay regions, as well as across the state (Pacific Shellfish Institute, 2013, 10). While the public record is diffuse with appreciation for cooperation from other agencies, frustrated representatives and Wiyot tribal members noted the difference between the legal requirement to hear from other agencies and a legal requirement to act on that input. Across these efforts, there was disagreement over the amount of allowable development. According to one attendee of a statewide shellfish stakeholder mediation regarding permitting conflicts among agencies, the CCC "wants no development at all. They won't consider any type of mitigation." This points to the unresolved questions about the framing within agencies and among agency representatives.

Governance issues that resulted from divergent framing

Divergent environmental framing created barriers for the CCC in at least two ways. First, the high level of uncertainty and the myriad of different impacts to consider became overwhelming. Multiple regulating agencies, oyster farmers, and constituents noted that commissioners seemed overwhelmed by the length and complexity of the permit application.

Monitoring the experimental phase of expansion and technology implementation was critiqued as inadequate because there was uncertainty about what to monitor (both from a normative perspective and an environmental research perspective) and what thresholds were appropriate to measure against. Given this, it was too risky to allow development with unknown, possibly irreparable, impacts. Uncertainty was exacerbated by requests to consider other impacts and mechanisms for monitoring impacts, such as monitoring requirements for herring or shorebirds. Key uncertainties included the effects of oysters on the environment – both from a positive lens (oysters are known to filter water and mediate ocean acidification and may even generate conditions for eelgrass to grow), as well as from a negative lens. Another key unknown for the project was whether oyster aquaculture limited the growth or health of eelgrass**.** Finally, there were concerns about the level of plastic debris from oyster operations.

The most relevant study for assessing the proposed project's environmental impacts became subject to intense scrutiny and controversy because it was a narrow study that was "not necessarily comparing oranges to oranges. … it got very very messy" (CDFW). Commissioners interpreted the information in varied ways; some said the monitoring requirements made them feel more comfortable with the project. Others indicated severe concerns with the monitoring thresholds and the possibility of irreversible damage. One National Oceanic and Atmospheric Administration (NOAA) official that contributed to the permitting process explained:

> "There is uncertainty coupled with a lack of understanding of what's important, what should be analyzed in the marine environment relative to an aquaculture operation. [There is] not a clear understanding of what to measure with monitoring and what to do with that information. These are all challenges in an evolving industry in a resource protective environment" (NOAA representative).

Although CEQA requires "the best available science" to assess any potentially significant negative impacts, the ability to leverage the science into a coherent interpretation was difficult due to the complexity and uncertainty of the impacts noted by the many divergent stakeholders.

Divergent environmental frames created a second barrier. The guiding legislation for environmental protection -- CEQA – does not articulate how preferences at a local, state, and in a limited sense, a national scale should influence the planning process. A CDFW employee asked,

> "How much aquaculture is appropriate for the state? It provides jobs, and it provides local seafood, and there's evidence that it improves water quality in some systems, but then at the same time, there's also evidence that it can have potential impacts to natural resources so what's more important? We struggle with that a lot. We try and do the best we can to balance the two."

These reactions underscore the challenges of determining appropriate outcomes for shellfish aquaculture permit applications incorporating community and agency preferences. Acknowledging the varied environmental preferences became an interpretive and contested decision that alone could not be divined through scientific studies. Instead, the CCC had to sift through the priorities and arguments offered within the proposal and public comment process and chart its own path.

Socio-ecological resilience shifts substance, process, and scale

Efforts to resolve divergent environmental frames led the permitting agency to shift from a narrow, site-specific evaluation. Instead, their perspective of the project became more closely aligned with social-ecological resilience, as it considered more environmental impacts in evaluating the permit application. As more environmental impacts were considered as part of an inter-relational, social-ecological system, the CCC struggled to resolve divergent environmental frames. As a result, it rejected treating Coast Seafoods' permit as a large-scale experiment, and therefore rejected adaptive co-management.

The California Department of Fish and Wildlife and CCC use an open-ended process to assess each project that applies for a coastal development permit. For Coast Seafood's second proposal, multiple stakeholder groups called for "cumulative impacts" to be considered. This is the process of looking not just at the isolated impacts from the proposed development, but how these impacts may lead to ripple effects or multiplicative impacts for natural resources. In effect, their frames argued that examining site-specific impacts failed to use the appropriate scale to consider the project's impacts on its social-ecological system. For example, the Black Brant's migratory pattern is from Alaska to Mexico. Removing any nesting habitat along this migration pattern would limit the Brant hunting industry, and it could cause the bird's migratory pattern to be disrupted. Other stakeholders reminded the CCC of the state requirement for no net loss of eelgrass, but the spatial extent of this requirement was not clear. A CDFW biologist described the challenge:

> "If I look at Humboldt Bay, at the eelgrass beds, it's doing fine. It's doing great. We actually monitor eelgrass. It's been very healthy. But look at our no net loss requirement, and it's like counting turions. If you lose that one turion, what does that mean? [laughter]. I struggle with that, and it's the same with CEQA, because CEQA is less than significant. What does that mean? Is that one eelgrass blade? Or is that one patch of eelgrass? Is that one bed of eelgrass? *Is that a whole north bay of eelgrass?*... Sometimes we're hamstrung by the law: our mandate is to protect every single blade of eelgrass. I think, even with the law stating that we have some flexibility for common sense and for compromise. That's where we're trying to get with the Coast project. … *The struggle is finding where the balance point is*" (CDFW). [emphasis added]

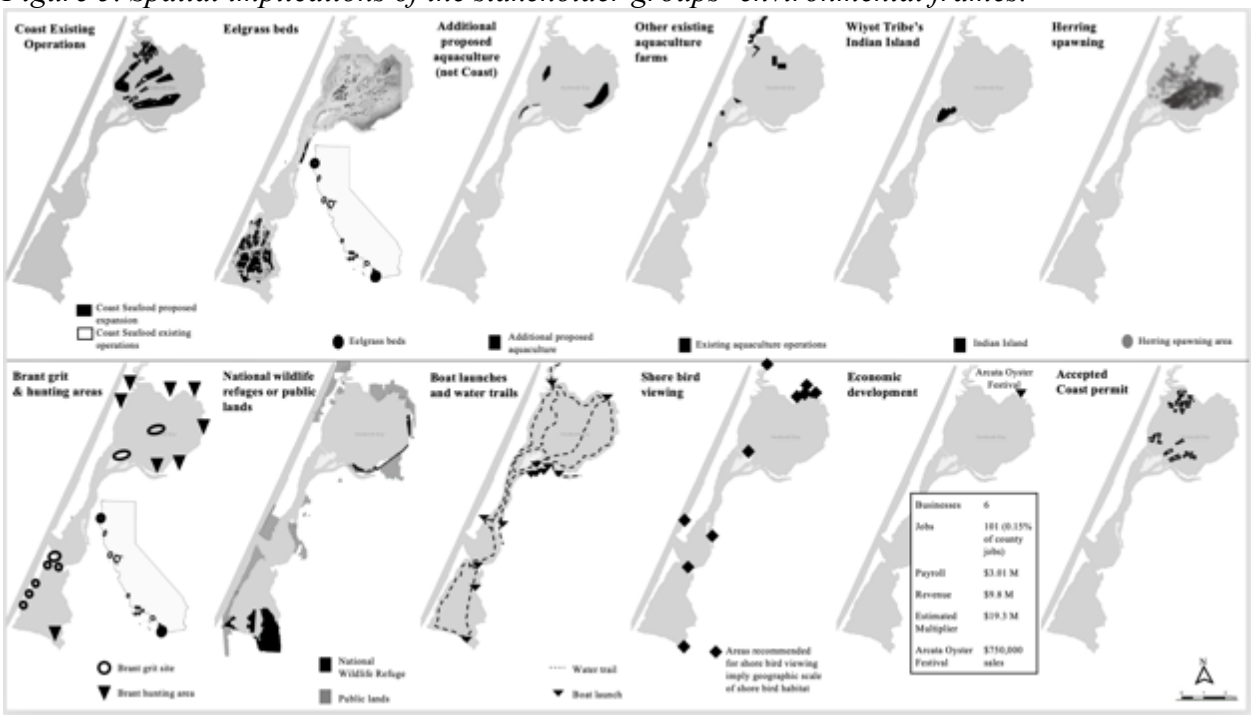
The law is difficult to enforce because it changes based on the spatial and temporal interpretation of statewide requirements of "net loss" measurements for eelgrass and the practical impossibility of measuring impacts down to a single blade of eelgrass. This difficulty then leaves room for the interpretive dance portrayed by agency officials to allow some level for "compromise" between protection and use, based on "common sense." Effectively, depending on the framing of the social-ecological system in question, the policy implications and material outcomes will differ

significantly. To resolve this, the CCC looked to the varying environmental frames submitted by stakeholders, which pushed them towards a broader, more social-ecological resilience-oriented mindset.

Figure 3. shows the social-ecological implications of many of the stakeholder's environmental frames. The top left frame shows the spatial footprint of Coast's operations when they submitted their permit expansion proposal in 2016. The bottom right frame shows the much smaller footprint of Coast Seafood's final approved permit in August 2017. In between these two frames are all of the other stakeholder environmental frames that shifted the substance and spatial extent of the planning process beyond the strict footprint of the proposal. For example, the "eelgrass beds" frame shows that eelgrass is persistent in the northern and southern parts of Humboldt Bay, as well as along the California coast. The CCC considered impacts to eelgrass at the site level, within the northern bay area, across the entire Humboldt Bay, and along the state coast. They also expanded their analysis of "cumulative impacts" by considering other existing and proposed shellfish aquaculture farms in the bay, essentially an industry analysis of environmental impacts. Paired with this, though, were considerations of the economic draw of the industry, including the regional impacts for economic activity from the Arcata Oyster Festival. Evaluations of effects to herring and Black Brant expanded the geographic and temporal scope of monitoring to include seasonality, such as herring spawning and bird migration patterns within the bay and from Alaska to Mexico. For recreationists such as bird watchers and boaters, the area within the bay was considered more intensely in light of multiple social uses. Stakeholders also recognized the importance of inter-dependence across their concerns. Exhibit 12 in the permit application, a map of the Coast Seafoods proposed expansion and other uses and projects within the bay was the most commented and inquired about exhibit

because it established the impact of the project concerning other uses, and focused on the potential for cumulative effects of the project to impact essential species and habitats.

Figure 5. Spatial implications of the stakeholder groups' environmental frames.



Data Sources: 1) Addendum to Staff Report for Coastal Development Permit Application 9-17- 0646, Coast Seafoods Company, September 8, 2017; 2) California Environmental Quality Act (CEQA) Addendum for Coast Seafoods Company Permit Renewal and Expansion Project Prepared by Confluence Environmental Company, 10/2017; 3) California Department of Fish and Wildlife Herring Spawning Management Plan 2016; 4) Humboldt Bay Area Beaches and Dunes Recreation Map; 5) Humboldt Bay Shellfish Mariculture Business Survey, 2018

The addition of these environmental frames led the CCC to consider holistic, inter-relational region(s) in light of the permit application and to adopt a more social-ecological resilience mindset. We see from the stakeholder arguments that the use of Humboldt Bay hinges on understanding its ecosystem – where eelgrass beds do well, so too do important species, which support recreational activities such as boating and hunting. Public lands protect natural resources for the community, and permitting in one location can impact the entire bay-wide ecosystem. As these stakeholders' views emerged, the CCC began to take a more comprehensive

look at regional impacts, in the context of other land uses, as opposed to an individual project by individual project evaluation, pointing to the concern for emergent negative impacts:

> "Where should aquaculture be relative to commercial fishing, to kayaking, to tribal resources, to natural resources? There are so many factors to think about. We all have to play well together in the sandbox, and right now, it's being decided on an ad hoc basis as these things come in front of us. I worry that we are going to get into a situation, 20-30 years down the road, where we've looked at each of these individual projects, and now we look at it as a whole, and maybe we look like the Chesapeake [considered very degraded]. I hope not, …but I don't know" (CDFW).

While regulators and environmentalists argued for a more regional understanding of impacts, proponents also incorporated a regional framing. Permit applicants, Coast employees, other oyster farmers, and local politicians began to frame the proposal as a way to protect existing jobs at Coast Seafoods and an opportunity to advance future opportunities in the industry for the entire region. They pointed to a 2007 economic development study done by the Humboldt Bay Harbor and Recreation District identifying shellfish aquaculture as an "economic cluster," or location of economic advantage relative to other places, putting Humboldt in a position "to be a leader in the state" (Wilson, 2013). Here, the argument was that the region relies on this industry and has an opportunity for additional growth. The industry, therefore, according to proponents, was better than other industries in the region that relied on natural resources because of its sustainability and future growth potential. They argued that Coast served as an anchor business because of its large size, and indeed workers from the firm had already started their own farms elsewhere in the bay. This argument was often taken further by policymakers in favor of shellfish aquaculture, who argued that domestic production was a form of import substitution that had the added benefit of limiting production in international settings with lower environmental quality standards. Essentially, they argue that production will happen, so it should occur in a state with high environmental standards to protect global environmental quality. This

argument expanded the perceived scope of potential impacts of the project and connected the project with the rest of the industry.

The Coastal Commission rejected adaptive co-management because divergent environmental framings by other agencies and stakeholders during the permitting process led the commission to incorporate formal consideration for a number of additional environmental impacts. These many frames, and the additional environmental impacts considered as a result, made the possibility of an experiment impossible: they could not agree on what the experiment would include or how to measure it.

In the final approved coastal development permit, the total project footprint was smaller and monitoring requirements for herring, shorebirds, and salmon were added. Whereas adaptive co-management would've treated the entire social-ecological system as an experiment, monitoring requirements collect data on multiple environmental impacts with more conservative production assumptions about environmental impacts. For a change in production methods, rather than creating opportunity within the permit (through adaptive co-management), Coast Seafoods will need to show long-term patterns supporting that change based on the broad-array of environmental impacts identified through this permitting process, in addition to more peer- and community- reviewed studies on smaller scales.

The scale of this project forced the CCC to think in terms of a social-ecological resilience framework. The inter-dependence of many factors – such as different species migratory patterns across the entire coast, fish spawning, and the confluence of freshwater and elevations – effectively broadened the impact space that the CCC considered. This change increased the complexity and interdependence of their analysis of the permit application, expanded the geographic and temporal scope of impacts considered, and shifted the locations under

consideration for expanded shellfish aquaculture. Once the commission considered these broader impacts, they reconsidered their monitoring needs because a significant expansion risked a regime shift if negative effects were experienced.

Ultimately the process was iterative. The first proposal was rejected outright based on public outcry and CCC staff concern about negative environmental impacts. The second proposal spurred two lawsuits, a dramatic increase in public comment submission both for and against the project, a CCC staff recommendation in support, and a CCC permit rejection. The success of the third and final proposal demonstrates the effectiveness of critics' environmental concerns. Yet, the desire to balance the economic prospects with environmental protection also played an important role. The final accepted permit balanced these needs by allowing the farm to increase its production and do so on a smaller acreage with more sustainable practices. This reflects the ability of re-framing and monitoring to align diverse interests. Through ongoing monitoring, it also raises the possibility for more aligned framing in the future: with more regular data collection about ongoing environmental impacts from shellfish aquaculture on a diverse range of resources, the potential for agreement on the extent and needs of the social-ecological system may become clearer.

Conclusion

Adaptive co-management is a relatively new way to deal with the problems of complexity and uncertainty in natural resource management; it offers the advantage of allowing policymakers and those working within an environment to shift practices as more is understood. However, the fundamental challenge of framing and community engagement will thwart the experimentation process, particularly as a regional approach encompasses even more stakeholders and impacts because agreement upon the "things to which [they] will attend and ...

the context in which [they] will attend to them" is not agreed upon (Schön, 1983, 40). In this case, different framings of the environment and natural resource use, whether the economic opportunity of a new sustainable industry, the statewide eelgrass management responsibilities, or habits of migratory birds, forced the CCC to consider broader, inter-dependent processes. For nebulous goals like sustainable development, the challenge of framing is even more pronounced than some of the early use-cases, such as flooding resilience. The possibilities for defining problems and solutions for sustainable development are endless. Instead, this case shows that planners can acknowledge multiple environmental frames by adopting a social-ecological resilience mindset, which influences the process, the substance, and the scale of planning, but exchanges the experimentation for monitoring.

This shift in the planning process does not preclude experimentation. It allows monitoring to take up the burden of accountability, leaving room for changes later in the process or next permitting renewal. In this sense, it creates opportunities for more stakeholders and viewpoints to feel secure in the planning process while also offering paths forward that do not depend on pre-established implementation goals (Kaza, 2019). Experimentation may be a valuable component of this process, but it must be done in the context of multiple, contested, and evolving environmental framing and social-ecological systems. Although framing and monitoring may be a useful and effective alternative to co-adaptive management, they also may be useful additions to the adaptive co-management framework. Framing may be an essential first step, while monitoring may be a contributor to frame agreement. This is an area for future research.

This study has several important implications. First, rather than viewing environmental and economic activities as trade-offs, it is evidence of the importance of analyzing

interdependent, relational activities in planning across space. When there is less of a unifying threat, such as disasters from climate change, the normative differences about how to incorporate these dynamics may be more challenging to pull together through experiments. Instead, a decision may be made that requires monitoring. As the connections between different natural systems at a local level are acknowledged, site-to-site impacts can be understood cumulatively within regions and across them, allowing for more responsive economic and environmental policy (Lowe & Feldman, 2017). For rural areas, it also shows how natural and cultural amenities can be an important form of endogenous economic development, providing examples more broadly for how economies can better integrate environmental sustainability.

CHAPTER III: BETWEEN THE FARM AND THE FORK: JOB QUALITY IN SUSTAINABLE FOOD SYSTEMS

Introduction

Advocates for structural change in the food system see opportunity in alternative food systems (AFS) (Dahlberg, 1993). AFS promote sustainability and equity to confront harms associated with industrial agriculture, including decreased public health, environmental degradation, heightened carbon emissions, loss of small farms and food businesses, and inequitable labor practices (Guthman, 2004; Schlosser, 2001; Fryar, Carroll, & Ogden, 2012; Martin, 2003; MacDonald, Hoppe, & Newton, 2018). Indeed, the labor practices in industrial agriculture are so poor that any alternative is assumed to be better. However, very little is known about the labor market in AFS. Failing to understand the labor market risks building a sustainable but exploitative industry. What work is in demand to establish and operate AFS? Is job quality consistent with the equity values that AFS seeks to uphold?

Using a unique and large data set on job openings in AFS, this paper analyzes contemporary trends in labor demand in the United States in terms of job type and job quality. Job advertisements are matched to 2018 Standard Occupation Codes to characterize work. Job wages are then compared to living wage standards and median incomes for each occupation within its local labor market.

This analysis documents a wide range of occupations in alternative food systems. The two most common occupation groups – food service and sales occupations – rely on direct-to-

consumer sales avenues and indicate that an equitable AFS labor market may be possible. Some frontline occupations in foodservice and sales earned more than their counterparts in other industries. Managerial roles in these same occupational areas, however, earned similar or less than their counterparts, suggesting the possibility of wage compression and more equitable compensation patterns. However, labor market competitiveness is concentrated in a few roles that struggle to earn living wages. Further, wage gains may reflect a reliance on higher wealth customers willing to pay higher food costs to boost wages, which, by itself, is not an effective strategy to generate broadscale job quality improvements across the food system. For other common occupation groups in demand, such as on farms and in industrial production, many jobs struggle to offer living wages and competitive wages. The challenge of job quality intensifies when considering labor in the context of careers; managerial positions struggle to compete, indicating the possibility of low-quality career pathways. Given that the food system must become more sustainable in the coming years in light of climate change and other crises precipitated by the current global food system, policies to create the conditions for high road development rather than extreme labor cost reduction strategies should be a priority.

Literature Review

The labor required to build alternative food systems

The phrase *alternative food systems* (AFS) refers to the myriad of counter-reactions to the negative impacts of industrial agriculture that initially comprised "local food" efforts, but de-emphasizes a particular local or regional scale. In this context, local and regional food efforts to build new systems and efforts to shift existing food systems represent the many experiments in identifying pathways to sustainable development. While the definition of local, alternative, or regional food systems is nebulous and evolving, commitments to economic development, equity,

and sustainability are central tenets to AFS because they comprise the potential benefits of an alternative system (Biewener, 2016).

A wide range of people are investing their intellectual and physical work to implement these new food systems arrangements across the supply chain. This includes, for example, new farming strategies such as cooperative regenerative agriculture (White, 2020), new processing strategies such as mobile slaughtering facilities to serve many small farmers collectively (Angioloni, Kostandini, Alali, & O'Bryan, 2016), innovative distribution strategies like food hubs (Cleveland, Müller, Tranovich, Mazaroli, & Hinson, 2014), commitments to sustainable food systems by foodservice organizations, and, for waste management, community composting and mobile operations to redirect waste (Veggie Rescue, 2021).

Labor is an essential component of *how* alternatives are built. It is difficult for small and medium-sized firms to join the global supply chains that typically bring products to consumers (Dunning, 2016). Instead, developing entirely new supply chains and infrastructure to support them are often necessary to build out these alternative systems. Indeed, despite the emergence of a "food movement," much of this work is small-scale and relatively experimental (Tewari, Kelmenson, Guinn, Cumming, & Colloredo-Mansfeld, 2018). How does labor demand reflect the range of different ways people engage in building and sustaining alternative food efforts? Understanding the types of jobs involved in this work will help unpack how people imagine and implement AFS strategies.

Job quality as a potential barrier to sustainable economic development in the food system

The ability of AFS to yield economic development, equity, and sustainability benefits *at the same time* is contested. Some scholars have articulated AFS as an interdisciplinary opportunity to connect ecological sustainability with social and economic justice (Feenstra,

1997), and planners have urged undergirding sustainability efforts with commitments to equity (Born & Purcell, 2006; Alkon & Agyeman, 2011). In practice, case studies cut away at this vision, finding that AFS typically prioritize sustainability at the expense of replicating economic inequality (Biewener, 2016; Daftary-Steel, Herrera, & Porter, 2015; Sbicca, 2015; Soper, 2020).

When these tenets are in tension, how is job quality impacted? There is a debate about whether food prices affect wages in the food system. Theoretically, a higher willingness to pay associated with "local and regional foods" (Thilmany, Bond, & Bond, 2008) could translate to higher profits passed onto employees. However, the increased costs associated with producing AFS may offset these profits (Hardesty & Leff, 2010), decreasing the wages offered to employees. For farmworkers, others have found that such a small fraction of the final cost of food goes to farmworker wages that prices have little impact on labor incomes (Costa & Martin, 2020). AFS are increasingly criticized for relying on free and underpaid work and exacerbating inequality based on race and class (Alkon & Agyeman, 2011; Allen, 2016; Biewener, 2016; Daftary-Steel, Herrera, & Porter, 2015; Janssen, 2010; Myers & Sbicca, 2015; MacAuley & Niewolny, 2016; Minkoff-Zern, 2017; Shreck, Getz, & Feenstra, 2006); Guthman, 2014). The literature documents inequities associated with farm work in AFS, and recent work has begun to connect farm labor with traditional labor organizing (Sbicca, 2015; Myers & Sbicca, 2015; Janssen, 2010; Gray, 2013). Small-scale producers struggle to provide good jobs, meaning that even as policy-makers and the public support smaller-scale production, workers often benefit more from positions at industrialized firms through access to higher wages, benefits, and rights (Lo & Delwiche, 2016; Shreck, Getz, & Feenstra, 2006; Guthman, 2014).[5]

5 This of course does not include the extremely poor working conditions of farm laborers in the industrialized food system, who are some of the worst paid in the United States. Though wages for industrial farmworkers are rising, they are still some of the least well-paid of any occupational group in the United States (Zahniser, Taylor, Hertz, & Charlton, 2018; Kandel, 2008; Pena, 2010)

These case studies raise questions about AFS' ability to offer a pathway to "high road" development, whereby businesses succeed in part because their employees have good jobs. Good jobs, in this context, are defined as ones providing a living wage, benefits (including paid sick days and vacation), a safe working environment, training, job security, opportunities for advancement, and the ability to collectively bargain (Liu, 2012; Biewener, 2016). Failing to offer good jobs poses risks to successful long-term AFS development that upholds its central tenets. Poor wages or career paths may disincentivize job seekers without personal wealth, limiting who will play leadership roles in AFS development while reinforcing low-wage status for those who cannot seek employment elsewhere (Alkon, 2013; Pisani & Guzman, 2016; Biewener, 2016). Second, AFS efforts will struggle to retain skilled workers without competitive wages, limiting their ability to succeed.

As efforts to transform food production practices mobilize, understanding job quality within a system that supports sustainable food production and its attendant supply chains is important for well-designed policy. However, a dearth of data limits our understanding of AFS job quality and its role in AFS development. Those working between the farm and the fork, in occupations such as processing, sales, logistics, and foodservice, are rarely studied. In addition, some scholars have argued that a lack of national data on small farm labor, as opposed to small farm owners, has intentionally hidden inequitable labor practices on small farms (Moskowitz, 2014; Arcury & Quandt, 2009; Mock, 2021). This paper lessens these gaps by providing a national scan of labor demand and quality in AFS job advertisements between 2010 and 2019.

Data and Methods

Alternative Food Labor Data

Thus far, examinations of job quality in AFS have been limited to case studies (Minkoff-Zern, 2017). Data on labor within the AFS sector is not readily available. The United States Department of Agriculture (USDA) Census does not provide disaggregated data regarding work on industrial farms versus smaller-scale farms with more sustainable production practices.

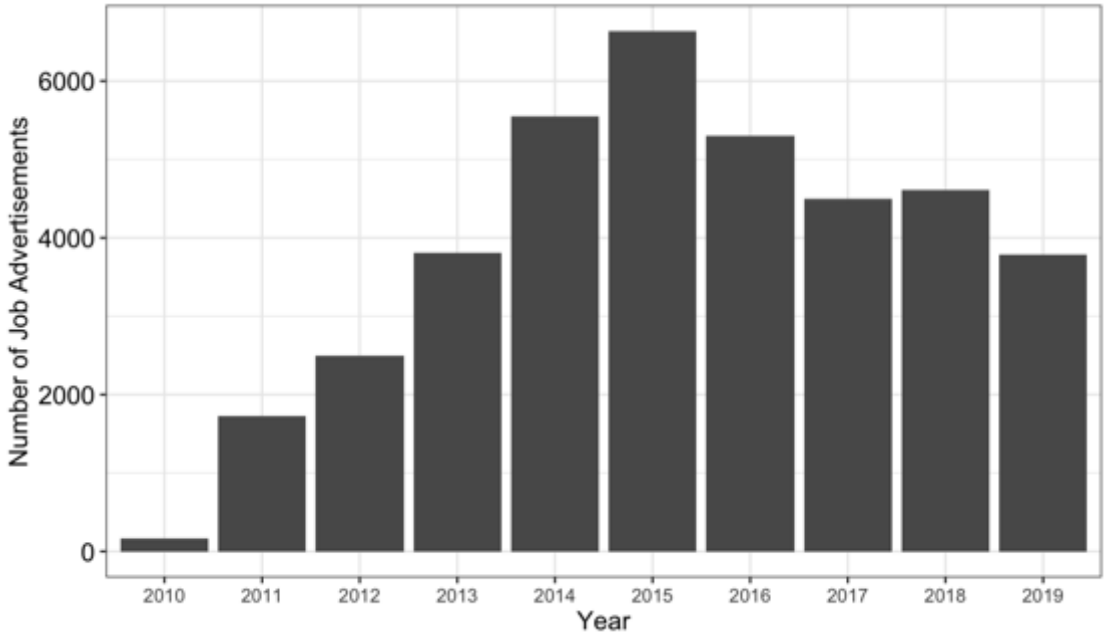
This paper relies on job openings advertised between January 1, 2010, and December 31, 2019, on a Good Food Jobs (www.goodfoodjobs.com) to assess occupational mix and job quality in alternative food systems. This company hosts job advertisements in AFS. Each job posting is vetted by one of the co-founders to ensure job quality and compliance with the company's editorial policy. Typically, "our identity as a small, alternative, grassroots organization has attracted companies of the same ilk" (Cocalis & Neagle, 2014). The editorial policy is subject to interpretation, and some standards have evolved,[6] but it attempts to uphold the following guiding principles: food justice, ecological justice, and anti-racism. The company does not post jobs considered "industrial agriculture" but has posted job openings at large corporations. The dataset contains the date of posting, job location, a text description of the company, and a text description of the job advertised. This data reflects labor *demand* in AFS.

Information about the organization advertising an opening and the wages, benefits, skills, and responsibilities for each opening were extracted from the advertisement when present. Some postings represented multiple openings; the dataset was adjusted to create an observation for

6 In 2014 the company required all postings to offer some form of compensation (college credit, room and board, barter, wages) or be a volunteer opportunity (one time event), a business for sale, or an educational program. Later (2021 data, which is not included in this analysis) the company stopped posting unpaid opportunities; meaning financial compensation is required on all posts starting in January of 2021. In 2016, the company started requiring more information of companies about compensation: whether the job was hourly, salaried, etc., and providing a range of possible compensations if not the exact compensation amount being offered.

each position when the posting provided enough information. However, the final dataset is an under-representation of total jobs that could have been filled. Other postings advertised multiple openings for the same position; in this case, the posting was not duplicated, but the presence of multiple openings was recorded. Unpaid positions represented 5.2% of postings but were removed for separate analyses. Businesses for sale (less than 1% of postings) and postings lacking adequate information (64 postings) were also removed, resulting in 38,572 job postings representing 44,782 openings (taking into account postings with multiple openings for the same position).

Figure 6. Job Postings in Alternative Food Systems 2010-2019



Wage information was available for 39% of postings. Compensation was standardized into hourly and annual incomes, taking into account seasonal and contract work and whether a range of compensation or hours was offered. For jobs with a range of possible compensation and possible hours, the minimum and maximum for each generated four possible scenarios. A similar process for openings with a range in either hours or wages generated two possible wage

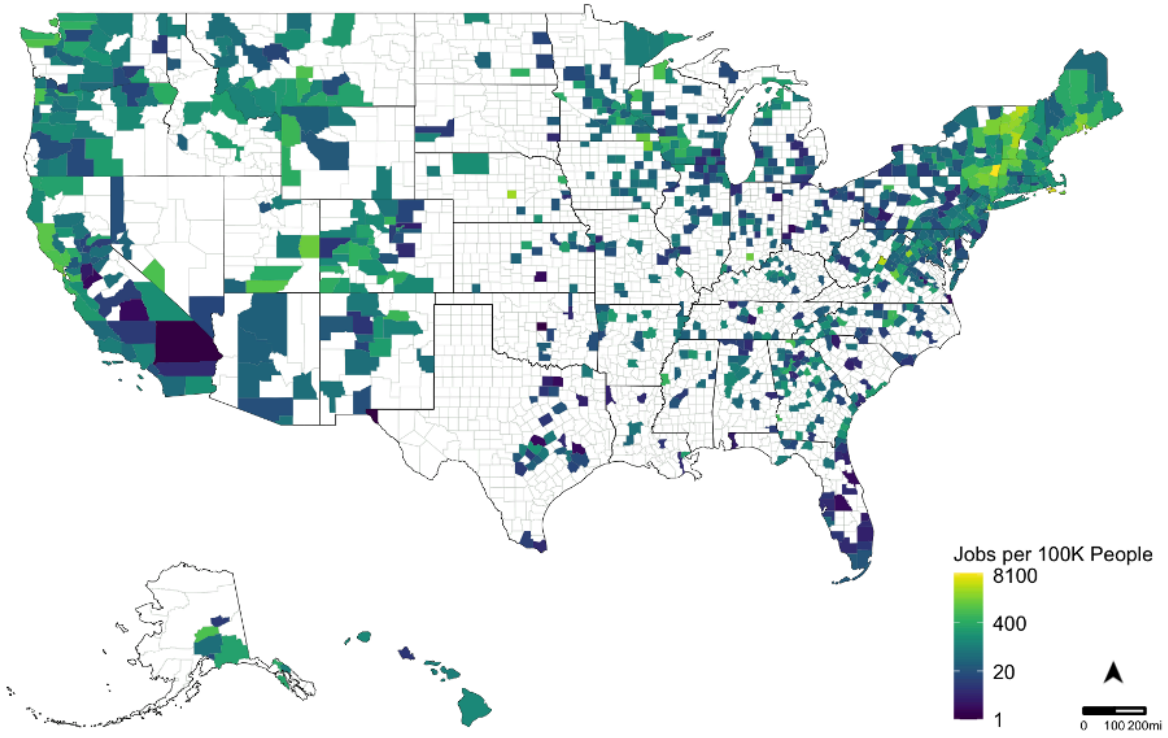
scenarios. For all postings with wage variability due to hours or compensation, an average of the scenarios was created and used for primary analyses.

Table 3. Alternative Food Systems Job Postings 2010-2019 by full-time status

Job Type	*Total Job Openings*	*With Wage Info.*
Full-Time	31,165 (81%)	11,404 (30% of all posts)
Part-Time	7,407 (19%)	3,662 (9.5% of all posts)
Total	38572 (100%)	15,066 (39% of all posts)

The distribution of jobs covers the entire country, with fewer postings in Nevada and the USDA Plains region (United States Department of Agriculture, 2019). This is consistent with other sources on local and regional food activities (Low, et al., 2015).

Figure 7. Maps of AFS job postings by year and aggregated across the decade (2010-2019)



Characterizing AFS Job Openings as Occupations

Each job posting was matched to a Detailed 2018 Standard Occupation Code (SOC) to characterize the types of work involved in AFS. The SOC classification system was created by the Bureau of Labor Statistics (BLS) and classifies all work into one of 867 SOCs. These "Detailed SOCs" are accompanied by a Detailed Title and description. Occupations with the same Detailed SOC have similar job duties and can be combined into increasingly general groups. There are 459 Broad SOC groups, 98 Minor SOC groups, and 23 Major SOC groups (U.S. Bureau of Labor Statistics, 2017). Mapping jobs to SOCs is helpful for newer industries such as AFS, where work dynamics are less understood.

For example, a pickle maker is characterized by the Detailed SOC 51-3092, titled "Food Batchmaker," alongside similar roles such as ice cream makers and peanut butter makers. Food Batchmakers comprise the Broad SOC 51-3090, titled "Miscellaneous Food Processing Workers" along with Detailed SOC 51-3091 (titled "Food and Tobacco Roasting, Baking, and Drying Machines" – i.e., coffee roasters), Detailed SOC 51-3093 (titled "Food Cooking Machine Operators and Tenders" – i.e., operator of a frying machine), and Detailed SOC 51-3099 (titled "Food Processing Workers, All Other"). Miscellaneous Food Processing Workers are combined with other Broad SOCs, including Broad SOC 51-3020, titled "Butchers and Other Meat, Poultry, and Fish Processing Workers" and Broad SOC 51-3010, titled "Bakers," into the Minor SOC 51-3000, titled "Food Processing Workers." The Food Processing Workers Minor SOC is within the Major SOC 51-0000, titled "Production Occupations" (Bureau of Labor Statistics, 2017).

One Major SOC group, "Managerial Occupations," comprises Detailed SOC occupations that manage roles in other Major SOC categories. For example, the Detailed SOC, "Food Service

Managers," is in the Managerial Occupations Major SOC group. Food Service Managers manage occupations in the Major SOC group "Food Preparation and Serving Occupations." For this study, the Detailed SOCs within the Managerial Major SOC will be analyzed with the Major SOC group they manage, except for "General and Operations Managers" and "Chief Executives," which are too general to be allocated to another Major SOC. Table 8. in the Appendix shows how the Detailed Occupations within the Managerial Major SOC will be grouped with other Major SOC groups.

A rule-based coding program matched jobs to a Detailed SOC. Openings were first sorted by title and compared to a list of Detailed SOC titles. The closest match became the first "guess" (two guesses were allowed). Then, using Detailed SOC descriptions and example occupation titles corresponding to the 2018 Detailed SOCs and example occupation titles corresponding to Detailed SOCs from the Occupational Information Network (O*NET), skills and responsibilities were used to confirm or deny whether the job posting matched a Detailed SOC. For job openings that did not match any Detailed SOC or matched multiple Detailed SOCs equally, manual categorization was used to break ties and quality control checks. When the matching was complete, every job posting within a SOC was manually checked for consistency and accuracy, and outliers were manually re-coded as necessary. This approach is consistent with similar approaches to this matching problem (Russ, Ho, & Colt, 2016).

To test the rule-based coding approach's accuracy each job advertisement was also coded with the machine learning algorithm for this purpose created by the U.S. National Institute for Occupational Safety and Health (NIOSH), which is called the Industry and Occupation Computerized Coding System (NIOCCS). The SOC codes assigned by NIOCCS were compared to the codes assigned by the rule-based method. The NIOCCS SOC assignment system was

expected to have strong to moderate kappa agreement at the Major SOC level based on comparisons in the literature between machine learning and hand-coded job descriptions (Buckner-Petty, Dale, & Evanoff, 2019; Schmitz & Forst, 2016). The NIOCCS SOC coding had moderate to substantial levels of agreement at the Major SOC level (Light's Kappa = 0.62, $p < 0$; percent agreement = 69%) and weak to fair agreement levels at the Minor SOC (Light's Kappa = 0.50, $p < 0$; percent agreement = 53%) (McHugh, 2012). This is an acceptable level of agreement based on two considerations. First, the NIOCCS algorithm was designed for health occupations only. Second, the jobs with disagreeing SOC codes had titles with compound words or two words, where the rule-based coding was more accurate. Out of 867 possible Detailed SOCs, 246 Detailed SOCs were identified; 133 Detailed SOCs had more than fifteen job openings.

Living Wage Comparisons

One assessment of job quality is whether wages cover the cost-of-living expenses. Cost of living expenses vary by geography. Analyzing job quality concerning the local cost of living conditions meaningfully changes assessments of labor conditions (Grimes, Prime, & Walker, 2019). Each job posting with wage information was compared to a living wage for that county and year for an individual with no children – the most generous living wage calculation – accounting for subsidies towards housing, healthcare, transportation, and food from employers. Living wages were calculated following Nadeau and Glasmeier (2019), with a few exceptions. These exceptions include: first, healthcare data was from the 2018 Bureau of Labor Statistics Consumer Expenditure Surveys. Second, decennial Census, American Community Survey, and Federal Communications Commission data were used to estimate cellphone and Internet costs.[7] Finally, local taxes were included in tax estimates.

7 https://www.fcc.gov/health/maps/developers

Each job posting was compared to the living wage calculated for that year in the county where the job was located. For job openings with a range of compensation values, the average estimate of compensation was used.

Labor Market Comparisons

Another way to examine job quality is by testing whether wages for a Detailed SOC within AFS are similar to wages for the same Detailed SOC in the same labor market in other industries. If AFS compensation in a given occupation and labor market is on par with compensation for the same occupation in other industries, it would be reasonable to conclude that wages are influenced more by occupation than by industry. If there is a significant difference in compensation for AFS work compared to other industries, AFS workers may be at an advantage or disadvantage.

Each AFS job opening with wage data was compared to the normalized distribution of hourly wages for its Detailed SOC across all industries in its respective labor market using data provided by the Occupational Employment and Wage Statistics (OES) program of the BLS. Labor markets were defined using the OES geographies. These labor markets included Metropolitan Statistical Areas (MSAs) and non-metropolitan areas, as well as MSA divisions for the eleven largest MSAs in the United States. An MSA is defined by the U.S. Census Bureau as containing "a core urban area of 50,000 or more population. Each MSA consists of one or more counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core." (Bureau of Labor Statistics, 2020). MSA divisions are component geographies of MSAs. In New England, the OES uses NECTAs and NECTA divisions which are analogous to MSAs and MSA divisions for the rest of the country but are defined in terms of

cities and towns rather than counties. The OES definitions are appropriate to use as proxies for labor markets because they are defined in terms of communities that have a high degree of economic and social integration with a population core. While data at the MSA and NECTA division was used when possible, comparisons are made at MSA level. This is to allow for variation across the MSA while preserving the accuracy of the MSA division-level data. Table 9. (in the appendix for Paper III) shows all the labor markets that contained one or more job opening. Out of 571 possible labor markets, 439 had one or more job openings; there were 159 labor markets with fifteen or more job openings across the decade.

In cases where the Detailed SOC wages were missing at the Detailed SOC level, but the Broad SOC wages were not, the Broad SOC data was used. This imputation strategy was used when either a) the title was the same for the Broad and Detailed SOCs or b) only two Detailed SOCs within the Broad SOC. In cases where the data was not available at the MSA or NECTA division level but was available at the MSA or NECTA level, the MSA or NECTA level was used. Finally, a small amount of OES data was suppressed for Detailed and Broad SOC levels at both division and MSA geographies, and the Major SOC wages were used. There were 15,066 job postings with wage data. Of these, 14,848 openings were compared to the *median hourly wage* in their *labor market* for their Detailed SOC, with 4% of median wages imputed from Broad or Major SOCs.

OES insufficiently samples the agricultural and forestry industry, so data from the National Agricultural Statistics Service (NASS) was used for agricultural production roles. NASS conducts quarterly surveys on farm labor for farms with at least $1,000 in annual sales for

fifteen multi-state labor regions and the single-state regions of California, Florida, and Hawaii (National Agricultural Statistics Service, 2021).[8]

A Wilcoxon signed-rank test was used to compare compensation in AFS jobs with compensation in the same occupations in other industries within the local labor market. A Wilcoxon signed-rank test is a nonparametric test that may compare the distributions of paired observations.[9] This test compared compensation between AFS jobs and *median hourly wages* in all industries, accounting for labor market and occupation (Datta & Satten, 2008). This method allows for the distribution of pair-wise differences to differ between clusters. All observations were adjusted for inflation to January, 2020 dollar values and included in the same comparison. The same test compared compensation between AFS jobs and all industries for each Detailed SOC, accounting for MSA when there were at least fifteen observations. Significance values are corrected for multiple comparisons using the Holm method (Chen, Feng, & Yi, 2017). The null hypothesis is that AFS wages are not distributed significantly differently than wages in the same occupations and MSA in other industries.

Results

What work is in demand to establish and operate AFS?

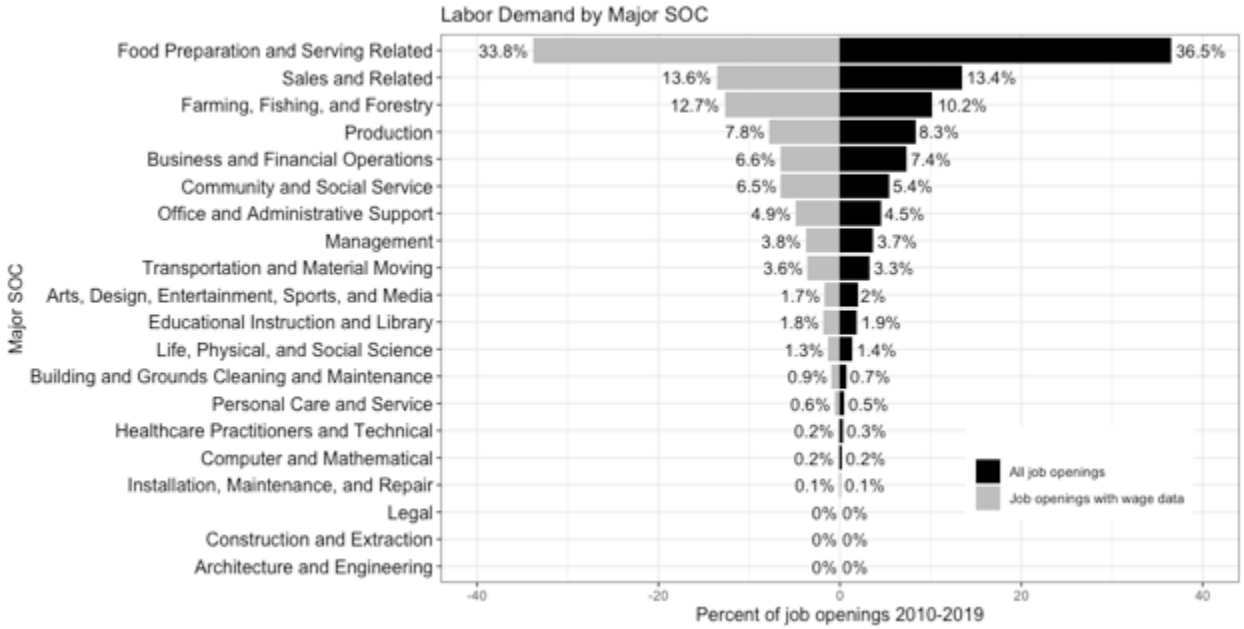
Job openings were classified into 235 Detailed SOCs from 20 Major SOC groups. Figure 5. shows labor demand for each Major SOC, alongside labor demand for job advertisements that provided wage information. These distributions are similar. Across the decade, the composition

8 The annual weighted average hourly wage rate for field and livestock workers from NASS is the Adverse Effect Wage Rate in the Federal H-2A allows admission of temporary non-immigrant alien farm workers.

9 A nonparametric test was selected because the differences between AFS hourly compensation and median hourly compensation did not follow a normal distribution, despite several possible transformations, according to the results of a Kolmogorov-Smirnov one-sample test (two-sided, DF = 15,088, p = .001). See Table 9. in the Appendix for more.

of labor demand stayed relatively stable, with most Major SOC groups experiencing minor fluctuations. See Figures 7. and 8. in the Appendix for a breakdown of labor demand within each Major SOC by year.

Figure 8: Distribution of Labor Demand in AFS from 2010-2019 for all job openings and openings with compensation data.



The Management Major SOC Group comprises only two Detailed SOC Titles: "General and Operations Managers" and "Chief Executives, " which are too general to be allocated exclusively to another Major SOC Group. When aggregating all 23 manager roles together, they comprised 21% of total labor demand.

Fourteen Detailed SOCs accounted for over 50% of total labor demand (TLD) (shown in Table 4.), which came from only six Major SOCs. Seven of the most common Detailed SOCs were Food Preparation and Serving occupations, comprising 29.5% of TLD. The remaining Major SOCs included occupations in the Farming, Sales, Production, Community and Social Service, and Management Major SOCs.

Table 4. Most common Detailed SOC titles comprising 50% of labor demand in AFS from 2010-2019.

Detailed SOC Title	Major SOC Title	% Labor Demand	Cumulative % Labor Demand
Chefs and Head Cooks	Food Preparation and Serving Related	7.86	7.86
First-Line Supervisors of Food Preparation and Serving Workers	Food Preparation and Serving Related	5.03	12.89
Farmers, Ranchers, and Other Agricultural Managers	Farming, Fishing, and Forestry	4.78	17.67
Cooks, Restaurant	Food Preparation and Serving Related	4.34	22.01
Food Preparation Workers	Food Preparation and Serving Related	3.68	25.69
Food Service Managers	Food Preparation and Serving Related	3.22	28.91
Bakers	Production	3.13	32.05
Retail Salespersons	Sales and Related	3.06	35.07
Community and Social Service Specialists, All Other	Community and Social Service	2.97	38.04
First-Line Supervisors of Retail Sales Workers	Sales and Related	2.75	40.79
General and Operations Managers	Management	2.74	43.53
Fast Food and Counter Workers	Food Preparation and Serving Related	2.69	46.23
Cooks, Short Order	Food Preparation and Serving Related	2.66	48.89
Farmworkers and Laborers, Crop, Nursery, and Greenhouse	Farming, Fishing, and Forestry	2.57	51.45

Food Service Occupations

Foodservice occupations include all Detailed SOCs within the Food Preparation and Serving Related Occupations Major SOC and the Detailed SOC "Food Service Managers" from the Manager Major SOC. Foodservice occupations made up the largest proportion of labor demand, at 37% of job openings across the decade.

The most common Detailed SOC occupations within this category were entry-level and supervisory roles in the front and back of the house. Many were among the most common Detailed SOCs across the entire dataset shown in Table 4., but also included Servers (1.9% TLD), Cooks (institution and cafeteria; 0.8% TLD), Hosts (0.8% TLD), and Bartenders (0.7% TLD).

Jobs in this occupation category were advertised by 4,916 distinct firms in 49 states (there were none in Kansas or North Dakota). Openings were primarily in restaurants and cafes but also included cafeterias. A small number of openings in food service were located on farms (3.2%). Foodservice offerings may be an option for farms seeking to diversify revenue streams with agritourism.

Sales Occupations

Sales occupations include all Detailed SOCs within the Sales Occupations Major SOC and the Detailed SOCs "Sales Managers" and "Advertising and Promotions Managers" from the Manager Major SOC. Openings comprised the second largest category of labor demand, at 13% of jobs.

Retail sales roles were the most common sales occupations. Retail Sales Persons, Demonstrators and Product Promoters, cashiers, and their supervisors made up 3.0%, 2.4%, 0.4%, and 2.8% of TLD, respectively. Retail positions were located in specialty food and beverage stores, consumer cooperatives, and farmers' markets. Sales representatives for wholesale or services comprised 2.4% and 0.2% of TLD, respectively. These positions were based in food production companies, catering and food delivery services, and food hubs. Sales Managers represented 2.0% of TLD.

Openings were advertised by 2,020 distinct companies in 50 states (North Dakota did not have any sales openings). Three hundred farms sought to hire a dedicated sales role (14% of sales openings were on farms), with the number of sales roles on farms increasing from between 10 and 13% of sales in the first five years to 21% in 2019. Most commonly, farms sought to hire demonstrators and product promoters for farmers' market booths or retail salespeople in farm stores and stands. There were fewer wholesale sales openings on farms, though farmer cooperatives were also enlisted to provide aggregation and sales services.

Farming Occupations

Farming occupations include all Detailed SOCs within the Farming, Fishing, and Forestry Major SOC and the Detailed SOC "Farmers, Ranchers, and Other Agricultural Managers" from the Manager Major SOC. In addition to the farming occupations noted in Table 4, First-Line Supervisors and Farmworkers (farm, ranch, or aquacultural animals) made up 1.87% and 0.80% TLD, respectively. Graders and sorters of agricultural products, agricultural equipment operators, agricultural inspectors, and animal breeders were less common. Labor demand in this category grew from 3% in 2011 to 11% in 2019. Across the decade, farming occupations made up 10% of labor demand.

Job openings were advertised by 1,807 different farms. Based on the text descriptions provided in the job advertisement, the majority of farms hiring farmworkers were small to medium-sized,[10] ranging from 0.25 acres to 87,000 acres, with a median of 12.5 acres and an average of 271. Not all acreage was in production. Most farms grew vegetables (88%), but 50% produced both animal and vegetable products.

[10] Farm size may be characterized by acreage or sales (MacDonald, Hoppe, & Newton, 2018). Acreage can be misleading because not all acreage must be in production, varies in quality, varies in use intensity, and varies in product. Thus, the USDA also uses sales to distinguish farm size. Sales data was not available for these farms, so acreage was used.

Production Occupations

Food production jobs include all Detailed SOCs within the Industrial Production SOC and "Industrial Production Managers" from the Manager Major SOC. In a food context, production occupations add value to raw food products systematically; for example, pickles made out of raw cucumbers at a large scale. Demand for food production occupations comprised 8% of TLD.

The most common production occupations were bakers (3.13% TLD), food batchmakers (1.42% TLD), production managers (0.95% TLD), butchers and meat cutters (0.71% TLD), and separating, filtering, clarifying, and precipitating occupations (i.e., cheesemakers; 0.67% TLD). Produced goods ranged from baked goods and cuts of meat to preserved foods like jams to pre-processed raw foods like chopped carrots to products requiring mixing or cooking like pierogis, to fermented goods such as yogurt. Several wineries, breweries, and distilleries also advertised openings.

Production jobs were located in 46 states among 1,493 distinct firms, with no openings in Washington DC, Kentucky, Nebraska, South Dakota, or Oklahoma. Openings were primarily at private companies, though several were cooperatively owned processing facilities or community spaces. Twelve percent of production job openings were on farms, the majority of which were dairies or farms with vegetable processing capacity.

Community and Social Service Occupations

Demand for Community and Social Service Major SOC occupations made up 4% of Approximately 980 firms in 50 states (excluding North Dakota) advertised openings. Community and Social Service Specialist was the most Detailed SOC (2.97% TLD). This role conducts

programmatic work. Their managers experience 1.67% of TLD, followed by Health Education Specialists (0.58% TLD).

The loci of this work – community health and economic vitality, sustainable farming, and policy advocacy – reflect long-term challenges for the food system. "Community health" work engaged with nutrition, food access, and gardening in schools, community gardens, and farmers' markets. Other organizations support land conservation, farmland access, sustainable farming practices (in some cases by providing certification of those practices), farmer training programs, and beginning farmer programming. Fifty-two farms advertised job openings in this category, usually teaching farms or community gardens supporting food access and nutrition education. Other organizations provided local and regional branding and small business incubation. Finally, still others mobilized community organizers around coalitions –focusing on farming practices or policy arenas at the regional and national level.

General and Operations Managers

"General and Operations Managers" and "Chief Executives" – the two Detailed SOCs not analyzed with another Major SOC they manage – made up roughly 4% of TLD. The majority were General and Operations Managers, comprising a large proportion of labor demand for a single Detailed SOC (2.74%).

Six-hundred and fifty-one firms in 47 states (Kansas, Kentucky, South Dakota, and Wyoming did not post any) advertised General and Operations Manager openings, which are supervisory roles in which the responsibilities are too varied to be categorized neatly (U.S. Bureau of Labor Statistics, 2017). Many openings were at food hubs. Other common openings within this Detailed SOC included farmers market managers, farm-to-institution program managers, cooperative association managers (for growers and consumers), and small business

operations managers. Organizations hiring these roles ranged from non-profits, small businesses, and local and state governments.

Job Quality: Living Wage Comparison

Overall, of the job openings with wage data, 66.7% offered an hourly living wage. When the wage was adjusted to consider free housing, food, or other benefits, 70% of jobs offered an hourly living wage. Annually 56.6% of jobs offered living wages. About 27% of full-time jobs did not offer an annual living wage, but 5% of part-time jobs did. In terms of benefits, 16.5% of jobs advertised financial benefits such as 401K contributions, 18.6% advertised paid time off, and 20.5% advertised some or full health insurance. These may be underestimates, as firms could offer these benefits but not have advertised them.

Some occupation groups performed better than others with respect to living wages. Figure 6. shows the distribution of differences between the advertised hourly wages and the corresponding living wage, grouped by Major SOC. A distribution coalescing around zero shows wages clustering around the living wage. Manager roles continue to be analyzed with the Major SOC they manage, reflecting career pathways within Major SOCs. Table 5. shows the 14 Detailed SOCs comprising over half of TLD and their living wage attainment rates.

Figure 9. Difference Between a Living Wage and Hourly Wages in AFS Jobs

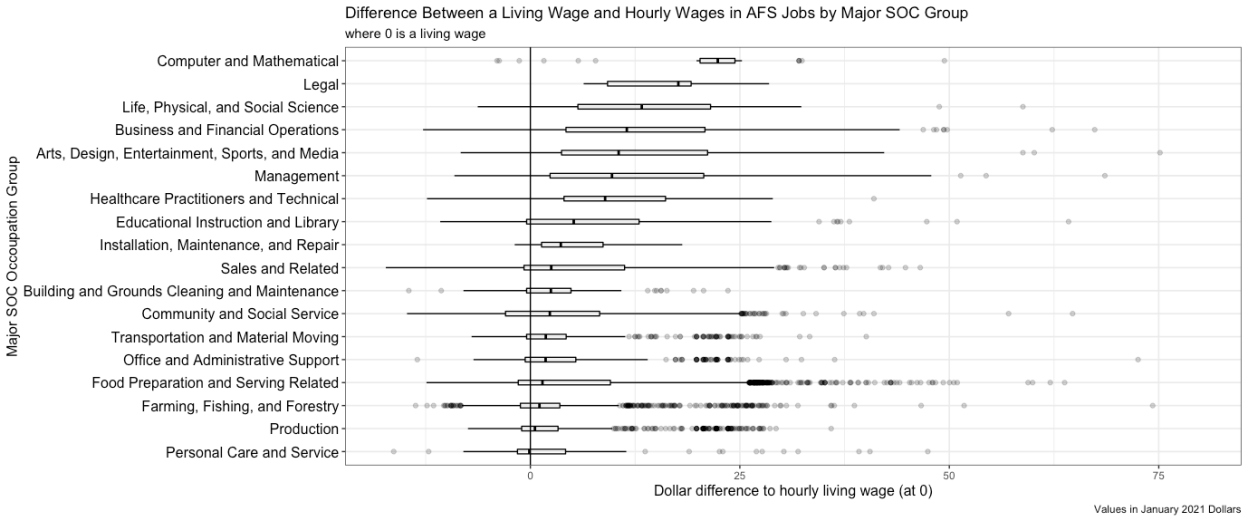


Table 5. Most Common SOCs' Living Wage Attainment Rates

SOC Category*	% Offered LW	Median Distance to LW (w/o outliers)	Average Distance to LW (w/o outliers)
Food Preparation and Service	**63%**	**$1.44 ($0.52)**	**$5.56 ($2.26)**
Chefs and Head Cooks	90%	$13.94 ($8.87)	13.83 ($11.59)
First-Line Supervisors	80%	$4.51 ($3.33)	$7.76 (5.52)
Cooks, Restaurant	51%	$0.04 ($0.34)	$0.47 ($0.45)
Food Preparation Worker	47%	- $0.38 (- $0.08)	$0.05 (- $0.16)
Food Service Managers	94%	$19.83 (12.97)	$17.48 (14.08)
Fast Food & Counter Workers	31%	- $1.97 (- $0.82)	- $0.03 (- $0.78)
Cooks, Short Order		- $0.45 ($0.23)	$0.20 ($0.15)
Sales and Related	**68%**	**$2.49 ($1.42)**	**$6.39 ($3.53)**
Retail Salespersons	47%	- $0.72 (- $0.57)	$0.34 (- $0.36)
First-Line Supervisors	74%	$3.10 ($ 2.93)	$6.11 ($5.00)
Farming, Fishing, and Forestry	**78%**	**$1.09 ($0.80)**	**$2.30 ($0.80)**
Farmers, Ranchers, & Other Agricultural Managers	89%	$4.02 ($3.42)	$6.47 ($4.01)
Farmworkers & Laborers (crop, nursery, & greenhouse)	70%	- $0.04 (- $0.02)	- $0.04 (- $0.18)
Production	**59%**	**$0.54 ($0.21)**	**$2.69 ($0.50)**
Bakers	50%	-$0.05 ($0.20)	$1.07 ($0.38)
Community and Social Service	**60%**	**$2.32 ($1.48)**	**$4.03 ($2.45)**
Community & Social Service Specialists	49%	- $0.69 ($0.83)	$1.52 ($0.58)
Managers	**89%**	**$9.74 ($7.25)**	**$ 11.833 ($10.05)**
General & Operations Managers	86%	$6.30 ($5.35)	$9.46 ($7.69

** Includes relevant managers*

Table 5. shows that more senior roles offered living wages more often than their Major SOC, pulling up the median and average differences between compensation and living wages (except General and Operations Managers, who share the group only with Chief Executives). At the Detailed SOC level, many occupations hovered right at or below living wage thresholds. These trends extend to entry-level versus more senior roles not among the 14 most common Detailed SOCs.

Among important Sales and Related Detailed SOCs not in Table 5., Demonstrators and Product Promoters were offered living wages 60% of the time. Their managers fared better, with 89% earning living wages. Wholesale sales representatives were offered living wages 58% of the time. Cashiers struggled the most of all occupations; they were offered living wages 17% of the time.

For farming occupations not in Table 5., 81% of Supervisors received living wages, while 63% of farmworkers were offered living wages. Despite low rates of living wages for farmworkers, average wages for crop workers increased faster than inflation, from $10.41 per hour in 2011 to $13.25 per hour in 2019 (in 2021 dollars). The number of crop worker jobs offering a living wage also increased over the decade, from 21% in 2011 to 71% in 2019.

Common Production Occupations not in Table 3. earned living wages between 45% and 93% of the time. These roles include, decreasing in TLD, Food Batchmakers (54% offered living wages), Industrial Production Managers (93% offered living wages), supervisors (67%), Butchers and Meat Cutters (45%), Meat, Poultry, and Fish Cutters and Trimmers (59%), and Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders (80%).

For Community and Social Service Occupations, managers and Health Education Specialists were offered living wages 90% and 43% of the time, respectively.

Does job quality pose a barrier to AFS development?

AFS wages are distributed significantly differently than wages in the same detailed occupations and MSA in other industries ($p<0.0001$), with AFS occupations earning less than their counterparts in other industries. Results were mixed when testing by Detailed SOC. Only Food Preparation and Serving Related Occupations consistently outperformed local labor markets; Table 6. shows all statistically significant results of paired Wilcoxon signed-ranked tests for Detailed SOCs, clustered by MSA.

Table 6. Paired Wilcoxon Signed-ranked Test Results

Major SOC Group	Detailed SOC name	Z- Statistic	Adjusted p-value (Holm)	p-value
Arts, Design, Entertainment, Sports, and Media Occupations	Public Relations Managers	-5.3	****	****
	Public Relations Specialists	-4.1	**	****
Building and Grounds Cleaning and Maintenance Occupations	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	-4.9	****	****
Business and Financial Operations Occupations	Market Research Analysts and Marketing Specialists	-6.2	****	****
	Marketing Managers	-5.9	****	****
	Fundraising Managers	-5.3	****	****
	Financial Managers	-4.5	**	****
	Fundraisers	-4.1	**	****
	Wholesale and Retail Buyers, Except Farm Products	-4.0	**	****
	Management Analysts	-4.0	**	****
	Human Resources Managers	-3.8	*	***
	Logisticians	-3.8	*	***
	Project Management Specialists and Business Operations Specialists, All Other	-3.3	ns	***
	Purchasing Managers	-3.2	ns	**
	Meeting, Convention, and Event Planners	-3.0	ns	**
	Buyers and Purchasing Agents, Farm Products	-2.6	ns	*
	Accountants and Auditors	-2.2	ns	*

Community and Social Service Occupations	Community and Social Service Specialists, All Other	-10.1	****	****
	Social and Community Service Managers	-6.9	****	****
	Health Education Specialists	-5.6	****	****
Educational Instruction and Library Occupations	Self-Enrichment Teachers	-3.7	*	***
	Farm and Home Management Educators	-3.4	ns	***
Farming, Fishing, and Forestry Occupations	First-Line Supervisors of Farming, Fishing, and Forestry Workers	-10.3	****	****
	Farmers, Ranchers, and Other Agricultural Managers	-8.7	****	****
	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	-8.3	****	****
	Farmworkers, Farm, Ranch, and Aquacultural Animals	-4.0	**	****
	Graders and Sorters, Agricultural Products	-2.9	ns	**
Food Preparation and Serving Related Occupations	Food Preparation Workers	7.6	****	****
	Counter Attendants, Cafeteria, Food Concession, and Coffee Shop	6.4	****	****
	Cooks, Short Order	6.0	****	****
	Dishwashers	6.0	****	****
	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop	4.7	***	****
	Waiters and Waitresses	4.7	***	****
	Chefs and Head Cooks	4.6	***	****
	Dining Room and Cafeteria Attendants and Bartender Helpers	4.2	**	****
	Cooks, Private Household	3.8	*	***
	Cooks, Restaurant	3.5	ns	***
	Cooks, Fast Food	3.0	ns	**
	First-Line Supervisors of Food Preparation and Serving Workers	2.6	ns	**
Healthcare Practitioners and Technical Occupations	Dietitians and Nutritionists	-3.7	*	***
Life, Physical, and Social Science Occupations	Political Scientists	-3.6	*	***
	Social Scientists and Related Workers, All Other	-3.6	*	***
	Food Scientists and Technologists	-2.7	ns	**
	Conservation Scientists	-2.5	ns	*
Management Occupations	General and Operations Managers	-9.1	****	****
	Chief Executives	-7.6	****	****
	Administrative Services Managers	-4.5	**	****

Office and Administrative Support Occupations	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	-3.8	*	***
	Executive Secretaries and Executive Administrative Assistants	-3.6	*	***
	Customer Service Representatives	-3.0	ns	**
	Office Clerks, General	-2.6	ns	*
	First-Line Supervisors of Office and Administrative Support Workers	-2.6	ns	*
	Office and Administrative Support Workers, All Other	-2.3	ns	*
	Stock Clerks and Order Fillers	3.0	ns	**
Personal Care and Service Occupations	Tour Guides and Escorts	2.3	ns	*
Production Occupations	Industrial Production Managers	-6.5	****	****
	First-Line Supervisors of Production and Operating Workers	-5.5	****	****
	Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	-4.7	***	****
	Butchers and Meat Cutters	-3.2	ns	**
	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	-3.0	ns	**
	Cooling and Freezing Equipment Operators and Tenders	-2.9	ns	**
	Food Batchmakers	2.0	ns	*
	Bakers	2.8	ns	**
Sales and Related Occupations	Retail Salespersons	7.1	****	****
	Sales Managers	-6.1	****	****
	Cashiers	4.2	**	****
	Demonstrators and Product Promoters	3.3	ns	***
	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	-3.3	ns	***
	Advertising and Promotions Managers	-2.7	ns	**
Transportation and Material Moving Occupations	Transportation, Storage, and Distribution Managers	-6.6	****	****
	Driver/Sales Workers	4.7	***	****
	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	-3.6	*	***

Packers and Packagers, Hand	3.0	ns	**
First-Line Supervisors of Material-Moving Machine and Vehicle Operators	-2.9	ns	**

Table of statistically significant detailed occupation groups, accounting for local labor market variation. Only showing significant results for Detailed SOCs with at least 15 observations in each local labor market cluster.
** = p< 0.05*
*** = p< 0.01*
**** = p< 0.001*
***** = p< 0.0001*
ns = not significant

Discussion

There is a wide range of occupations in demand in AFS; occupations engaged directly in the food system included farming, food production, and food service roles, while other occupations enabled food businesses to function, including sales and business and financial operations roles. At a national level, another living wage comparison (aside from this one) is not available. However, one case study in Seattle in 2011 by the Regional Food Policy Council found that 20% of non-farm food system workers earn a living wage, meaning that AFS living wage attainment rates, though low, would pose a significant improvement. This study finds more mixed results when considering job quality at the Detailed SOC level. Higher price-points and margins in industries experiencing considerable labor demand, like food service, may translate to higher wages. Indeed, entry-level Detailed SOCs in foodservice and retail outperformed their local labor markets. However, some of these signals are mixed, as occupations that are competitive in their local labor markets still struggle to achieve living wages, suggesting more will be needed in the way of institutional action and coordination if we want to get there

Foodservice occupations comprised the largest proportion of labor demand. While potentially reflecting high turnover, this is consistent with research showing service occupations accounting for a large proportion of recent job growth (Grimes, Prime, & Walker, 2019). Though they sometimes struggle with higher transaction costs and establishing stable supplies,

restaurants may be well-suited AFS buyers. Chef-driven restaurants change their menus frequently, and chefs are comfortable using difficult to cook, more expensive, or less well-known items. In addition to higher margins in restaurants, prices for locally branded food are also higher (Jayaraman, 2014; The Food Industry Association, 2021).

Reliance on higher margins in foodservice seems to have translated to higher wages. Wages in entry-level roles (i.e., Food Preparation Workers, Servers, and Counter Attendants) and more senior positions (i.e., Chefs, Cooks) in AFS saw higher wage distributions than all industries. One reason wages may be higher is "locally sourced" food restaurants tend to be higher-end restaurants, garnering higher prices.

Competitive entry-level wages also exist for a few retail roles, Delivery Drivers, Packers, and Order Fillers, while their supervisors were offered wages below the local labor market. Distinct from foodservice, where all occupations seemed to benefit, wage compression between entry-level and senior roles appears to be present. This could be a positive sign in that it signals a more equitable distribution of wages among workers, but it could also negatively affect career paths.

In light of these competitive wages for foodservice and sales roles, AFS seems to have done a good job raising wages in some of the most common occupations – a very positive sign. These higher prices may "lift all boats" or may reflect more equitably shared profits among workers. This is a potential area for future research. However, these positive signs come with asterisks. Many of the "competitive" jobs in foodservice and retail are not meeting living wage standards. Only half of these jobs offered living wages, meaning wage gains secured through higher margins and higher price points are marginal. In addition, this may show that AFS are overly reliant on higher price points and margins. Foodservice in AFS tends to cater to higher-

income folks who can dine out. Similarly, the high levels of labor demand and relatively high wages for retail sales roles point to a reliance on direct-to-consumer sales, which also cater to wealthier individuals. Focusing on individual consumption patterns, especially only wealthy individual consumption habits, was not enough to regularly shift wage compensation above living wages even in the small subset of roles that experienced benefits; it will not lead to wage enhancement across the food system.

This problem is starkly depicted when considering wages for farming occupations. Labor demand for farming occupations was 10.2% of TLD, the third-largest occupation category. This level of demand in AFS stems from several factors. First, AFS farming practices are labor-intensive (Bauman, Thilmany McFadden, & Jablonski, 2018; Weil, Silva, Hendrickson, & Mitchell, 2017; Ahearn, Liang, & Goetz, 2018). Second, there is a national labor shortage for farmworkers, which may be related to the concurrent increase in the number of small and medium-sized farms and their sales (United States Department of Agriculture, 2020) (Hoppe, MacDonald, & Korb, 2010). Increased demand has translated into increased wages for Farmworkers and Laborers (Crop, Nursery, and Greenhouse), whose wages rose faster than inflation. This trend is consistent with USDA data documenting similar trends (Zahniser, Taylor, Hertz, & Charlton, 2018).

Despite these positive signs and increased prices seen in foodservice and retail settings, all farming Detailed SOCs underperformed compared to their local labor markets. Though this comparison is for occupations and not for industries, the specificity of farm work means that AFS jobs likely do not compensate as well as similar jobs in industrial agriculture. This finding is consistent with the literature, which sees larger farms as more able to provide stable wages and benefits for their "on the books" roles. They are more likely to be required to report and follow

labor regulations (Lo & Delwiche, 2016). Consumer food prices would need to increase dramatically for farmworkers to see a substantial wage increase. Costa and Martin (2020) found that farmworkers earn just $0.10 for every food dollar spent in the United States "even though most, and in some cases all, of the work it takes to prepare fresh fruits and vegetables for retail sale takes place on farms." Simply put, too little of our food dollars reach farmworkers for a price support alone to fix the structural job quality issues in the food system, particularly for farmworkers.

In addition, the farm-related jobs in this dataset are likely a best-case scenario for labor conditions; the dataset does not capture immigrant labor, unpaid family labor, or internship labor. The USDA estimated that 55,000 non-family workers were employed on small farms in 2020, but "this group has some of the most limited legal protections of any group of workers in the country" (Mock, 2020, 139) and "remain one of the most understudied groups, especially as compared to how much time and attention is spent studying farm business owners" (Arcury & Quandt, 2009, p. 147). Even among farms that are large enough to be adequately regulated, farmworkers are not entitled to overtime pay, unemployment insurance, or disability coverage. Of course, undocumented workers' labor conditions are even worse for undocumented workers (McLaughlin & Weiler, 2017).

Job quality challenges intensify in the context of careers. Managerial jobs struggled to compete in local labor markets, indicating the possibility of low-quality career pathways in AFS. The positive signs in foodservice and retail roles are not enough to entice the visionaries of food system change to continue working in this industry. One example is the current reliance on direct-to-consumer sales avenues. Developing the sales and business skills to make ends meet or scale up are a long-term challenge for AFS (Mock, 2021; Tewari, Kelmenson, Guinn, Cumming,

& Colloredo-Mansfeld, 2018). Ignoring career quality will limit the ability of AFS workers to gain the expertise to develop new production systems and supply chains to support this.

Several trends indicate that larger scaled, systemic change may be in the pipeline but is not fully materialized. A smaller but meaningful number of food production roles indicate some reliance on value-adding and scaled-up production, as does labor demand business and financial operations occupations that support business activities and growth at larger scales. General and Operations Managers and Community and Social Service Occupations reflect different areas of creative development in AFS. The wide-ranging responsibilities of general and operations managers lend themselves to new, small, growing, or evolving spaces and highlight the difficulty of characterizing food systems work that does not follow the Taylorized production strategies of industrialization or industrial agriculture. The predominance of this role reflects the need for someone to work across many areas, often in developing or novel labor structures. Elsewhere, Community and Social Service Specialists reflect the ongoing efforts to advocate and establish alternative systems that may be less conducive to immediate capitalist interventions, though these roles may be experiencing multiple downward wage pressures: from being in the non-profit sector as well as the AFS sector.

What policies can support AFS development and wage equity such that high road development is a possibility? Extending labor protections and wage standards to AFS workers, and farmers and food service workers in particular, is an essential first step (Lester, 2020; Grimes, Prime, & Walker, 2019). As Mock (2020) argues, food systems businesses are not held to the same standards as other businesses. Worker protections could include: unemployment insurance, overtime pay, mandated rest days, safer working conditions, and the ability to unionize. Shifting subsidies away from industrial agriculture to shift away from extreme wage

reduction strategies will support these efforts. Institutions may need to commit to not only buying more AFS products, allowing AFS firms to more quickly achieve scale, but also to integrate wage quality standards into their partnership expectations.

Limitations

There may be biases in terms of who decides to post which job opening on this website. It seems likely that jobs that are difficult to fill will be more likely to result in a job posting on a national website, which costs money to post, than a job that can easily be filled through the local community. Meaning that easily filled jobs from the local labor market may not be included in this dataset, biasing the results away from compensation that is more similar to local labor markets. Difficult-to-fill jobs may be those that require specific skill sets, particularly in rural areas, are underpaid jobs, or have unique requirements (such as living on a farm), among others. Second, there are fewer posts from earlier years when the website was just emerging. Finally, firms may post jobs on this site to capitalize on an employee's "psychic wage," or the benefits they perceive from working in a space they are passionate about, in exchange for a worker willing to stay in a role longer or for a lower wage. This "altruism gap" may thus be showing jobs that are systematically lower than local labor markets precisely because prospective employers are hoping to pay enthusiastic employees less – though this may be a form of bias, it also is a form of explanation for the observed results in this dataset. This bias may also be targeting certain demographics, such as women, or people of color, that may be more inclined to accept a lower paid job. The website was created by two well-educated white women, and this may have impacted how jobs are selected for publication or how they are advertised.

The wage information in this dataset is limited in a few ways. First, only 40% of job openings provided wage information. The data does not include wages for business owners,

including farm owners, nor does it reflect unpaid labor, which is common on farms. Finally, undocumented workers are common on small farms, exempt from many labor protections and data reporting mechanisms (Mock, 2021). Because of these trends, the farm labor patterns shown here are optimistic. Despite this, there are no other data sources on labor in AFS; and this optimistic perspective is a valuable snapshot into work in this space. Second, wages in job postings are job offers, and have not necessarily been filled. These jobs are compared to actual wages of workers in the OES data, so this comparison is not exact. We do not observe any negotiations that may happen through the process of hiring.

In addition, several forms of bias mean the depiction of living wage rates is likely conservative. First, the website hosts screens for job quality, so other (worse) jobs may not have been posted. Second, firms posting job openings are likely to resort to national searches when the job requires higher skill levels or is more difficult to fill – as seen by the high demand for managerial roles (21% of all job openings) – thereby garnering higher wages. Finally, living wages are calculated for a single person without children and will not be enough to sustain larger families.

Lastly, the Wilcoxon signed-rank test uses median hourly wages for each labor market. When using a paired differences test, the median hourly wages value is repeated within each local labor market for a given year. Thus, although the comparison of wages accounts for local labor market conditions, the labor markets are not independent clusters. This bias is less significant in the context of this research problem because independent clustering is typically a problem when only selected clusters are used to generalize to a much larger population. Here, all clusters with fifteen observations are used, so the results are not generalized to other clusters.

Conclusion

There is limited data on labor in AFS, despite several case studies identifying job quality as an issue. This paper narrows this gap by assessing labor demand between 2010-2019 and job quality by analyzing living wage attainment rates local labor market competitiveness.

A wide range of occupations is in demand in AFS, reflecting the myriad ways AFS are already being built. Most jobs are directly engaged in food systems work, though business and support occupations are involved. Optimistically, high labor demand for managers in charge of Major SOC categories shows that many businesses may seek someone to guide the next growth phase, particularly on farms and in production. Reliance on foodservice and retail jobs may be a strategy to anchor profitability that supports other components of AFS development, but also poses questions about whether AFS currently caters too much to high-income customers and individual behavior change without attending to structural deficiencies in the current food system.

In considering living wage tests and local labor market competitiveness together, the potential for high job quality in AFS is mixed. Entry-level jobs in foodservice and retail have a higher floor in AFS compared to the same jobs in other industries. Both entry and senior-level positions in AFS Food Service occupations perform better than their counterparts in other industries, while AFS Sales occupations display signs of wage compression. These patterns are positive signs of enhanced labor equity and may support equity development more broadly. However, these gains should not be overstated, as they are limited to a few roles and have wage levels that are not substantially higher than the base living wage.

For many other important occupations, including farming, food production, business and financial operations, community and social service, and general and operations management,

AFS wages underperform. This includes higher-level management occupations, particularly at new, small, growing, or evolving businesses.

AFS growth is desperately needed to move toward an environmentally secure future. However, the ability to grow and expand this industry should not come at the expense of economic equity. Low wages may undermine industry performance and innovation by creating untenable working conditions and livelihoods. In addition to policies enhancing wages and labor protections, funders and community groups engaged in sustainability in AFS must become advocates (and made accountable) to raising wage standards and working conditions.

CONCLUSION

The provision of food is a basic human need, and current systems of production and distribution do not serve human health and well-being in our communities. Examinations of scaling up alternative food systems are important for shifting this pattern to be more sustainable and more equitable.

This dissertation examines challenges to and from scaling up alternative food systems from three perspectives. First, it examines firm and industry level approaches to scale that both broaden distribution and access of food produced in ways that are consistent with the alternative ethos and communicate those values to consumers in meaningful ways. By developing the concept of *merroir* alongside a larger-scaled values-based supply chain, producers amplify local place-based commitments to sustainable place-making and economic development alongside their efforts to reach consumers across broader geographies. Along the way, lead firms incorporate smaller farms to benefit from their scaled-up infrastructure – a challenging prospect for small farmers in land and sea-based production systems. This case study points to a blended model of the *merroir* and values-based supply chain strategies that is useful for alternative food systems beyond shellfish aquaculture.

Paper II examines the difficulty of discerning potential environmental risks and benefits when alternative food systems are scaled up. At a larger scale, the environmental impacts may be "emergent" and permitting processes to understand the environmental impacts, even for industries known for their sustainability benefits, are difficult to identify and manage. Normative

framings of how humans should interfere with the environment, and at what scale, is a fundamental challenge for permitting agencies. The permitting agency in this paper expanded the number of environmental frames in consideration of environmental impacts in order to accommodate this challenge, shifting from a site-specific permitting process to a social-ecological mindset that accommodates complex and uncertain environmental impacts at multiple geographic and temporal scales. This case study reflects on both the difficulty of this process for scaling up alternative food systems, and future opportunities to better integrate economic activities with sound natural resource management.

Finally, Paper III explores labor quality in alternative food systems. While equity is considered a foundational principle of an alternative food system, research has only begun to apply this to labor quality. This study is the first to document the structure of labor demand in alternative food systems in the United States, and compare compensation levels with local living wages and local labor market compensation benchmarks. The growth of food service and retail jobs is consistent with national trends; there are some bright spots where AFS jobs offer better compensation than those in other industries. There are also signs of occupation growth in areas that will be important for scaling up AFS, such as value-adding and processing roles. However, overall, wages in AFS jobs are less competitive that similar jobs in their local labor markets and many do not offer a living wage. Without policy support to enhance labor conditions, AFS labor quality will not live up to the potential of AFS structural change aspirations.

APPENDIX: PAPER I

Interview Preamble for semi-structured qualitative interviews:
Thank you for taking time out of your schedule to speak with me. Before we get started, I will briefly explain this research study. I am trying to learn about how and why communities are using oyster farming and the evolving roles of oyster farming in building up the local food system, as well as local economies. I am trying to learn what programs and approaches work out best. I am going to ask you about your background in this area, your role/the organization, and its history and challenges, and how things have changed in the industry in general. Participation in this interview is completely voluntary. You can choose not to answer any question and/or end the interview at any time, or re-direct the interview in a direction that feels more comfortable to you. I am here to listen and understand. Do you have any questions or concerns that I can answer? [wait for answer] If you don't have any other questions/concerns, do you agree to participate in this interview?

Table 7. Distribution of Manager Detailed SOCs to the Major SOC groups they manage

Managerial Detailed SOC Name	*Managerial Detailed SOC*	*Number*	*Major SOC Group Managed*	*Major SOC*
Public Relations Managers	11-2032	181	Arts, Design, Entertainment, Sports, and Media Occupations	27-0000
Facilities Managers	11-3013	13	Building and Grounds Cleaning and Maintenance Occupations	37-0000
Property, Real Estate, and Community Association Managers	11-9141	13	Building and Grounds Cleaning and Maintenance Occupations	37-0000
Marketing Managers	11-2021	573	Business and Financial Operations Occupations	13-0000
Fundraising Managers	11-2033	208	Business and Financial Operations Occupations	13-0000
Financial Managers	11-3031	132	Business and Financial Operations Occupations	13-0000
Human Resources Managers	11-3121	92	Business and Financial Operations Occupations	13-0000
Purchasing Managers	11-3061	72	Business and Financial Operations Occupations	13-0000
Training and Development Managers	11-3131	11	Business and Financial Operations Occupations	13-0000
Social and Community Service Managers	11-9151	644	Community and Social Service Occupations	21-0000
Computer and Information Systems Managers	11-3021	26	Computer and Mathematical Occupations	15-0000
Education Administrators, Postsecondary	11-9033	26	Educational Instruction and Library Occupations	25-0000
Education Administrators, Kindergarten through Secondary	11-9032	11	Educational Instruction and Library Occupations	25-0000
Farmers, Ranchers, and Other Agricultural Managers	11-9013	1844	Farming, Fishing, and Forestry Occupations	45-0000
Food Service Managers	11-9051	1243	Food Preparation and Serving Related Occupations	35-0000
Administrative Services Managers	11-3012	174	Office and Administrative Support Occupations	43-0000
Personal Service Managers, All Other	11-9179	11	Personal Care and Service Occupations	39-0000
Industrial Production Managers	11-3051	368	Production Occupations	51-0000
Sales Managers	11-2022	764	Sales and Related Occupations	41-0000

Advertising and Promotions Managers	11-2011	41	Sales and Related Occupations	41-0000
Transportation, Storage, and Distribution Managers	11-3071	373	Transportation and Material Moving Occupations	53-0000
General and Operations Managers	11-1021	1058	*	11-0000
Chief Executives	11-1011	386	*	11-0000

Table 8. Results will present managers with the Major SOC group they manage, i.e. Food Service Managers will be presented with the Major SOC Group Food Preparation and Service Occupations, even though Food Service Managers are a Detailed SOC within the Manager Major SOC.

Figure 10. AFS Job Postings by Major SOC Group by Year

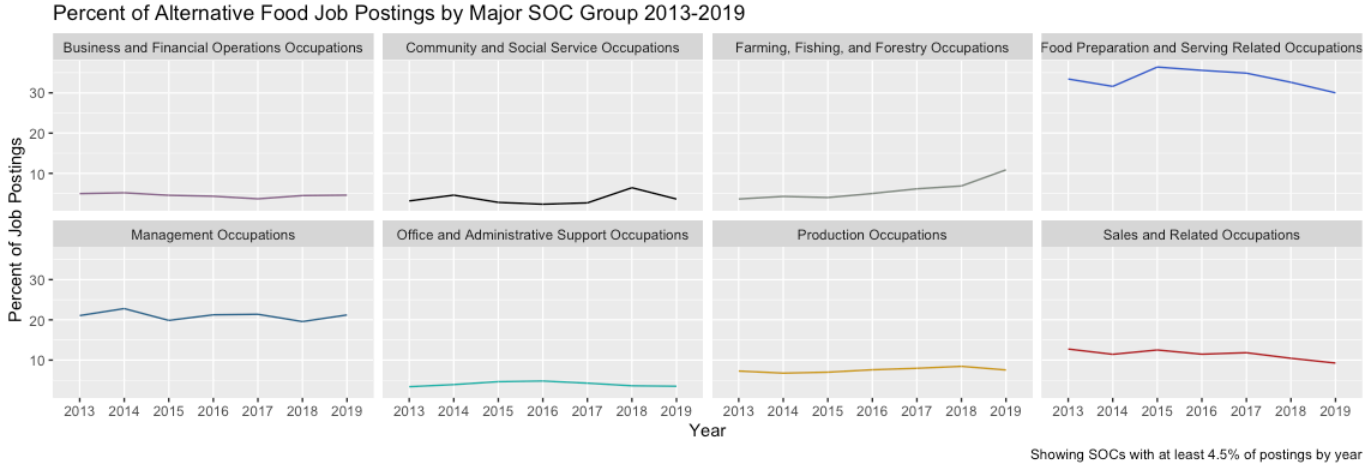


Figure 11. AFS Manager Postings by year and Major SOC Group 2011-2019

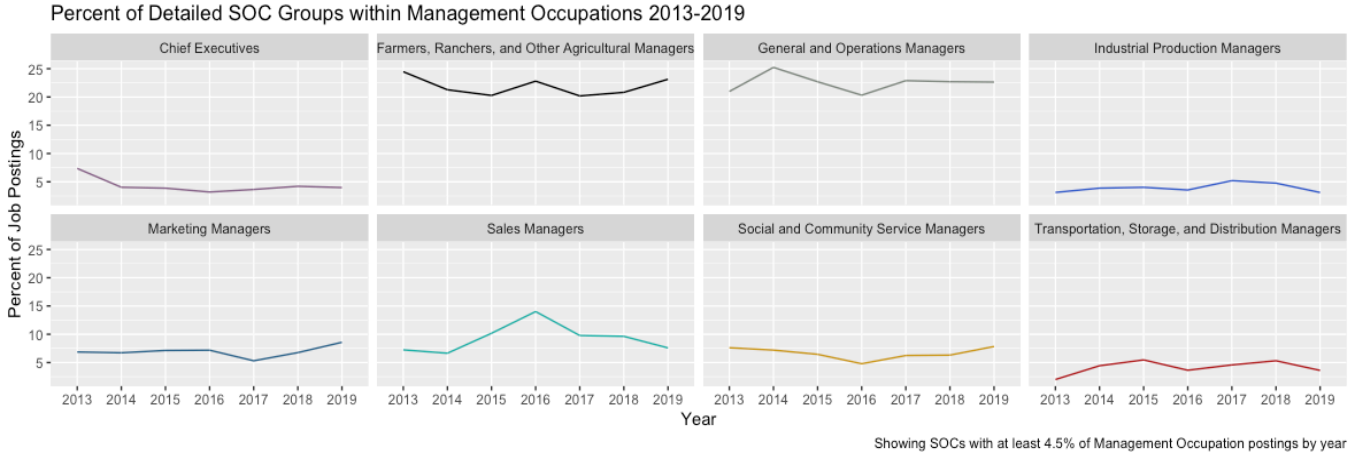


Table 8. Kolmogorov-Smirnov one-sample test results.

Variable	*Test results*
Hourly	D = 0.99661, p-value < 0.001
Log(hourly)	D = 0.95154, p-value < 0.001
Hourly-median	D = 0.44378, p-value < 0.001
Hourly - mean	D = 0.50631, p-value < 0.001
Log median diff	D = 0.26188, p-value < 0.001
Log mean diff	D = 0.29021, p-value < 0.001

A nonparametric test was selected because the differences between AFS hourly compensation and median hourly compensation did not follow a normal distribution, despite several possible transformations, according to the results of a Kolmogorov-Smirnov one-sample test (two-sided, DF = 15,088, p = .001). A nonparametric test is needed because hourly wages, as well as differences between hourly wages and comparison groups, did not follow normal distributions. Their logarithmic transformations did not follow normal distributions either. The Shapiro-wilk test for normality was not used because of the sample size constraints for that test.

Table 9: Labor Markets

Labor Market	**Jobs**	**State(s)**
Anchorage, AK	11	AK
Alaska nonmetropolitan area	7	AK
Balance of Alaska nonmetropolitan area aka Railbelt / Southwest Alaska nonmetropolitan area	3	AK
Southeast Alaska nonmetropolitan area	2	AK
Fairbanks, AK	1	AK
Birmingham-Hoover, AL	61	AL
Tuscaloosa, AL	25	AL
Montgomery, AL	5	AL
Huntsville, AL	3	AL
Northeast Alabama nonmetropolitan area	3	AL
Northwest Alabama nonmetropolitan area	2	AL
Southwest Alabama nonmetropolitan area	2	AL
Auburn-Opelika, AL	1	AL
Decatur, AL	1	AL
Dothan, AL	1	AL
Florence-Muscle Shoals, AL	1	AL
Memphis, TN-MS-AR	35	AR, MS, TN
Fayetteville-Springdale-Rogers, AR-MO	30	AR
Little Rock-North Little Rock-Conway, AR	13	AR
Springfield, MO	9	MO
Fort Smith, AR-OK	7	AR, OK
Central Arkansas nonmetropolitan area aka North Arkansas nonmetropolitan area	6	AR
East Arkansas nonmetropolitan area	5	AR

South Arkansas nonmetropolitan area	1	AR
Phoenix-Mesa-Glendale, AZ aka Phoenix-Mesa-Scottsdale, AZ	74	AZ
Tucson, AZ	19	AZ
Prescott, AZ	7	AZ
Flagstaff, AZ	5	AZ
Southeast Arizona nonmetropolitan area	3	AZ
Arizona nonmetropolitan area	2	AZ
San Francisco-Oakland-Hayward, CA	3945	CA
Los Angeles-Long Beach-Anaheim, CA	1011	CA
Santa Rosa-Petaluma, CA aka Santa Rosa, CA	405	CA
San Jose-Sunnyvale-Santa Clara, CA	289	CA
San Diego-Carlsbad-San Marcos, CA aka San Diego-Carlsbad, CA	151	CA
Santa Cruz-Watsonville, CA	146	CA
Sacramento--Arden-Arcade--Roseville, CA aka Sacramento--Roseville--Arden-Arcade, CA	129	CA
North Coast Region of California nonmetropolitan area	121	CA
Napa, CA	119	CA
Salinas, CA	83	CA
Northern Mountains Region of California nonmetropolitan area	39	CA
Oxnard-Thousand Oaks-Ventura, CA	39	CA
Santa Barbara-Santa Maria-Goleta, CA aka Santa Maria-Santa Barbara, CA	39	CA
Riverside-San Bernardino-Ontario, CA	17	CA
Chico, CA	15	CA
North Valley Region of California nonmetropolitan area aka North Valley-Northern Mountains Region of California nonmetropolitan area	15	CA
Vallejo-Fairfield, CA	13	CA
Fresno, CA	11	CA
Bakersfield-Delano, CA aka Bakersfield, CA	9	CA
San Luis Obispo-Paso Robles-Arroyo Grande, CA aka San Luis Obispo-Paso Robles, CA	9	CA
Eastern Sierra Region of California nonmetropolitan area aka Eastern Sierra-Mother Lode Region of California nonmetropolitan area aka Mother Lode Region of California nonmetropolitan area	7	CA
Yuba City, CA	3	CA
Stockton-Lodi, CA	2	CA
El Centro, CA	1	CA
Modesto, CA	1	CA
Visalia-Porterville, CA	1	CA
Denver-Aurora-Broomfield, CO aka Denver-Aurora-Lakewood, CO	254	CO
Boulder, CO	163	CO

Southwest Colorado nonmetropolitan area aka Western Colorado nonmetropolitan area	58	CO
North Central Colorado nonmetropolitan area aka Northwest Colorado nonmetropolitan area	30	CO
Fort Collins-Loveland, CO aka Fort Collins, CO	22	CO
Eastern and Southern Colorado nonmetropolitan area	13	CO
Colorado Springs, CO	4	CO
Greeley, CO	4	CO
Central Colorado nonmetropolitan area	1	CO
Grand Junction, CO	1	CO
Bridgeport-Stamford-Norwalk, CT	232	CT
Connecticut nonmetropolitan area aka Northwestern Connecticut nonmetropolitan area	130	CT
Worcester, MA-CT	92	CT, MA
Capital/Northern New York nonmetropolitan area	80	CT, NY
Hartford-West Hartford-East Hartford, CT	79	CT
New Haven, CT	68	CT, NY
Norwich-New London-Westerly, CT-RI aka Norwich-New London, CT-RI	57	CT, RI
Eastern Connecticut nonmetropolitan area	1	CT
Salisbury, MD aka Salisbury, MD-DE	8	DE, MD
Sussex County, Delaware nonmetropolitan area	2	DE
Dover, DE	1	DE
Miami-Fort Lauderdale-West Palm Beach, FL aka Miami-Fort Lauderdale-Pompano Beach, FL	72	FL
North Port-Bradenton-Sarasota, FL aka North Port-Sarasota-Bradenton, FL	21	FL
Gainesville, FL	16	FL
Tampa-St. Petersburg-Clearwater, FL	13	FL
Jacksonville, FL	12	FL
Orlando-Kissimmee-Sanford, FL	8	FL
Cape Coral-Fort Myers, FL	5	FL
Tallahassee, FL	5	FL
Naples-Immokalee-Marco Island, FL aka Naples-Marco Island, FL	2	FL
North Florida nonmetropolitan area	2	FL
Port St. Lucie, FL	2	FL
South Florida nonmetropolitan area	2	FL
Deltona-Daytona Beach-Ormond Beach, FL	1	FL
Lakeland-Winter Haven, FL	1	FL
Northeast Florida nonmetropolitan area	1	FL
Pensacola-Ferry Pass-Brent, FL	1	FL
Atlanta-Sandy Springs-Marietta, GA aka Atlanta-Sandy Springs-Roswell, GA	580	GA

Athens-Clarke County, GA	50	GA
North Georgia nonmetropolitan area	34	GA
Savannah, GA	29	GA
Brunswick, GA	28	GA
South Georgia nonmetropolitan area	23	GA
Middle Georgia nonmetropolitan area	11	GA
East Georgia nonmetropolitan area	6	GA
Augusta-Richmond County, GA-SC	4	GA
Columbus, GA-AL	2	GA, AL
Gainesville, GA	1	GA
Macon, GA	1	GA
Valdosta, GA	1	GA
Warner Robins, GA	1	GA
Hawaii / Kauai nonmetropolitan area aka Hawaii / Maui / Kauai nonmetropolitan area	38	HI
Honolulu, HI aka Urban Honolulu, HI	7	HI
Kahului-Wailuku-Lahaina, HI	7	HI
Northeast Iowa nonmetropolitan area	41	IA
Ames, IA	13	IA
Iowa City, IA	9	IA
Southeast Iowa nonmetropolitan area	9	IA
Cedar Rapids, IA	8	IA
Davenport-Moline-Rock Island, IA-IL	4	IA, IL
Waterloo-Cedar Falls, IA	3	IA
Dubuque, IA	2	IA
Northwest Iowa nonmetropolitan area	2	IA
Southwest Iowa nonmetropolitan area	1	IA
Boise City-Nampa, ID aka Boise City, ID	15	ID
East Idaho nonmetropolitan area aka Southeast Idaho nonmetropolitan area	6	ID
Northwestern Idaho nonmetropolitan area	4	ID
South Central Idaho nonmetropolitan area	3	ID
North Idaho nonmetropolitan area aka Panhandle of Idaho nonmetropolitan area	2	ID
Southeast-Central Idaho nonmetropolitan area	2	ID
Southwest Idaho nonmetropolitan area	1	ID
Chicago-Naperville-Elgin, IL-IN-WI	730	IL, IN, WI
St. Louis, MO-IL	89	IL, MO
Champaign-Urbana, IL	26	IL
Northwest Illinois nonmetropolitan area	12	IL
Rockford, IL	8	IL

West Central Illinois nonmetropolitan area	8	IL
Danville, IL	3	IL
Springfield, IL	3	IL
Bloomington, IL	2	IL
East Central Illinois nonmetropolitan area	1	IL
Peoria, IL	1	IL
Indianapolis-Carmel-Anderson, IN aka Indianapolis-Carmel, IN	61	IN
Louisville-Jefferson County, KY-IN	29	IN, KY
Southern Indiana nonmetropolitan area	20	IN
Central Indiana nonmetropolitan area	6	IN
Bloomington, IN	3	IN
Evansville, IN-KY	3	IN
Terre Haute, IN	3	IN
Lafayette, IN	2	IN
Northern Indiana nonmetropolitan area	2	IN
Fort Wayne, IN	1	IN
Muncie, IN	1	IN
Kansas City, MO-KS	53	KS, MO
Topeka, KS	8	KS
Kansas nonmetropolitan area	5	KS
Lawrence, KS	3	KS
Southeast Kansas nonmetropolitan area	1	KS
Manhattan, KS	1	KS
Wichita, KS	1	KS
Central Kentucky nonmetropolitan area aka West Central Kentucky nonmetropolitan area	25	KY
Cincinnati-Middletown, OH-KY-IN aka Cincinnati, OH-KY-IN	20	KY, OH, IN
Lexington-Fayette, KY	7	KY
Owensboro, KY	2	KY
South Central Kentucky nonmetropolitan area	2	KY
East Kentucky nonmetropolitan area	1	KY
New Orleans-Metairie-Kenner, LA aka New Orleans-Metairie, LA	112	LA
Alexandria, LA	9	LA
Baton Rouge, LA	3	LA
Monroe, LA	1	LA
Natchitoches nonmetropolitan area	1	LA
Shreveport-Bossier City, LA	1	LA
Boston-Cambridge-Nashua, MA-NH	2187	MA, NH
Providence-Fall River-Warwick, RI-MA aka Providence-Warwick, RI-MA	176	MA, RI
Springfield, MA-CT	168	MA, CT

Pittsfield, MA	158	MA
Nantucket Island and Martha's Vineyard nonmetropolitan area	72	MA
Northwest Massachusetts nonmetropolitan area	43	MA
Barnstable Town, MA	40	MA
Massachusetts nonmetropolitan area	40	MA
Washington-Arlington-Alexandria, DC-VA-MD-WV	1704	DC, VA, MD, WV
Baltimore-Columbia-Towson, MD aka Baltimore-Towson, MD	324	MD
Upper Eastern Shore nonmetropolitan area aka Upper Eastern Shore of Maryland nonmetropolitan area	9	MD
Hagerstown-Martinsburg, MD-WV	4	MD, WV
California-Lexington Park, MD	3	MD
Garrett County, Maryland nonmetropolitan area	2	MD
Cumberland, MD-WV	1	MD, WV
St. Mary's County, Maryland nonmetropolitan area	1	MD
Portland-South Portland-Biddeford, ME aka Portland-South Portland, ME	239	ME
Southwest Maine nonmetropolitan area	214	ME
Northeast Maine nonmetropolitan area	64	ME
Lewiston-Auburn, ME	14	ME
Bangor, ME	13	ME
Detroit-Warren-Dearborn, MI	97	MI
Ann Arbor, MI	69	MI
Northwest Lower Peninsula of Michigan nonmetropolitan area	48	MI
Grand Rapids-Wyoming, MI	33	MI
Lansing-East Lansing, MI	31	MI
Niles-Benton Harbor, MI	16	MI
Balance of Lower Peninsula of Michigan nonmetropolitan area	13	MI
Kalamazoo-Portage, MI	12	MI
Northeast Lower Peninsula of Michigan nonmetropolitan area	8	MI
Battle Creek, MI	5	MI
Holland-Grand Haven, MI	4	MI
Upper Peninsula of Michigan nonmetropolitan area	4	MI
Muskegon-Norton Shores, MI aka Muskegon, MI	3	MI
Flint, MI	1	MI
Midland, MI	1	MI
Monroe, MI	1	MI
Saginaw-Saginaw Township North, MI	1	MI
Minneapolis-St. Paul-Bloomington, MN-WI	456	MN, WI
Southeast Minnesota nonmetropolitan area	56	MN
Rochester, MN	17	MN
Northwest Minnesota nonmetropolitan area	14	MN

Duluth, MN-WI	13	MN
Southwest Minnesota nonmetropolitan area	12	MN
West Central Wisconsin nonmetropolitan area aka Northeastern Wisconsin nonmetropolitan area	11	MN
St. Cloud, MN	8	MN
Mankato-North Mankato, MN	4	MN
Northeast Minnesota nonmetropolitan area	2	MN
Columbia, MO	11	MO
North Missouri nonmetropolitan area	4	MO
Southeast Missouri nonmetropolitan area	4	MO
Central Missouri nonmetropolitan area	3	MO
Northeast Mississippi nonmetropolitan area	18	MS
Jackson, MS	6	MS
Northwest Mississippi nonmetropolitan area	6	MS
Southwest Montana nonmetropolitan area aka Southwestern Montana nonmetropolitan area	42	MT
West Montana nonmetropolitan area aka Western Montana nonmetropolitan area	13	MT
East-Central Montana nonmetropolitan area	8	MT
Billings, MT	7	MT
Missoula, MT	7	MT
Central Montana nonmetropolitan area	2	MT
Great Falls, MT	1	MT
Durham-Chapel Hill, NC	287	NC
Raleigh-Cary, NC aka Raleigh, NC	71	NC
Asheville, NC	49	NC
Charlotte-Concord-Gastonia, NC-SC aka Charlotte-Gastonia-Rock Hill, NC-SC	26	NC, SC
Mountain North Carolina nonmetropolitan area aka Western North Carolina nonmetropolitan area	22	NC
Greensboro-High Point, NC	14	NC
Northeast Coastal North Carolina nonmetropolitan area aka Other North Carolina nonmetropolitan area	7	NC
Winston-Salem, NC	6	NC
Burlington, NC	4	NC
Northeastern North Carolina nonmetropolitan area aka Southeast Coastal North Carolina nonmetropolitan area	4	NC
Wilmington, NC	4	NC
Goldsboro, NC	2	NC
Hickory-Lenoir-Morganton, NC	2	NC
Piedmont North Carolina nonmetropolitan area	2	NC
Myrtle Beach-Conway-North Myrtle Beach, SC-NC	1	NC, SC
Rocky Mount, NC	1	NC

Bismarck, ND	4	ND
East Central North Dakota	2	ND
Fargo, ND-MN	2	ND
Grand Forks, ND-MN	1	ND, NM
West Central North Dakota nonmetropolitan area	1	ND
Omaha-Council Bluffs, NE-IA	16	NE
Central Nebraska nonmetropolitan area	8	NE
Lincoln, NE	7	NE
Northeastern Nebraska nonmetropolitan area	3	NE
South Nebraska nonmetropolitan area	3	NE
Southeastern Nebraska nonmetropolitan area	1	NE
Western Nebraska nonmetropolitan area	1	NE
Northern Vermont nonmetropolitan area	382	NH, VT
Southwestern New Hampshire nonmetropolitan area	46	NH
West Central-Southwest New Hampshire nonmetropolitan area	35	NH
Dover-Durham, NH-ME	34	NH
Central New Hampshire nonmetropolitan area aka Other New Hampshire nonmetropolitan area	32	NH
Manchester, NH	31	NH
West Central New Hampshire nonmetropolitan area	30	NH
Northern New Hampshire nonmetropolitan area	19	NH
Trenton-Ewing, NJ aka Trenton, NJ	107	NJ
Allentown-Bethlehem-Easton, PA-NJ	51	NJ, PA
Ocean City, NJ	11	NJ
Atlantic City-Hammonton, NJ	2	NJ
Albuquerque, NM	37	NM
Santa Fe, NM	26	NM
North and West Central New Mexico nonmetropolitan area	7	NM
Las Cruces, NM	4	NM
Northern New Mexico nonmetropolitan area	4	NM
Eastern New Mexico nonmetropolitan area	2	NM
Southwestern New Mexico nonmetropolitan area	2	NM
Las Vegas-Henderson-Paradise, NV aka Las Vegas-Paradise, NV	22	NV
Reno-Sparks, NV aka Reno, NV	9	NV
South Nevada nonmetropolitan area	2	NV
Carson City, NV	1	NV
Other Nevada nonmetropolitan area	1	NV
New York-Newark-Jersey City, NY-NJ-PA	14042	NJ, NY, PA
Kingston, NY	270	NY
Central East New York nonmetropolitan area	267	NY

East Central New York nonmetropolitan area	251	NY
Albany-Schenectady-Troy, NY	98	NY
Poughkeepsie-Newburgh-Middletown, NY	93	NY
Central New York nonmetropolitan area	76	NY
Buffalo-Cheektowaga-Niagara Falls, NY aka Buffalo-Niagara Falls, NY	46	NY
Rochester, NY	46	NY
Syracuse, NY	40	NY
Ithaca, NY	25	NY
Southwest New York nonmetropolitan area	20	NY
Glens Falls, NY	16	NY
Utica-Rome, NY	11	NY
Binghamton, NY	9	NY
Watertown-Fort Drum, NY	3	NY
Elmira, NY	1	NY
Columbus, OH	58	OH
Cleveland-Elyria-Mentor, OH aka Cleveland-Elyria, OH	29	OH
Akron, OH	12	OH
Wheeling, WV-OH	10	OH, WV
North Northeastern Ohio non-metropolitan area (non-contiguous) aka Other Ohio nonmetropolitan area	8	OH
Youngstown-Warren-Boardman, OH-PA	4	OH
Sandusky, OH	3	OH
Dayton, OH	2	OH
Toledo, OH	2	OH
Mansfield, OH	1	OH
Southern Ohio nonmetropolitan area	1	OH
West Northwestern Ohio nonmetropolitan area	1	OH
Southeast Oklahoma nonmetropolitan area aka Southeastern Oklahoma nonmetropolitan area	3	OK
Tulsa, OK	3	OK
Northeast Oklahoma nonmetropolitan area	1	OK
Oklahoma City, OK	1	OK
Portland-Vancouver-Hillsboro, OR-WA	511	OR, WA
Eugene-Springfield, OR aka Eugene, OR	44	OR
Salem, OR	20	OR
Medford, OR	18	OR
Bend-Redmond, OR aka Bend, OR	16	OR
Corvallis, OR	16	OR
Coast Oregon nonmetropolitan area aka Coastal Oregon nonmetropolitan area	11	OR
Southern Oregon & Linn County nonmetropolitan area	9	OR

Albany, OR	8	OR
Eastern Oregon nonmetropolitan area	8	OR
Central Oregon nonmetropolitan area	5	OR
North Central Oregon nonmetropolitan area	5	OR
North Coast Oregon nonmetropolitan area	3	OR
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	770	DC, PA
Pittsburgh, PA	70	PA
Lancaster, PA	52	PA
State College, PA	37	PA
Reading, PA	24	PA
Northern Pennsylvania nonmetropolitan area aka Northeastern Pennsylvania nonmetropolitan area	22	PA
Harrisburg-Carlisle, PA	16	PA
Southern Pennsylvania nonmetropolitan area	14	PA
East Central Pennsylvania nonmetropolitan area	10	PA
Far Western Pennsylvania nonmetropolitan area aka Western Pennsylvania nonmetropolitan area	9	PA
Chambersburg-Waynesboro, PA	7	PA
East Stroudsburg, PA	7	PA
Gettysburg, PA	7	PA
York-Hanover, PA	7	PA
Scranton--Wilkes-Barre--Hazleton, PA aka Scranton--Wilkes-Barre, PA	5	PA
West Central Pennsylvania nonmetropolitan area	5	PA
Williamsport, PA	3	PA
Bloomsburg-Berwick, PA	1	PA
Lebanon, PA	1	PA
Charleston-North Charleston-Summerville, SC aka Charleston-North Charleston, SC	78	SC
Greenville-Anderson-Mauldin, SC	12	SC
Columbia, SC	3	SC
Hilton Head Island-Bluffton-Beaufort, SC	3	SC
Spartanburg, SC	1	SC
Rapid City, SD	2	SD
Eastern South Dakota nonmetropolitan area	1	SD
Sioux Falls, SD	1	SD
Nashville-Davidson--Murfreesboro--Franklin, TN	66	TN
Knoxville, TN	21	TN
Chattanooga, TN-GA	16	TN, GA
South Central Tennessee nonmetropolitan area	5	TN
Johnson City, TN	4	TN

East Tennessee nonmetropolitan area aka Eastern Tennessee nonmetropolitan area	2	TN
West Tennessee nonmetropolitan area	2	TN
Clarksville, TN-KY	1	TN
North Central Tennessee nonmetropolitan area	1	TN
Austin-Round Rock-San Marcos, TX aka Austin-Round Rock, TX	165	TX
Houston-Sugar Land-Baytown, TX aka Houston-The Woodlands-Sugar Land, TX	85	TX
Dallas-Fort Worth-Arlington, TX	63	TX
San Antonio-New Braunfels, TX	25	TX
McAllen-Edinburg-Mission, TX	8	TX
Central Texas nonmetropolitan area aka Hill Country Region of Texas nonmetropolitan area	4	TX
Brownsville-Harlingen, TX	2	TX
North Central Texas nonmetropolitan area	2	TX
Waco, TX	2	TX
College Station-Bryan, TX	1	TX
Eastern Texas nonmetropolitan area	1	TX
El Paso, TX	1	TX
Tyler, TX	1	TX
Salt Lake City, UT	26	UT
Eastern Utah nonmetropolitan area	18	UT
South Western Utah nonmetropolitan area aka Southwest Utah nonmetropolitan area	9	UT
St. George, UT	6	UT
Wasatch Back nonmetropolitan area	2	UT
Central Utah nonmetropolitan area	1	UT
Richmond, VA	68	VA
Charlottesville, VA	54	VA
Northwest Virginia nonmetropolitan area aka Northwestern Virginia nonmetropolitan area	22	VA
Staunton-Waynesboro, VA	14	VA
Roanoke, VA	11	VA
Blacksburg-Christiansburg-Radford, VA	8	VA
Virginia Beach-Norfolk-Newport News, VA-NC	8	VA
Southside Virginia nonmetropolitan area	7	VA
Harrisonburg, VA	6	VA
Lynchburg, VA	4	VA
Northeast Virginia nonmetropolitan area	2	VA
Winchester, VA-WV	2	VA, WV
Southwestern Virginia nonmetropolitan area	1	VA
Southern Vermont nonmetropolitan area	312	VT

Burlington-South Burlington, VT	272	VT
Seattle-Tacoma-Bellevue, WA	615	WA
Bellingham, WA	55	WA
Mount Vernon-Anacortes, WA	55	WA
Northwest Washington nonmetropolitan area aka Northwestern Washington nonmetropolitan area	52	WA
Western Washington nonmetropolitan area	36	WA
Olympia-Tumwater, WA aka Olympia, WA	29	WA
Bremerton-Silverdale, WA	12	WA
Walla Walla, WA	12	WA
Central Washington nonmetropolitan area	10	WA
Eastern Washington nonmetropolitan area	9	WA
Wenatchee-East Wenatchee, WA aka Wenatchee, WA	8	WA
Yakima, WA	7	WA
Spokane-Spokane Valley, WA aka Spokane, WA	5	WA
Kennewick-Pasco-Richland, WA aka Kennewick-Richland, WA	4	WA
East Washington nonmetropolitan area	2	WA
Southwest Washington nonmetropolitan area	1	WA
Madison, WI	123	WI
Southwestern Wisconsin nonmetropolitan area aka Western Wisconsin nonmetropolitan area	62	WI
Milwaukee-Waukesha-West Allis, WI	57	WI
South Central Wisconsin nonmetropolitan area	37	WI
Eastern Wisconsin nonmetropolitan area aka Northwestern Wisconsin nonmetropolitan area	11	WI
Northern Wisconsin nonmetropolitan area	9	WI
Sheboygan, WI	7	WI
Fond du Lac, WI	5	WI
Green Bay, WI	4	WI
Racine, WI	4	WI
Appleton, WI	2	WI
Eau Claire, WI	1	WI
Janesville-Beloit, WI	1	WI
La Crosse-Onalaska, WI-MN	1	WI
Southern West Virginia nonmetropolitan area	10	WV
North Central West Virginia nonmetropolitan area aka Northern West Virginia nonmetropolitan area	6	WV
Huntington-Ashland, WV-KY-OH	5	WV
Morgantown, WV	3	WV
Charleston, WV	1	WV
Southwest Wyoming nonmetropolitan area aka Southwestern Wyoming nonmetropolitan area	12	WY

Northwestern Wyoming nonmetropolitan area	3	WY
Western Wyoming nonmetropolitan area	3	WY
Eastern Wyoming nonmetropolitan area	2	WY
Central-Southeast Wyoming nonmetropolitan area	1	WY
Cheyenne, WY	1	WY

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