agronomic, and policy barriers. We are studying the barriers, motivations, and enabling conditions that affect the ability of California farmers to use healthy soils practices. We are currently surveying field staff in the Natural Resources Conservation Service, UC Cooperative Extension, and Resource Conservation Districts across California. We will also interview a sample of farmers in the leafy greens, almonds, and strawberry sectors. (2017-2019)

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Photo credit: Patrick Baur

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Collaborating organizations

Regional Conservation Districts of Santa Cruz and Monterey Counties, The Nature Conservancy, Driscoll Strawberry Associates, Inc., Wild Farm Alliance, Organic Farming Research Foundation, California Certified Organic Farmers, Agriculture and Land-Based Training Association, California Farm Bureau Federation, California Department of Food and Agriculture, Community Alliance with Family Farmers, and The Farmers Guild.

Contributing research scientists

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RESEARCH SUMMARY

The Berkeley Food Institute seeks to transform food systems—to promote sustainable and equitable agriculture and expand access to healthy, affordable food. Visit our website to learn more about our full suite of research and programming: food.berkeley.edu.

The Center for Diversified Farming Systems (CDFS) is an interdisciplinary research hub within the Berkeley Food Institute that examines how biological, economic, and cultural diversity affect the productivity, resilience, sustainability, health, and equity of agriculture. With internationally-recognized experts in a broad range of both natural and social sciences, the Center for Diversified Farming Systems is uniquely positioned to rethink agriculture and find solutions to restore ecosystem services, sustain biodiversity, equitably promote farm livelihoods, and ensure food security.

Funding to support interdisciplinary research on farming systems that blends scientific disciplines is essential to the continued sustainability and competitiveness of US agriculture. Findings from the CDFS projects below highlight key linkages among farming practices and behavior, ecosystem services, and agricultural policies that together affect farm outcomes. **By understanding these complex interactions, we can develop more effective policies that support truly sustainable food systems for the benefit of the American people.**

Publications related to these projects and related research by CDFS affiliates can be found on our website: https://food.berkeley.edu/resources/bfi-publications/cdfs-publications/

1. What are the benefits and costs of building diversified farms?

Growing food in ways that promote environmental quality can reduce the need for burdensome, costly

Photo credit: Amber Sciligo

regulations that can hurt both farmers and taxpayers. Farming practices that enhance biodiversity also sustain long-term agricultural productivity. For example, cover cropping, crop rotation, integration of livestock or poultry, and composting promote soil fertility, while floral strips and hedgerows support healthy populations of beneficial insects and pollinators. However, adopting these methods may introduce new costs and challenges for farmers, and these benefits and costs may vary depending on the type of farm.

Our interdisciplinary team worked across 27 organic strawberry farms in California's leading produce growing region, the Central Coast, to investigate:

1. How a range of diversified farming practices affects crop yields, economic performance, and the overall resilience of farm operations
2. How these practices affect beneficial biodiversity and in turn influence soil fertility, crop pollination, pest and disease control, and water and air quality
3. How growers experience these practices, in terms of benefits, costs, and feasibility

For long-term sustainability, farming methods should both protect environmental quality and provide stable income for farmers. More research is needed to understand how such practices, at a range of scales, affect farmer livelihoods and the environment simultaneously.

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The first results from this project revolve around birds. Many farmers value birds because they eat insects that can harm crops. Yet farmers also see birds damage their crops and introduce food safety risks. Our experiments revealed that insect-eating birds saved 3.8% of berries from insect damage, while strawberry-eating birds damaged about 3.2% of berries. This suggests that the benefits and costs of birds were roughly the same in strawberry production. Additionally, farms with more natural habitat were visited by fewer strawberry-eating birds and suffered less crop damage. These findings suggest that policy recommendations intended to reduce bird damage should promote, rather than suppress, natural habitat.

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While further analysis is in progress, this research has also led to a number of new project components, highlighted below.

Photo credit: Amber Sciligo

2. What barriers to land access do beginning organic farmers face?

This research focuses on land access, a key barrier to entry for beginning organic farmers, some of whom are particularly interested in adopting diversified agricultural practices. In particular, the research identifies existing policy misalignments, examining how land access is dependent on social networks and is influenced by sociocultural barriers embedded in the tenant farming system of California. This research also considers questions of farmland tenure and access in relation to mechanisms that hinder or facilitate the adoptions of diversified farming system practices. (Sept 2013 – Dec 2018).

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3. How do new food safety rules affect small farmers, conservation, and farm workers?

Fresh produce has caused deadly outbreaks of foodborne illness in the United States. Federal regulators and food industry leaders have adopted food safety policies to ensure that farmers follow best practices to prevent dangerous human pathogens from contaminating vegetables, fruits, and nuts. While many critical food safety improvements have been made, implementation is progressing unevenly and with unintended, serious economic and environmental consequences. Our case study of the California leafy greens industry shows that pressure to maximize food safety has increased farmer concern for liability risk and overshadowed concern for environmental stewardship and support for family farms, while exacerbating an already challenging farm labor shortage. Ongoing research evaluates the extent to which on-farm food safety practices impact economic and environmental viability, sustainability, and resilience for other crops and growing regions in California. (Sept 2013 – Jan 2019)

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4. Can environmental conservation benefit food safety?

Foodborne illness outbreaks have put in motion system-wide reforms in agriculture that pressure growers to eliminate natural habitat in farmland. We found that habitat removal did not mitigate food safety risk. No pathogen was more prevalent on farms with more surrounding riparian or other natural vegetation. Rather, Salmonella and infectious E. coli increased over time on farms that had cleared natural vegetation in the past. These scientific findings suggest that achieving both food safety and nature conservation goals are possible and current regulations that promote the removal of natural habitat should be reconsidered.

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5. How do pollinators benefit from healthy soils full of microbes?

Healthy soils may be important not only for plant health and crop productivity, but also for pollinator health. This project explores the connection between pollinators and beneficial soil micro-organisms like arbuscular mycorrhizal fungi that are known to enhance the capacity of plants to take up water and nutrients. When plants take up more nutrients and water, their pollen and nectar may be more nutritious and attractive to pollinators. In this case, not only might these plants be important sources of nutrition for pollinators, but they may also receive more pollinator visits, leading to greater crop production. This project compares diversified against monoculture farms in Fresno County, using squash as the focal plant. (June 2017 - Aug 2019)

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6. How do hedgerow plantings influence native pollinator communities and crop pollination?

Working in California's Central Valley, we have found that diverse perennial plantings of native shrubs, forbs, and grasses along the edges of crop fields (or hedgerows) help to conserve native bee and syrphid fly pollinators by bringing back a diverse suite of floral resources into landscapes that are now comprised primarily of monoculture crops. For some crops, adding hedgerows back into the landscape may also help with crop pollination. In general, however, our findings suggest that hedgerows are too small, relative to the large size of the fields needing pollination (30 to 40 acres), to provide sufficient pollinators to improve yields. Our studies show that hedgerows also supply important floral resources for honey bees, so by planting hedgerows, farmers could obtain pollination through a mixture of managed honey bees and native pollinators. Alternatively, to reduce reliance on honey bees, farmers could both plant hedgerows and diversify crop plantings, simultaneously diminishing the demand for pollination services and improving the conditions for native pollinator persistence, such that the native pollinator populations may then suffice. (2006-2018)

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Photo credit: Celeste Ets-Hokin

7. What policy and market barriers are stopping farmers from building healthy soils?

Farmers can adopt an array of healthy soils practices, such as cover cropping, composting, no-till, or rotating crops, that lead to carbon storage in soil, higher/more durable crop yields, better farmer livelihoods, and increased crop quality and nutrition. However, farmers often do not adopt these beneficial methods because of multiple, reinforcing market, knowledge,