



SCOPE OF WORK

Berkeley Food Institute

<http://food.berkeley.edu>

Project Title: Promoting Soil Health Innovations: Barriers, Motivations, Enabling Conditions

Principal Investigator:

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Project Team:

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Postdoctoral Fellow (to be hired)

Other UC Berkeley, UCANR, and UC Davis faculty to be determined and invited

Partners:

Rodd Kelsey, The Nature Conservancy

Sasha Gennet, The Nature Conservancy

Renata Brillinger, CalCan - to be invited

Amrith Gunesakara, CDFR - to be invited

Others TBD (will include farmer groups of different kinds)

Abstract

In California and nationally, there is currently a great interest in “soil health”, promoted by major droughts and deluges that have afflicted California and other parts of the country in recent years. BFI will draw on this growing interest to develop innovative policy analysis and recommendations to support diversified farming systems. Over 1.5 years, BFI will conduct a comprehensive analysis of the barriers, motivations, enabling conditions and innovations that affect the ability of farmers in California to implement diversified and agroecological farming practices that advance beneficial soil health outcomes. To accomplish this goal, BFI will (1) review social science and grey literature, (2) survey UC Cooperative Extension and RCD personnel, and (3) supplement this survey with interviews of a sample of farmers representing different crops and soil regions across California. Throughout the project, BFI will convene partners and key stakeholders to obtain input on the project, stay abreast of related, complementary efforts, and best position the results of the project to influence state and federal policy.

Outputs will include a synthesis report, policy briefs, cost-return studies, and information aimed at legislators, government policy-makers, and agricultural industry actors.

Project Description

Background. Diversified farming systems (DFS) use a suite of agricultural practices and innovations to promote beneficial agrobiodiversity, such as soil microbes and macrofauna, pollinators and natural enemies of pest organisms (Kremen and Miles 2012). These organisms supply and regenerate critical ecosystem services within the agroecosystem, like soil nutrient capture and delivery, carbon sequestration, water capture and storage in soils, and pollination and pest control. Many of these ecosystem services function through soils, including soil biota and soil organic matter. The integrative concept of “soil health” highlights soil as an important part of agroecosystems. Many soil health practices have been shown through scientific research and farmer observations to enhance soils. These practices include polyculture, crop rotation diversification, cover cropping, no or minimal till, organic matter inputs like green manuring and composting, and insectary strips. Adopting such practices can enable farmers to use ecosystem services to manage key farm processes, avoid chemical inputs, and increase agrobiodiversity. Simultaneously, the practices may contribute to production improvements such as better crop quality and higher nutrition value (Ahmed and Stepp 2016); in many cases, they can improve yields, or maintain yields through times of environmental stresses such as drought and storms (Morris and Buccini 2016; Carlisle 2016; Liebman and Schulte 2015). As a result, adopting soil health practices can lead to favorable economic outcomes for farmers, including fewer production costs and perhaps higher crop prices.

Recognizing these potential ecological, health, and economic benefits, some producers throughout the US (though a minority) have adopted agricultural practices for soil management and agroecosystems, with successful outcomes. Organic agriculture exemplifies this, as does the use of innovative methods based on agroecological principles. However, such beneficial techniques are often not adopted by farmers because of multiple, reinforcing market, knowledge, agronomic, environmental, and policy barriers (Iles and Marsh 2012; Carlisle 2016). Farming methods that enhance soils require knowledge and skills that take time to develop, may entail costly risks during early implementation, and/or may not be economically competitive in the market vis-à-vis conventional farming approaches. For example, food companies and retailers may engage in supply chain practices (e.g., contract growing and produce specifications) that deter farmers from diversifying their crops and nurturing agrobiodiversity. Consumer preference or demand may also play a key role. Due to the prevalence of high-value fresh fruits and vegetables, high land prices, and reliance on irrigation, farmers in California may face additional challenges relative to commodity producers in other regions. Drought years and reduced irrigation supplies may deter farmers from growing cover crops or less profitable cash crops in rotation, while food safety regulations may undermine farm and landscape diversity.

Government policies and incentives often do not sufficiently recognize these challenges nor help farmers overcome them. Policies may also create further barriers through, for instance, crop insurance and price support schemes that discourage diversification. Several federal and California government agri-conservation programs have contributed to the growing uptake of diversified farming and soil health practices. These programs include the Environmental Quality Incentive Program (EQIP), Conservation Reserve Program (CRP), and Conservation Innovation Program (CIP) at the USDA’s Natural Resources Conservation Service. They provide a range of incentives and technical advice to farmers and others who are involved in developing and implementing practices that can enhance soil health, resource conservation, and other diversified farming methods. These programs, however, are ill-resourced and routinely over-subscribed; many farmers in California may not be able to gain access to the resources. It is also unclear whether and how the programs may be influencing farmers to diversify and to successfully protect soils. At state level, the new Healthy Soils Initiative (administered by CDFA) provides incentives

for farmers' adoption of soil health practices and supports demonstration projects. It is too soon to see results from this initiative, as it begins work in summer 2017.

Specific Objectives and Approach: Our objectives are to: (1) build an accurate picture of barriers, motivations, and enabling conditions that affect the ability of California farmers to implement soil health practices; (2) develop policy recommendations for legislators, policy-makers, and key industry representatives at the California and national levels to facilitate adoption of these practices to benefit growers, consumers, and environmental quality; and (3) increase adoption of these practices by communicating to California's farmers and consumers about the benefits of soil health in sustainable agriculture and the role of diversification practices in improving soil health.

In Year 1, between July 2017 and June 2018, BFI will conduct a comprehensive analysis to identify the challenges to and opportunities for adopting soil health practices. BFI will focus survey work strategically on two statewide networks: University of California Cooperative Extension Specialists (UCCE) and county-level Resource Conservation District (RCD) advisers. Each network covers the entire state such that surveys of these specialists and advisers, who serve farmers as their main clientele, will efficiently yield a representative understanding of barriers and opportunities to adoption of soil health practices. These advisers often hold significant but 'hidden' knowledge as part of their ongoing farmer need assessments, their practical experiences, and observations. They work with numerous crop types and growers so they can provide insight on a cross-section of farming activities. The online surveys of RCD and UCCE personnel will elicit their evaluations of whether and how crop type, farm characteristics, land tenure status, agricultural markets, industry supply chains, farmer knowledge, local farming community, land use, agronomic conditions, policy incentives (or lack thereof), and other elements may create barriers to farmers adopting diversified and agroecological innovations for soil health. The surveys will ask about what motivates farmers to adopt soil health practices, as well as what opportunities exist to boost the ability of farmers to do so. This data will be qualitatively and quantitatively analyzed to determine whether statistically significant patterns exist.

These surveys will be complemented with additional surveys and semi-structured interviews targeting a sample of 20-30 growers representing different regions in California (e.g., Central Coast, Central Valley, Imperial Valley), to verify and add to the results obtained via the UCCE and RCD networks. These growers and regions will be chosen according to soil types/regions, crop types, water availability/rights, and marketing mechanisms.¹ A sub-group will comprise growers who have been chosen to receive incentives under the Healthy Soils Initiative, to begin establishing a longer term project to follow the effects of HSI incentives on the uptake of soil health practices.

Also in Year 1, BFI will assess the existing published and grey literature on barriers, motivations, and adoption of diversified farming practices specifically in California--especially those which directly or indirectly benefit soil health. BFI will convene stakeholders and partners as needed to obtain input on the project. BFI has already investigated federal policy barriers to protecting soil health through literature review (Carlisle 2016) and will extend this work to the state level as well as to other types of barriers and opportunities. Any available data on the effect of the Healthy Soils Initiative on farmer adoption and performance will be integrated in (the HSI is only beginning to make incentive payments

¹ The exact criteria for choosing growers to interview will need to be developed in collaboration with the postdoctoral fellow. We may need to target a subset of crops (e.g., leafy greens such as lettuce, nuts such as almonds, fruits such as lemons, tomatoes). Each crop type may have some different reasons for using or not using these practices. It may also make sense to focus on regions that have particularly acute soil health issues (e.g. San Joaquin) or opportunities (places with mollisols, floodplain, or some key soil type).

Synthesis and Outcomes: In Year 2, between July 2018 and December 2018, BFI will synthesize the results of this project and will develop several policy briefs, materials, and presentations based on this work for communicating the results to policy-makers and key industry representatives.

It may also be feasible to pick a small number of growers representing a few crops and clustered in a region, who are willing to share detailed information on their economic costs and returns in adopting diversified farming practices that benefit soil health. These growers would be chosen from within the sample of interviews, once relationships of trust are established. This information would then be combined with the interviews to generate cost return profiles² that are publicly available and that help make the economic case for uptake of diversified farming practices. Cost-return studies are already widely used in California agriculture.

Importantly, BFI will bring together not only the results of this specific project, but of several other related works currently underway through BFI faculty affiliates and BFI partners, including large-scale surveys of barriers and opportunities for adoption of diversification practices for selected commodity crops nationally and in California, a pooled expert assessment of the ecological evidence of the effects of soil health practices for promoting ecosystem services, and other initiatives (see below, Further Details). BFI will also develop communication strategies and materials in tandem with this research to maximize the impact of the results. We will hold stakeholder workshops in California to report on our findings. Overall, federal and state policymakers will be better informed about policy obstacles to, and options for, enhancing soil health through diversification practices on farms.

Staffing: BFI will hire a specialist or postdoctoral fellow to carry out key survey and synthesis activities, manage the project, and collaborate with and convene Berkeley faculty and off-campus partners. The fellow/specialist will be well-versed in social science research methods (especially design and execution of interviews and surveys and analysis of such data), have a strong background in sustainable agriculture or agroecology, or sustainable agricultural economics, and a minimum of one year work experience in project management and other related work experience (e.g. for an NGO, on policy, in government, or for industry). The fellow will report to the Principal Investigator and be housed at BFI. The fellow may convene a team of URAP and graduate student assistants to help with various facets of the project. Further support may be needed for a cost-return study component.

Further Details

Early in Year 1, we will form an advisory group comprised of farmer, key industry, CalCAN, UCCE, and NRCS representatives to provide feedback on the project as it evolves and on findings, cost-returns, and proposed recommendations.

In Year 2, we will turn to developing a “model” policy framework, applicable in California and potentially nationwide, with specific recommendations for policy interventions to overcome barriers and increase opportunities for soil health practices. This framework will include natural and social scientific evidence to support these recommendations, for use in engagement with policy-makers, legislators, and key industry representatives in California.

To help build this framework, we will draw on several companion projects that are happening simultaneously:

² UC Davis gathers and publicizes a large amount of cost-return studies focused on specific crops and regions: <https://coststudies.ucdavis.edu/current/>.

1. **The Conservation Agriculture Evidence project** (The Nature Conservancy + Cambridge University) synthesizes decades of research conducted by UC faculty, UCCE researchers and others, to assess the evidence for or against the merits of specific farming practices in supporting biodiversity and ecosystem services in Mediterranean regions including California. Many of the practices may enhance soil health outcomes. Using the Delphi method, the project is rating the strength of support and the certainty of the evidence for or against these practices, drawing on the expertise of a wide range of scientists. The project should be completed, and the findings added to the Conservation Evidence [web site](#), by the end of 2017. This project will also provide a formal meta-analysis of the ecosystem service benefits of reduced tillage, cover cropping, and organic soil amendments in particular.
 - a. *This project will provide important ecological evidence for particular management practices not just for soil health outcomes but for agrobiodiversity and ecosystem services outcomes. This evidence will reflect the conditions of California.*
2. **Socio-economic surveys of diversification practices** for strawberry in California (UC Berkeley C-DFS) and cole crop growers (Cornell University, UC Berkeley, TNC). The Cornell study will focus on barriers and opportunities. The interviews will be cole crop specific and be limited to California while the survey will be national and cover specialty crops generally.
 - a. *This project will generate important granular evidence for social and economic barriers and opportunities affecting farm diversification more generally.*
3. **Effects of diversification practices on biodiversity and ecosystem services** in Central Coast region of California, and perceptions and experiences of farmers related to these practices (UC Berkeley C-DFS). This in-depth study could provide some specific examples for illustrating benefits of these practices, as well as barriers or opportunities.
 - a. *This project will provide ecological evidence for both specific management practices and diversified farms for agrobiodiversity and ecosystem services outcomes. Some of these data pertain to soil health.*
4. **Healthy Soils Initiative.** Starting in summer 2017, CDFA will make ~ 150 small grants of up to \$25,000 each to farmers across California to provide incentives to undertake NRCS-defined management practices that contribute to soil health while sequestering carbon in soil. These grants are supposed to be combined with NRCS agri-conservation program grants. There will also be a number of demonstration projects carried out by academic, NGO, and industry partners to test various management practices and to gather more scientific data on California-specific conditions. The program is still in development and many management practices remain to be recognized for HSI purposes. HSI may generate data that can inform the development of policy recommendations, though the timing is most likely not compatible with our immediate time frame. BFI's project may in turn help shape the HSI's future funding and growth.
 - a. *This initiative may eventually provide ecological evidence of whether specific farming practices contribute to soil health. It may also constitute an excellent sample of farmers (those who apply for incentives) to determine whether incentives may exert a significant impact in the context of many other on-farm and off-farm factors. These farmers may also be studied to understand the barriers and motivations for adopting soil health practices.*
5. **Mechanization Project.** Alastair Iles, Patrick Baur, and several URAP students at UC Berkeley are currently finishing data collection for a project investigating agricultural mechanization in California between 1945 and 1980, in order to identify biological, technical, social, and economic variables that influence whether or not specific crops are successfully mechanized. As part of this project, data is being gathered as to the ways in which mechanization can displace diversified farming and soil health practices, as well as labor.

- a. *Working backwards from this, the project may provide some insights into the role of mechanization as a barrier to the uptake of soil health practices.*
6. **Diversified agroecological practices and soil health study at UC Davis.** Amelie Gaudin is conducting ongoing research into the ecological, soil biota and SOM, and water impacts of adopting certain soil health practices. One of her goals is to determine the specific conditions under which these practices can function most effectively. Gaudin has agreed to share her findings as they emerge.
- a. *This work may add to the information used to establish whether particular farming practices contribute to soil health.*

Citations

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