

# Symposium: Managing Lands in a Changing Climate to Improve Agricultural Resilience, Food Security, and Health

September 10, 2018



## Lightning Talk Abstracts

### 2:30 PM Lightning Talks | Success Stories at the Ag-Food Security Nexus

#### Addressing the 2050 Food Challenge – a Sustainable Solution Must Include Livestock

Frank Mitloehner, PhD, Professor & Air Quality Specialist; Animal Science, UC Davis

By 2050, Earth will be home to 9.5 billion people, a tripled human population during our lifetime. Only 1.8% of the Earth's surface is arable land that can be used for growing crops. A mere 1/3 of all agricultural land is arable (i.e. usable to grow crops), and 2/3 are marginal land that can only be used to graze ruminant livestock due to poor soils or insufficient water availability. In the face of finite resources and a changing climate, we need sustainable and integrated crop & livestock solutions to the 2050 food challenge.

Critics often claim that livestock production is in serious competition for land, water and other resources. However, particularly ruminant livestock act as “upcyclers” in our food system--they consume and use resources of lower value and upgrade them to higher value products such as proteins. For example, while most beef cattle in the United States eat corn-based diets for the last 4 months of their life in feedlots, they spend most of their lives grazing marginal grasslands and eating food humans do not eat. Less than 10% of what US beef cattle consume during their lifetimes, is human-edible-grain. Grasses and hay account for over 80% of their lifetime diet and the remainder includes byproducts from the biofuels, food, and fiber industries.

Livestock production in the US has one of the lowest carbon footprints in the world. The United States' success in this arena lies in the production efficiencies of these commodities. Fewer animals are needed to produce a given quantity of animal protein food: GHG production for that same amount of milk is four times lower for the United States versus the Mexican--and nine times lower than from an Indian cow. Unfortunately, the developing world shows great inefficiencies in livestock production and is responsible for the majority of global livestock GHG for enteric--and manure emissions (80 and 75%), respectively. Progress we have seen in the US over the past 70 plus years, in which the carbon footprint of livestock has shrunk by well over 60%, could be repeated spatially and particularly in developing countries.

Our food, fiber, and biofuel industries are integrated. It's time to abandon reductionist singularly focused approaches and recognize that sustainable solutions are about improving the whole food system and must

include livestock for us to nourish close to 10 billion healthy people in 2050 and preserve the planet for future generations.

## Long-term, large-scale agroecological experiments are unique testbeds for investigating climate change adaptation and mitigation in agriculture

Kate Scow, Professor, Soil Science and Microbial Ecology in the Department of Land, Air and Water Resources, UC Davis and Director of the Russell Ranch Sustainable Agriculture Facility, and Nicole Tautges, Research Manager, Russell Ranch Sustainable Agriculture Facility, UC Davis

California's Mediterranean agroecosystems, which provide much of the country's fruits and vegetables, are quite vulnerable to climate change, yet also provide opportunities for mitigation measures. Climate-smart management of soil and water can greatly increase the resilience of row crop systems to drought, high temperature extremes, and climate unpredictability, while providing ecosystem services and other benefits to support agricultural sustainability. Long-term, large-scale, replicated ecological experiments provide unique testbeds for investigating questions about climate change adaptation and mitigation over decadal time scales.

At the University of California Davis' Russell Ranch Sustainable Agriculture Facility (RRSAF), the 100--year "Century Experiment" is a farm-scale replicated study of 11 management systems with both row crop (tomato/corn and tomato/corn/alfalfa) and small grains (wheat) based systems, and a native grassland. These farming systems, now in their 25th year of management, differ in their inputs of irrigation water, carbon and fertilizer (particularly nitrogen), and pesticide use. Sustainability is measured based on long-term trends in yield, profitability, efficiency in use of limited resources (such as water or energy), soil health, and environmental impact. Soil management and irrigation are an important focus for developing climate-smart strategies in Mediterranean agroecosystems.

Variation in yields and resilience of corn and tomatoes differ across management systems. Experiments with soil amendments indicate different benefits of adding compost, biochar, cover crops, and/or dairy waste biodigestate in their capacity to increase soil organic carbon, soil aggregate stability, soil biodiversity, and drought resistance. Use of soil and evapotranspiration sensors, as well as imagery and spectroscopy data collected from satellites and drones, can support development and implementation of climate-smart, technology-based monitoring and decision-making tools for irrigation scheduling. Irrigation water inputs can be reduced substantially using deficit irrigation practices in processing tomatoes with increased fruit quality and no reduction in yields. Use of subsurface irrigation in tomatoes can reduce soil greenhouse gas emissions substantially below that in furrow irrigated systems. RRSAF's rich history of data, to be collected for decades to come, will help elucidate some of the mechanisms driving short- and long-term responses to climate change, and provide support for the solutions needed to respond to the agricultural challenges that lie ahead.

## Meadow Restoration as a Strategy to Increase Resiliency for Climate Change

Carrie Monohan Ph.D., The Sierra Fund and California State University, Chico and Cody Reed, University of Nevada, Reno

Meadows unique hydrologic and ecological functions make them vital to watershed health and valued for the ecosystem goods and services they provide. Of the nearly 19,000 meadows in the Sierra Nevada, approximately 60-70% (180,000 – 210,000 acres) have been degraded as a result of land use activities exacerbated by climate events.

In meadows with low levels of disturbance, dense vegetative root mats dissipate high flows throughout the floodplain resulting in extended periods of saturated soil conditions that support hydric plant communities and contribute to late season stream flows. High rates of above- and below-ground vegetative growth

coupled with seasonally low temperatures and anoxic soil conditions lead to high rates of ecosystem carbon (C) sequestration – rates roughly 10 fold higher than surrounding forests and greater than those reported for tropical forests.

Activities, such as overgrazing, and climatological events that destabilize stream banks and increase erosive forces can lead to channel incision and disrupted floodplain hydrology. Stream channel incision allows water to rapidly drain from meadows, increasing the potential for downstream erosion during high flow events and decreasing groundwater storage to sustain late season flows. Increased depth to groundwater following incision leads to changes in vegetative community composition, decreased primary productivity, and aerobic soil conditions. These changes alter ecosystem C dynamics, converting meadows from net C sinks to net sources of C to the atmosphere and creating positive feedbacks for climate change.

Current climate change predictions of increased winter precipitation as rain could accelerate rates of erosion in watersheds rendered vulnerable by historic and ongoing land use activities. Meadow restoration efforts designed to reconnect floodplain hydrology have the potential to revive late season flows and reverse soil C losses. By promoting dispersion throughout the meadow, restoration activities increase the residence time of water within the ecosystem and decrease depth to groundwater. This leads to changes in vegetation community composition, increased rates of primary productivity, and increased soil C sequestration. In their current condition, C losses from degraded Sierra Nevada meadows outpace C sequestration in functioning meadows, leading to regional net C emissions of ~135,000 tons of C annually. Policies designed to preserve hotspots of soil C sequestration and restore degraded meadows with high C losses could increase watershed resilience to climate change.

## **The Bay Area Agriculture and Food Economy: Existing Conditions and Strategies for Resilience**

Sibella Kraus, Director, Sustainable Agriculture Education

The economic viability of agricultural enterprises and of the regional supply chains in which they operate is critical for effectively managing working lands in a changing climate. The white paper, the Bay Area Food Economy: Existing Conditions and Strategies for Resilience, is a first-time quantitative and qualitative analysis of our region's agriculture and food sector. It analyzes the significant contributions that farms and food business make to our region's economic prosperity, environmental sustainability and vibrant cultural life. It also outlines the vulnerabilities and opportunities facing the agriculture and food sector. The white paper concludes by identifying specific strategies, actions, investment needs, and implementation agents necessary to build on the ag and food sector's assets and address its challenges.

The lightning talk will focus on the role and needs of agriculture within the Bay Area food economy and the broader regional resilience framework. Farmland and grazing land account for approximately 40 percent of the region's 4.5 million acres of land, contribute over \$6 billion to the region's economy and provide a foundation for the region's acclaimed food culture. Farmers and ranchers face considerable barriers, such as labor shortages, land conversion and cost, regulatory challenges, insufficient distribution and processing facilities for local markets, and limited land access opportunities for new farmers. They also have new opportunities, particularly in the arena of transitioning to multi-benefit operations that can maximize provision of eco-systems services. It is critical to empower and support farmers and ranchers as front-line land managers in the effort to mitigate, and adapt to, a changing climate.

The Bay Area Food Economy was produced by Sustainable Agriculture Education (SAGE) and American Farmland Trust (AFT). The Association of Bay Area Governments (ABAG) commissioned the white paper as part of its Comprehensive Economic Development Strategy (CEDS) and included agriculture and food related strategies from the white paper in the CEDS Economic Action Plan, formally adopted by the ABAG Board in May. The CEDS and Economic Action Plan documents are part of the region's pending application to establish a Bay Area Economic Development District (EDD), as designated by the U.S. Economic

Development Administration. In order to ensure that the agriculture and food sector will continue to be well represented in EDD implementation and investments, SAGE, AFT, ABAG and other key stakeholders are supporting the development of a dedicated Bay Area Agriculture and Food Economic Development program (BAAFED).

## 4:30 PM Lightning Talks | Success Stories at the Food-Health Nexus

### Healing People, Places, and the Planet

Courtney Crenshaw, CA Regional Coordinator, Healthy Food in Health Care program at Health Care Without Harm

The health care sector is at the frontline of climate change, bearing the costs of increased diseases and more frequent, severe extreme weather events. Health systems are beginning to recognize their contribution to the problem, and health professionals are playing a greater role in driving awareness to the threats that climate change poses to public health.

As anchor institutions and trusted authorities on health and wellness, hospitals have the potential to improve public and environmental health and to strengthen the economic vitality of their communities. They are rooted in place, hold significant investments in real estate and social capital, are among the largest employers in their communities and are often explicitly oriented toward supporting community health in alignment with their healing mission.

Health Care Without Harm (HCWH) empowers and builds capacity within the health sector to leverage its influence and purchasing power to build a sustainable food system that improves public and environmental health. We are focused on three goals that use a regenerative agricultural approach:

- (1) Transition health care food service to a healthier dietary pattern that is less resource intensive, protecting the environment and our finite resources;
- (2) Transform meat production systems away from an industrialized model towards scale appropriate, diversified, ecologically responsible production; and
- (3) Empower health care facilities to employ population health management by building local food systems and creating access and affordability of healthy local food through their investments, purchasing, and operations.

HCWH has worked with the health sector to reduce the amount of meat purchased and served and to increase plant-based protein options. We help baseline their meat purchasing and track their progress towards meat reduction. In the first year 38 hospitals achieved a reduction of over 1 million pounds of beef and poultry collectively. This equates to taking 4500 vehicles off the road or the reduction of 2.3 million gallons of gasoline. In 2016, 57 percent of our network hospitals reported reducing the amount of meat they serve.

HCWH encourages hospitals to look beyond their hospital walls and to support and invest in food and agricultural systems and infrastructure that will create health and wealth in their communities as part of a health prevention strategy. Health is a driver for people to create change and understand the implications for themselves, their families, future generations and the future of our planet.

## Analyzing health, land use and agriculture through a multidisciplinary lens

Federico Castillo, Environmental/Agricultural Economist, Department of Environmental Science, Policy and Management, University of California, Berkeley

The lighting talk discusses two multidisciplinary research projects currently under way that frame issues related to food security, health, land use and climate change as inter-related rather than independent of one another. Both projects are part of the research portfolio of the Planetary Health Center of Expertise (PHCOE), a multi-campus, multidisciplinary research center which is part of the University of California Global Health Initiative (UCGHI). Our research analyzes climate change impacts taking into account the complex interactions between climate and socio-economic variables instead of unidirectional and linear.

The first project, just started and titled “Agricultural Productivity and Worker Health: The Hidden Costs of Heat Waves”, relates agricultural worker health and labor productivity to heat waves occurrence. While most past studies have analyzed the relationship between outdoor temperature and worker health the current project extends the analysis to include heat waves impact on worker productivity. In turn, labor productivity outcomes will be linked to income/earnings with anticipated cascading effects on food security and health. The research component of the project includes data collection at the farm and household levels. This results in a more comprehensive analysis that includes not only the agricultural worker but the household in a more inclusive system.

The second project presented is research undertaken in Oaxaca, Mexico and titled “Ecosystem Based Adaptation to Climate Change by Small Coffee Farmers and Forest Dependent Communities”. We explore how demographic and socio-economic household characteristics as well as farm management practices determine whether or not low income farmers have the capacity to adapt to and minimize climate change impacts without the availability of “high end” technology such as that present in high income regions. We find that small farmers have the capacity to adapt to climate change via marginal changes in farm management practices, especially when there are strong institutional community ties across households. For forest dependent communities we find that common ownership of forest resources provides a safety net for communities to adapt to climate change. Communal land ownership arrangements are not enough to cope with climate change in the region under analysis as we find that household income diversification complements the income generated by forest goods, thus providing a safety net against the negative impacts of a changing climate.

## Urban River Interface Disease

David Wolking, Senior Manager, Global Programs, One Health Institute, UC Davis

More than 50% of the world’s population is living in cities, and rates of urbanization and growth of cities are projected to increase substantially, especially in developing countries. Rapid population growth in areas with high levels of mobility and a lack of urban planning can lead to population densities in areas with an absence of residential and sanitation infrastructure, creating conditions that exacerbate risks for vulnerable communities to natural disasters and facilitate disease transmission.

We selected four disadvantaged and vulnerable urban settlements in the Kathmandu Valley considered at-risk for flood and climate-related disasters and that were considered high-risk for communicable, vector-borne, and zoonotic diseases. All settlements were situated adjacent to urban rivers in riparian zones and along flood plains, a common settlement pattern for vulnerable, displaced, homeless, and economically disadvantaged populations around the world. At the settlements, we trapped wildlife and tested specimens for viral families associated with zoonotic disease risk. To investigate vulnerability, we conducted observational research and key informant interviews and administered a risk factor survey with 264 individuals. There was very little knowledge of zoonotic disease risk in the surveyed communities, though

over 50% of individuals surveyed reported contact with wildlife. Among these respondents, contacts with rodents and shrews represented the majority (91%). We developed a vulnerability index to characterize settlements according environmental, climate, or zoonotic disease risk. Settlements directly adjacent to rivers with temporary structures and uncertain land tenure were at elevated risk for disease transmission and most susceptible to impacts from disasters. The unique ecology and social and behavioral factors at this urban-river interface present planners and the health community with a considerable challenge: how to manage the rapid and unorganized growth of these settlements while promoting health and food security.

Our work signals a need to recognize the role of the environment and wildlife in disease dynamics in these at-risk communities and to incorporate this unique social and urban ecology in urban planning. Additionally, this study reinforces the need to work with community members to develop and implement effective solutions that adequately address the multitude of environmental, ecological, and social challenges that life on the river margins presents.

## Empowering Women Smallholder Farmers in the Sahel

Alisha Graves, President of Venture Strategies for Health and Development and a Founder of the OASIS Initiative (Organizing to Advance Solutions in the Sahel)

The gender gap in agriculture is well documented. This talk will focus on women smallholder farmers in the Sahel, who have less access to land and inputs and low decision making power. This effects their yields and household food security.

The Women's Empowerment in Agriculture Index includes measures related to women's "access to and decision making power over productive resources." However, there is no mention of decision-making over fertility. High fertility poses challenges to food security and nutrition at household and regional levels. This talk will highlight one or two key findings from our baseline survey evaluating empowerment and nutrition among women gardeners and their families in the Zinder region of Niger. The survey was completed by UC Berkeley's OASIS Initiative in late 2017 as part of a Gates Grand Challenge award. Concise recommendations will be made to help empower women smallholder farmers in the Sahel, which may apply to other low-resource contexts.



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