UMassAmherst
Clean Energy Extension

Impacts of Dual-Use Solar on Crop Productivity and the Agricultural Economy

March 2023

With support by the U.S. Department of Energy Solar Energy Technologies Office, the UMass Clean Energy Extension and its University research partners – UMass Extension, UMass Cranberry Station, and the Department of Resource Economics – are evaluating the impacts of dual-use solar, or agrivoltaics (the co-location of solar arrays and agriculture), on crop productivity and the agricultural economy in Massachusetts and beyond**.** The research team is collaborating with the American Farmland Trust, solar developers, and farmers who are implementing agrivoltaic operations at sites around the Commonwealth.

Research Team

UMassAmherst
Clean Energy Extension
Cranberry Station
UMass Extension
Resource Economics
American Farmland Trust

Project Partners and Developers

SolAg
BLUEWAVE
aes
DOER Massachusetts Department of Energy Resources
HYPERION SYSTEMS Harvest the Sun!
PINEGATE RENEWABLES
MDAR
Greenbacker

Project Objectives

We are studying **impacts of agrivoltaic arrays on farming,** including crop productivity, soil health, and cropping practices. Site trial monitoring and measurements will include collection of data on soil moisture, shading, temperature, and agricultural yields. These impacts are studied across diverse farming systems including vegetable crops, grazing, hay, and cranberries, as well as a range of agrivoltaic array designs, including fixed tilt and single-axis tracker layouts, and bi-facial modules. The project is also exploring the **impacts and implications for economic systems**, including on-farm economics, agricultural economies, and the public welfare in Massachusetts and nationally.

Sites and Crops

This research work is supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Solar Energy Technologies Office Award Number DE-EE0009374.

Areas of Study

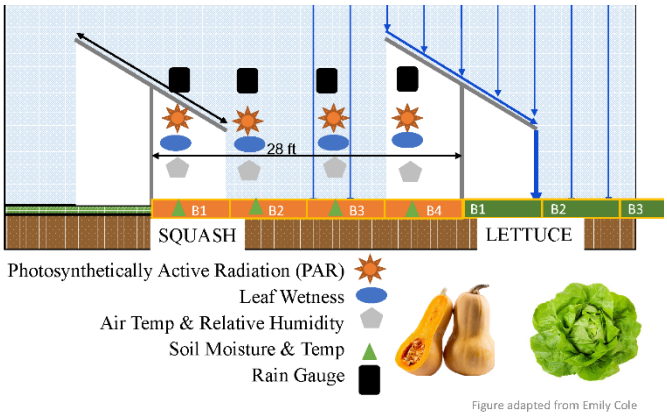

Figure adapted from Emily Cole

Vegetable crops and grazing – soil & microclimate research:

- Soil chemical characteristics
- Soil temperature & moisture
- Soil compaction & health indicators
- Surface vegetation
- Relative humidity & air temperature
- Photosynthetically active radiation (PAR)
- Precipitation

Cranberry research design & data collection:

Experiments will be conducted on two cranberry varieties – 'Stevens' and 'Howes' – and over four shading regimes. Field measurements will include:

- Yield & fruit quality (e.g., color, firmness, size)
- Microclimatic conditions (e.g., rainfall, wind speed)
- Plant ecophysiology & biomass (e.g., light interception)
- Soil compaction and plant nutrient analysis

Economic analysis of agrivoltaic adoption:

- Site trial costs and returns
- Public acceptance
- Farm adoption of agrivoltaics
- Possible effects on agricultural sector

Work to Date

We have prepared research protocols for all sites, taken pre- and post-construction soil samples as available, and demonstrated the field deployment of monitoring equipment. Solar arrays have been constructed on three sites, two in Grafton and one in Monson, with a first year of monitoring. At one of the Grafton sites, we are studying two crops: 1) winter squash, a crop for which the fruit is harvested, requires high energy, and is heat tolerant and sun loving; 2) lettuce, with its leaf and stem harvested, is a less energy intensive crop which is heat sensitive and shade tolerant. The second site in Grafton is a livestock grazing operation, and the site in Monson provides hay. Across the projects, we are studying a range of arrays, with different spacing and shading, as well as both fixed and tracking collectors. In the economic research, we have designed a tool for tracking costs, enabling a comparison of costs for crops grown in a dual use context versus not.

Expected Project Outcomes

The project will continue through March 2025, with collection of agricultural and economic data during the 2023 and 2024 growing seasons. Anticipated outcomes include a significant contribution to the literature on the impact of agrivoltaics on agricultural productivity, particularly as applicable to Massachusetts and to agricultural activities similar to the ones studied. The research will reveal an understanding of the economic impacts of this technology, both on the farm scale and on the level of the agricultural economy. These outcomes will be disseminated, in both general public and research literature, to farming and solar constituencies, to policy makers, and to the agricultural and energy research communities. The project data and analyses will assist farmers, solar developers, and policymakers in making informed decisions. To learn more and stay up to date on the project work, visit our project website linked here.