The Rise of Agrivoltaics

Feb 1, 2023 | Land Use Tradeoffs

These sheep live at the La Ola Solar Farm on Lanai Hawaii. They keep the weeds and grass trimmed in the hard-to-reach places between and under the solar panels. Credit: Merrill Smith via Wikimedia Commons

By Tyler Swanson

Agriculture is a staple of American life. While metropolitan regions exist throughout the nation, it rarely takes more than an hour of driving to find yourself on a road surrounded by fields of grain, livestock, or other commodities that feed and clothe the world. Yet, increasingly, you may find yourself on a similar road surrounded by a field harvesting a far different product: solar energy. At first glance, an environmentally minded traveler may view solar fields as an encouraging sign of a brighter future independent of fossil fuels;

however, this perception misses a critical insight into the tensions and conflicts that went into the conversion of that field from agricultural land to a solar site.

Today, farmers across the United States are faced with a critical choice as globalization and trade disputes cause agricultural commodity prices to fluctuate. Farmers may continue to farm their land as they have for years, possibly generations, in hopes that better days will come. Or instead, they could turn that land over to a solar developer and attain financial security, receiving steady payments for several decades. On the flip side, solar developers are rapidly running out of land to build solar farms and are increasingly turning to farmers for land to rent. Sometimes, the price a solar developer will pay for a farmer's land is too high to refuse. For example, one North Carolina farmer claims to receive between $700 and $1,100 per acre annually from a developer for the right to construct a solar array on the farmer's land. (For comparison, a farmer can generally expect to make $320 an acre planting corn or soybeans.)

The growing demand for solar energy is spurring the conversion of agricultural land usage as state and national policies simultaneously promote renewable energy development to combat climate change. The American Farmland Trust, an organization focused on the conservation of agriculture, estimates that building out the nation's solar energy supply will result in the conversion of nearly 2.1 million acres from agricultural use to utility-scale solar generation in the contiguous United States by 2040. Two million is only a sliver of the nation's nearly 900 million acres of agricultural land, but the conversion of farmland to solar facilities has a significant impact at the local level, where residents hesitate to trade rolling fields and pasture for uniform lines of glaring glass. In some cases, the rapid buildout of solar farms has led to intense public opposition. In 2017, Currituck County, North Carolina, banned solar array construction after growing local opposition to the visual appearance of solar panels; and in 2019,

Oregon prohibited solar development on prime farmland in an effort to protect land for agricultural use.

I spoke with Alexis Pascaris, Director of AgriSolar Consulting, about the issue of solar-agricultural land use tensions. Her work is dedicated to creating synergy between solar energy generation and agriculture. Pascaris explains the plight of rural communities undergoing a transition from agricultural to solar land use:

"(A) lot of my neighbors are grazing cattle, and I love the aesthetic. I think, 'Would I want to see solar panels over the heads of these cows?' … (but) I can only imagine what folks feel who grew up in rural communities whose fathers farmed on this land forever, think about that agricultural heritage. … And then think about telling folks we're gonna transform it, and we're gonna put energy infrastructure on it."

Fortunately, creative scientists have formulated a compromise that may help solve the land-use debate: agrivoltaics.

Defined as the co-location of agricultural production and solar energy generation on the same plot of land, agrivoltaics presents a means to soothe the concerns of rural residents fearful of losing their agricultural heritage while addressing the nation's need for clean energy. This land-use technique has exploded in popularity in recent years as researchers across the country test the technological feasibility of co-locating crop and solar production. The University of Illinois has recently become a leader in agrivoltaics research with the development of the SCAPES (Sustainably Colocating Agricultural and Photovoltaic Electricity Systems) project, an interdisciplinary effort to research agrivoltaics, develop educational materials, and conduct outreach via extension services. Meanwhile, an entire industry has rapidly grown around the principle of grazing livestock on solar sites as a means of vegetation control, a practice aptly named "solar

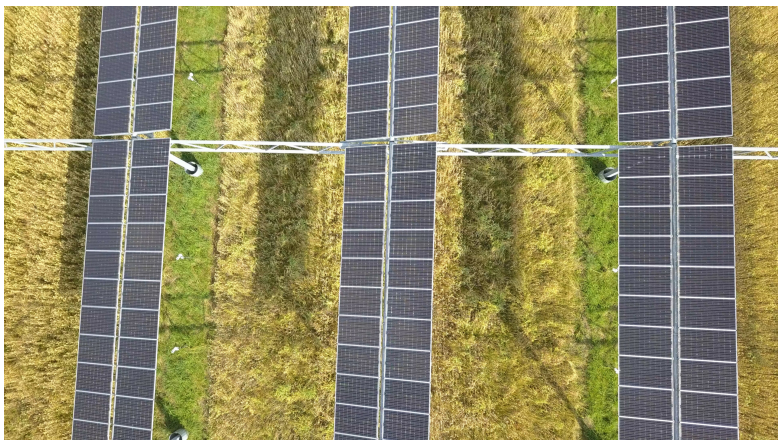
grazing" that ensures the grass and weeds on solar farms do not grow high enough to cast shade on the solar panels.

In an effort to learn more about this budding industry surrounding grazing sheep on solar farms, I scoured the internet for news on the practice, eventually landing upon an article about sheep being contracted to graze the new solar site at Susquehanna University in Pennsylvania. Caroline Owens is one of the hundreds of farmers across the United States engaged in the practice of solar grazing. During a phone interview with Owens, I learned that her experience began in 2019 when Susquehanna University reached out to her with a request to lease her flock of sheep to fill the role of vegetation management for the university's new 14-acre solar site. "The minute I heard about it, I knew it was a good thing … it was a perfect fit," she said. Owens attributes Susquehanna's decision to lease her sheep for the solar farm to her farm's visibility in the community, jokingly referring to herself as "the sheep lady." While humorous, it is also an accurate title. Owens Farm offers farm tours to interested community members and university classes, as well as selling meat and livestock raised on the farm.

Three years after Owens began grazing her sheep on the Susquehanna University solar site, it is evident that the decision has paid off. She collects payments from the university for the vegetation management services the sheep provide and is in talks to expand her solar grazing service to other solar farms, providing Owens Farm with an additional revenue stream. Solar grazing has led Owens to a seat on the Board of Directors of the American Solar Grazing Association, an industry trade organization that serves as a hub for solar grazing education and for connecting farmers and solar developers who want to use solar grazing on their property.

In addition to providing a financial boon for farmers, scholars note the potential solar grazing holds for the broader rural economy. Professors

Nikola Kochendoerfer and Michael L. Thonney of Cornell University project that solar grazing could spark a 14% increase in sheep farms and a 65% increase in the New York sheep flock, generating $5 million to $8 million in tax revenue and increasing lamb sales by $12 million per year. Owens is equally optimistic about the economic benefits of solar grazing. She spoke of the “huge trickle-down effects. People are going to need more of everything, more hay, more feed, more buildings, more border collies, more handling systems. … It’s just a huge opportunity for everything down the line.”



The agrivoltaics pilot plant by Fraunhofer Institute for Solar Energy Systems at the Heggelbach farming community in the south of Germany. Solar modules are mounted 5 to 8 meters above ground with supports spaced in ways that allow the operation of normal farm machines. Credit: Tobi Kellner via Wikimedia Commons

As the solar grazing industry has grown and its economic benefits continue to materialize, a critical question about agrivoltaics remains: Will it resolve the land-use dilemma? The answer may change depending on who you ask. Owens says that the community surrounding the Susquehanna University solar site has come to love the sheep that graze the field. “It really softens the whole industrial look. Having field fencing instead of chain link fencing is one very simple thing. … If it looks like woven wire, it’s the thing they’ve always looked at in rural communities.” She is also confident about the direction of the solar grazing industry and expects to see more and more solar farms with grazing sheep. “I think

these conversations are taking place all over the country. And I think it's going to ramp up quickly."

The concept of agrivoltaics has also gained support among policymakers in recent years. In Massachusetts, the State Department of Energy runs a program that provides monetary compensation for solar developers who build agrivoltaics. Additionally, the U.S. Department of Agriculture awarded a $10 million grant to SCAPES, the U of I-led project that seeks to optimize the design of agrivoltaic systems. The growth of agrivoltaics-related industries and policymaker support is critical to bringing about a solution to the land-use dilemma, but this does not mean agrivoltaics is a panacea that will end all of the contentions around solar siting. Pascaris stresses its situational potential: "I don't think all ag land is going to be agrivoltaics … I think marginal agricultural land can be agrivoltaics, and in places where agriculture is dying and struggling, we can revitalize it with agrivoltaics. I see it in niche applications that create these awesome benefits. … We've got to look to the built environment first: rooftops, car ports, super fund sites, and all that degraded land."

Whether or not agrivoltaics will solve the agricultural-solar land use debate, the concept's growth is undeniable. For example, BlueWave Solar, a Massachusetts-based solar energy development company, has positioned itself as a leader in this space, developing agrivoltaic farms in New Jersey, Maine, and Massachusetts. In Colorado, farmer Bryon Kominek has expanded his family farm into Jack's Solar Garden, home of the Colorado Agrivoltaic Learning Center. The center offers public tours to curious residents and partners with governments and universities to further research the potential of agrivoltaic systems. On the west coast, Solar Oregon, a solar energy advocacy group, organizes public tours of Oregon wineries that feature solar panels in their vineyards, presenting agrivoltaics not just as a novel land-use technique but also as a tourist attraction.

Transitioning from a fossil-fueled to an electrified world presents many novel challenges to society. Chief among these is the question of where to build solar sites and how to develop them in a way that is not destructive to practices as culturally and economically significant as agriculture. Agrivoltaics has presented itself as a partial solution rapidly gaining traction among stakeholders, and the approach provides a lesson to scientists and policymakers pushing the energy transition forward. Achieving a clean energy grid is possible, but it requires that the energy infrastructure be collaborative and not competitive. In its current form, solar energy appears to be the latter, fomenting public opposition as communities fear the loss of their cultural identity. Alternatively, agrivoltaics advocates see the practice as collaborative, an opportunity to advance toward a clean energy grid in a manner that is conscious of the rural identity. Either way, the question of how to sustainably build out a clean energy grid must be solved as the energy transition persists. Agrivoltaics is quickly establishing itself as one partial solution to the problem.

About the Author …

Tyler Swanson is a senior from Pecatonica, Ill. He studies Agricultural & Consumer Economics with a concentration in Environmental Economics & Policy. He is minoring in the Sustainability, Energy, and Environment Fellows Program and Urban Planning. Upon graduating, he hopes to pursue a career in academia.

This article was the feature category winner in the 2022 Janelle Joseph Environmental Writing Contest.

WORKS CITED

Institute for Sustainability, Energy, and Environment (iSEE)

1101 W. Peabody, Suite 350 (NSRC),

MC-635 | Urbana, IL 61801

217-333-4178 | Fax: 217-244-2006

Contact *Q* editors: qmagazineillinois@gmail.com