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Specialty Crop Agrivoltaics in the Southeastern USA: Profitability and the Role of Rural Energy for America Program

Bijesh Mishra, Ruiqing Miao, Ngbede Musa, Dennis Brothers, Madhu Khanna, Adam N. Rabinowitz, Paul Mwebaze, and James McCall

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U.S. solar energy production increased threefold from 2017 to 2022 (Hodge, 2023) as the federal government aimed to achieve carbon-free electricity by 2035 to combat climate change (Mamun et al., 2022; Gomez-Casanovas et al., 2023; U.S. Department of Energy, 2023). Solar energy has been the fastest-growing electric power sector since 2023, with this growth expected to persist through 2025 (Hess and Tsai, 2024). Solar energy production is increasing in cropland areas due to cropland's higher solar potential, flat surface, and proximity to electrical infrastructure (Adeh et al., 2019; Katkar et al., 2021; U.S. Department of Energy, 2023). The solar future study projected that about 10.3 million acres (41,683 km^2) of land would be required for the large-scale electrification and decarbonization of buildings and transportation (Heath et al., 2022). This creates land-use competition between solar energy development and agricultural production, causes community opposition, and delays the development of projects. Collocating solar panels with crops—agrivoltaics (AVs)—is an innovative approach to minimize this competition (Macknick et al., 2022; Pascaris et al., 2022) and increase the efficiency of cropland use (Gomez-Casanovas et al., 2023) while reducing community opposition to traditional solar energy projects (Pascaris et al., 2021).

Despite the higher solar potential, solar energy production is limited in the southeastern region (Sengupta et al., 2018) because of the higher PV installation costs and lower electricity prices. When investing in AV, the southeastern region can benefit from the Rural Energy for America Program (REAP)—a policy designed to support investments in renewable energies made by agricultural producers or rural small business owners (Pascaris, 2021; Steinberg et al., 2023). AVs reduce community opposition to solar energy, minimize land competition between energy and food production, and facilitate solar penetration in the rural United States. Thus, AVs can be a potential option for joint solar energy and food production in the southeastern United States. Economic analyses of AVs in other areas in the United States suggest that AVs increase revenue and profit compared to crops alone (Majumdar and Pasqualetti, 2018; Cuppari, Higgins, and Characklis, 2021). However, the profitability of AV in the southeastern United States is unclear. We aim to fill this gap.

In this article, we examine the profitability of tomato and strawberry agrivoltaics (TAV and SBAV, respectively) and the impact of REAP on AV profitability under various solar panel configurations. We focused on the effects of REAP on AV because producers could benefit from this policy by making energy-efficient improvements, such as AV project development, on their farms. Tomatoes and strawberries are popular crops in the southeastern United States, with economic, social, and cultural significance. Tomato and strawberry producers often diversify their farm operations, connecting the community through agritourism, revitalizing the producer's market and rural economy, creating seasonal jobs, supplying local fresh products, and hosting social events and festivals (Sweet Grown Alabama, 2024; Velasco, 2024). AV adoption enhances farm diversification and generates additional revenue through agritourism, project demonstration, and social events. TAVs and SBAVs have the potential to increase farm profitability while providing access to clean energy and helping to mitigate climate change in this region. Our analysis uses Alabama as a representative state for the southeastern US. In what follows, we will explain the AV configurations, calculation methods, and profit from TAVs and SBAVs. We will further discuss the impact of the REAP on AV farm profit and make policy recommendations.

Method

We calculated the revenue, cost, and profit of TAVs and SBAVs for a hypothetical 1-acre, square-shaped plot in four regions of Alabama. The parameters for the calculation are presented in Table 1. We assumed the number and size of crop plots remain unaffected by PV density—the number of solar panels per acre—because

Table 1. AV System Parameters and Model Specification

System parameters	**Values and units**	**Sources**
Locational parameters		
Northern region zip code	35769	Model specification
Central region zip code	35136	Model specification
Black belt region zip code	35040	Model specification
Southern region zip code	36507	Model specification
PV costs and electricity price		
CAPEX for 4.6 ft fixed open rack panels	$1.59/watt	Horowitz et al. (2020)
CAPEX for 6.4 ft fixed open rack panels	$1.85/watt	Horowitz et al. (2020)
CAPEX for 8.2 ft fixed open rack panels	$2.33/watt	Horowitz et al. (2020)
CAPEX for 4.6 ft single-axis rotating panels	$1.73/watt	Horowitz et al. (2020)
CAPEX for 6.4 ft. single-axis rotating panels	$1.92/watt	Horowitz et al. (2020)
CAPEX for 8.2 ft single-axis rotating panels	$2.11/watt	Horowitz et al. (2020)
Annual operational and maintenance cost (OPEX)	3% of annualized total CAPEX	Model specification
Annual PV insurance cost	0.5% of annualized total CAPEX	Model specification
Electricity price	$0.04/kWh	Model specification
PV configuration		
Total solar panels at 100% PV density	885	Model specification
Panel edge-to-edge distance at 100% PV density	6 ft	Model specification
PV density range	0% to 100%	Model specification
Solar panel length	7.75 ft	Model specification
Solar panel width	3.5 ft	Model specification
Total land (square-shaped)	1 acre	Model specification
Length and width of land	417.42 ft	Model specification
Interest/discount rate	7%	Model specification
Lifespan of PV	25 years	Model specification
Solar panel efficiency	19%	Dobos (2014)
Energy policies		
Renewable energy credit (REC)	$6.6/MWh	Heeter and O'Shaughnessy (2019)
Annual investment tax credit (ITC)	30% of annualized total CAPEX	U.S. Department of Energy (2024)
Rural Energy for America Program (REAP)	25% and 50% of total CAPEX	U.S. Department of Agriculture (2024)
Specialty crop parameters		
Tomato production at benchmark yield	1,360 25-lb cartons/acre	Boswell et al. (2023)
Tomato production cost at benchmark yield	$7,580.62	Boswell et al. (2023)
Tomato harvest labor cost at benchmark yield*	$1,760	Boswell et al. (2023)
Tomato harvest boxes cost at benchmark yield*	$1,700	Boswell et al. (2023)
Tomato marketing cost at benchmark yield*	$2,720	Boswell et al. (2023)
Tomato prices	$17, $20, and $23 per carton	Boswell et al. (2023)
Strawberry production at benchmark yield	3,075 4-quart buckets/acre	Boswell et al. (2023)
Strawberry production cost at benchmark yield	$14,274.34	Boswell et al. (2023)
Strawberry harvest labor cost at benchmark yield*	$996	Boswell et al. (2023)
Strawberry harvest bucket cost at benchmark yield *	$2,460	Boswell et al. (2023)
Strawberry prices	$3, $6, and $9 per bucket	Boswell et al. (2023)
Tomato and strawberry yield range	-50%, 0%, +50% of benchmark yield	Model specification

Notes: Single asterisks (*) indicate that these costs are part of the total production cost of the respective crop. Carton refers to a 25-pound carton and bucket refers to a 4-quart bucket.

Table 2. Profit from TAVs at Benchmark Tomato Yield and Price

Solar Panel Height (ft.) →			4.6	6.4	8.2	4.6	6.4	8.2	4.6	6.4	8.2	4.6	6.4	8.2
REAP	Regions	Array	Profit from TAVs											
50%	North	Fixed	11,869	11,369	10,434	14,865	13,699	11,519	17,862	16,030	12,604	20,860	18,362	13,690
50%	Central	Fixed	12,063	11,563	10,628	15,317	14,151	11,971	18,573	16,741	13,315	21,829	19,331	14,659
50%	Black Belt	Fixed	12,189	11,690	10,755	15,612	14,447	12,266	19,037	17,205	13,779	22,462	19,964	15,292
50%	South	Fixed	12,235	11,736	10,801	15,720	14,554	12,374	19,206	17,374	13,948	22,692	20,194	15,522
50%	North	Tracking	12,368	12,001	11,635	16,031	15,176	14,320	19,695	18,351	17,006	23,359	21,526	19,693
50%	Central	Tracking	12,658	12,292	11,925	16,709	15,853	14,998	20,760	19,415	18,071	24,810	22,977	21,144
50%	Black Belt	Tracking	12,802	12,435	12,068	17,043	16,187	15,332	21,284	19,940	18,596	25,526	23,693	21,860
50%	South	Tracking	12,890	12,523	12,157	17,249	16,393	15,538	21,608	20,264	18,920	25,968	24,135	22,301
25%	North	Fixed	8,572	7,542	5,614	7,174	4,769	272	5,777	1,998	-5,070	4,379	-774	-10,411
25%	Central	Fixed	8,766	7,736	5,808	7,626	5,221	724	6,487	2,709	-4,359	5,349	196	-9,441
25%	Black Belt	Fixed	8,893	7,863	5,935	7,921	5,517	1,019	6,951	3,173	-3,895	5,981	828	-8,809
25%	South	Fixed	8,939	7,909	5,981	8,029	5,624	1,127	7,120	3,341	-3,726	6,212	1,059	-8,578
25%	North	Tracking	8,782	8,026	7,270	7,665	5,900	4,135	6,547	3,774	1,002	5,430	1,649	-2,132
25%	Central	Tracking	9,073	8,316	7,560	8,342	6,577	4,813	7,612	4,839	2,066	6,882	3,100	-681
25%	Black Belt	Tracking	9,216	8,460	7,703	8,676	6,911	5,147	8,137	5,364	2,591	7,597	3,816	35
25%	South	Tracking	9,304	8,548	7,792	8,882	7,118	5,353	8,461	5,688	2,915	8,039	4,258	477

Notes: Profits from TAVs producing 1,360 cartons of tomato per acre (benchmark yield) assuming no yield penalty or benefit from solar crop interactions. Electricity and tomato carton prices are $0.04/kWh and $20 (benchmark price) respectively.

solar panels are mounted on metallic poles at 4.2 feet or higher to accommodate cultural operations and plant maturation height. We excluded land rent, assuming that the producer owns cropland, grows crops, and operates the established AV. We calculated the direct current (DC) system size and total annual energy output at the given PV densities using the PVWatts Calculator (Dobos, 2014; National Renewable Energy Laboratory, 2024), using the exact PV specifications specified in the calculator.

We varied tomato and strawberry yields from a 50% decrease to a 50% increase from their benchmark yields to account for crop yield uncertainty in the AVs because of crop, soil, microclimate, and PV interactions (Mamun et al., 2022; Gomez-Casanovas et al., 2023). Solar panels provide shade to plants, reducing heat, temperature, and water stresses. The interactions among increased disease resistance, improved water use efficiency, reduced sunlight, change in microbial composition, and soil disturbances may increase or

Table 3. Profits from SBAVs at Benchmark Strawberry Yield and Price

Solar Panel Height (ft.) →			4.6	6.4	8.2	4.6	6.4	8.2	4.6	6.4	8.2	4.6	6.4	8.2
REAP	Regions	Array	Profit from SBAVs											
50%	North	Fixed	6,425	5,925	4,991	9,421	8,255	6,075	12,419	10,587	7,160	15,416	12,918	8,246
50%	Central	Fixed	6,619	6,119	5,185	9,873	8,708	6,527	13,130	11,298	7,871	16,386	13,887	9,215
50%	Black Belt	Fixed	6,746	6,246	5,312	10,169	9,003	6,823	13,594	11,762	8,335	17,018	14,520	9,848
50%	South	Fixed	6,792	6,292	5,357	10,276	9,110	6,930	13,762	11,930	8,504	17,249	14,750	10,078
50%	North	Tracking	6,924	6,558	6,191	10,588	9,732	8,877	14,251	12,907	11,563	17,915	16,082	14,249
50%	Central	Tracking	7,215	6,848	6,481	11,265	10,410	9,554	15,316	13,972	12,627	19,367	17,534	15,700
50%	Black Belt	Tracking	7,358	6,991	6,625	11,599	10,743	9,888	15,841	14,496	13,152	20,082	18,249	16,416
50%	South	Tracking	7,446	7,080	6,713	11,805	10,950	10,094	16,165	14,820	13,476	20,524	18,691	16,858
25%	North	Fixed	3,129	2,098	171	1,730	-675	-5,172	333	-3,446	-10,513	-1,064	-6,218	-15,855
25%	Central	Fixed	3,323	2,292	365	2,183	-222	-4,720	1,044	-2,735	-9,802	-95	-5,248	-14,885
25%	Black Belt	Fixed	3,450	2,419	492	2,478	73	-4,424	1,508	-2,271	-9,338	538	-4,615	-14,252
25%	South	Fixed	3,495	2,465	537	2,585	180	-4,317	1,677	-2,102	-9,169	768	-4,385	-14,022
25%	North	Tracking	3,339	2,582	1,826	2,221	456	-1,308	1,104	-1,669	-4,442	-14	-3,795	-7,576
25%	Central	Tracking	3,629	2,873	2,116	2,898	1,134	-631	2,168	-605	-3,378	1,438	-2,343	-6,124
25%	Black Belt	Tracking	3,772	3,016	2,260	3,232	1,468	-297	2,693	-80	-2,853	2,154	-1,628	-5,409
25%	South	Tracking	3,860	3,104	2,348	3,438	1,674	-91	3,017	244	-2,529	2,595	-1,186	-4,967

Note: Profit from SBAV producing 3,075 buckets of strawberries per acre (benchmark yield) assuming no yield penalty or benefit from solar-crop interactions. Electricity and strawberry bucket prices are $0.04/kWh and $6 (benchmark price) respectively.

decrease crop yield and fruit quality (Al-agele et al., 2021; Barron-Gafford et al., 2019; Mamun et al., 2022; Omer et al., 2022; Othman et al., 2020; Walston et al., 2018; Weselek et al., 2021; Willockx et al., 2022). The interactions among crops, PV parameters, soil, and microclimate variation are less understood for tomatoes and strawberries due to the need for more research. We varied harvest, labor, packaging, and marketing costs proportionately with the crop yield from the tomato and strawberry enterprise budgets compiled by the Alabama Co-operative Extension System (Boswell et al., 2023). The budgets do not vary across the state. Thus, we assumed that the cost of crop production and expected yield are constant across the state.

We assume that the producers receive a federal investment tax credit (ITC) and renewable energy credit (REC), and part of the initial capital investment cost (CAPEX) is compensated through REAP within 6 months. We calculated 6 months of simple interest on compensated CAPEX and summed it with the uncompensated portion of the CAPEX as a loan to repay over 25 years. We multiplied annual energy production by the electricity price and subtracted annual PV cost to estimate annual profit from energy production. The total annual cost for the PV includes loan repayment, insurance, and operational and maintenance costs. Finally, we generated all combinations of energy and crop profits and added them to estimate total AV profits. The complete analysis has 814,968 AV combination outcomes for each crop, and each REAP scenario, which can be accessed on GitHub (https://github.com/bijubjs/AVAlabama)

Results

Based on the parameters listed in Table 1, the annual profit from PV alone at 50% REAP and 100% PV density ranges from $4,070 to $16,348 per acre, depending upon electricity price, solar array types, and operation region. At 25% REAP, the loss from PV alone at 100% PV density ranges from $1,580 to $20,030 per acre. The annual profits from tomatoes and strawberries alone under benchmark yield and price from 1 acre of land are $9,619 and $4,176, respectively. In the remaining part of this section, we discuss the profits from TAVs and SBAVs.

Tomato Agrivoltaics System (TAV)

The annual profit from 1,360 cartons of tomato alone produced on 1 acre and sold at $20 per carton is $9,619. When 50% of total PV CAPEX is compensated through the REAP (henceforth, “50% REAP” for 50% compensation; “25% REAP” for 25% compensation), the profits from TAV at benchmark yield and crop price from an acre of land range from $10,434 to $25,968, depending upon PV density, panel heights, array types, and geographical regions (Table 2). At 50% REAP, benchmark yield, and crop price, TAVs are profitable in all scenarios, and the profit increases in PV density. However, at 25% REAP and benchmark yield and price, TAVs are less profitable than tomatoes alone. TAVs become unprofitable throughout the state at 25% REAP, 75% or higher PV density, and fixed panels raised above 8.2 ft. The TAV profit is reduced by 27% to 176% at the benchmark yield and price depending upon PV configuration and location if REAP is reduced from 50% to 25%.

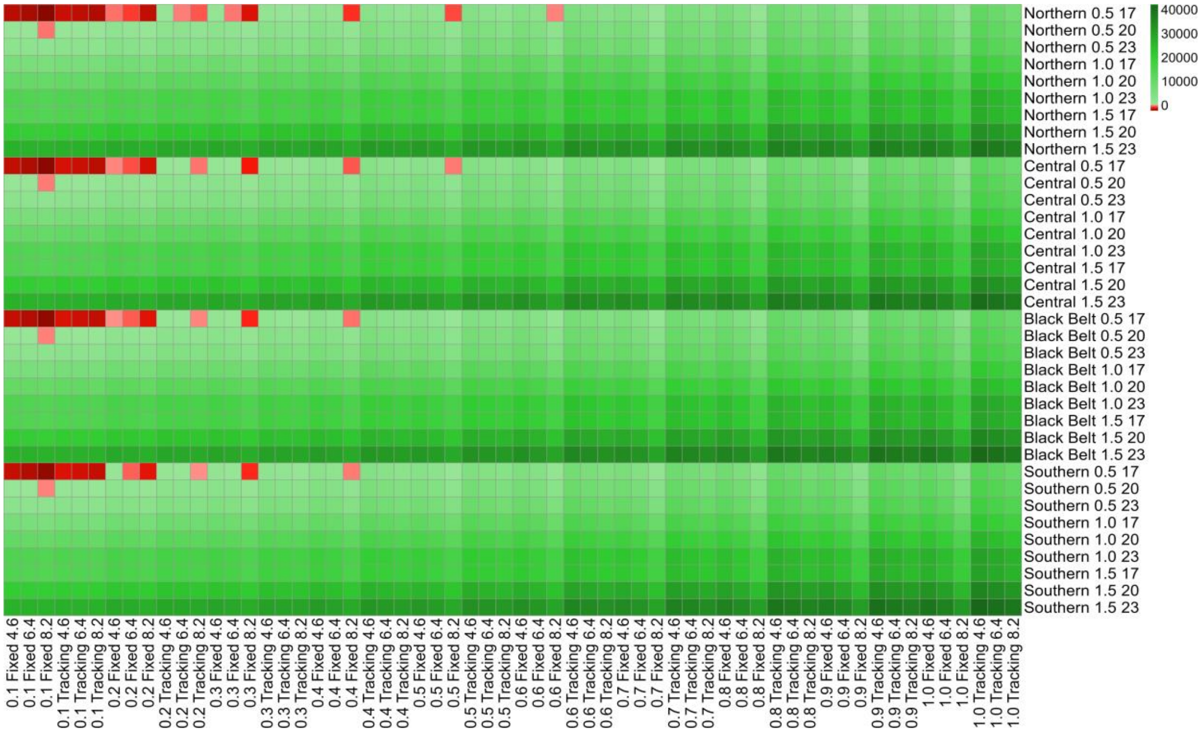
Figure 1 shows a set of two 2,160 TAV profit scenarios under 50% REAP (Figure 1a) and 25% REAP (Figure 1b), respectively. At 50% REAP, most of the TAV scenarios are profitable (Figure 1a), but some are less profitable than crops alone. For example, TAV is break-even or more profitable than crop alone at benchmark yield and $17 price when tracking panels are placed at 40% density. Under the same crop yield and price, higher profit from AV than the tomato alone can be achieved at 30% PV density with fixed panels mounted at 4.6 feet. At 50% REAP and higher PV densities, TAVs are mostly profitable even if the yield dropped by 50% and price dropped to $17. For example, TAVs become unprofitable in the northern region at 50% REAP when yield loss is 50%, tomato price is $17 per carton, and fixed panels with 60% PV density are mounted at 8.2 feet. TAV with the same configurations and crop prices becomes unprofitable in the Black Belt and southern regions, at 40% PV density.

Many TAV scenarios become unprofitable at 25% REAP (Fig: 1b). In this case, almost all TAVs become unprofitable if tomato yield is reduced to 50% of the benchmark yield across the state for all prices. The TAV profit at a $17 per bucket of tomatoes depends upon other system parameters. TAVs are unprofitable at a $17 tomato price and 8.2-foot-high fixed panels at 80% or above PV density. For TAVs to become profitable at 25% REAP, producers should either lower PV height to 4.2 feet, maintain benchmark or higher yield, receive $20 or above market price, or maintain combinations of more than one of these conditions. Tomato yield must increase by 50% and receive at least $20 per carton for TAVs to remain profitable in all four regions when 8.2-foot-tall fixed solar panels cover 80% of the plot. When fixed panels are mounted at 8.2 feet at 100% PV density, tomato yield must increase by 50% and receive a market price of $23 per 25 pounds for TAV to remain profitable in northern Alabama. The losses from TAVs generally decrease as we progress toward the south from the north due to higher solar energy production, but they are still insufficient to make a profit.

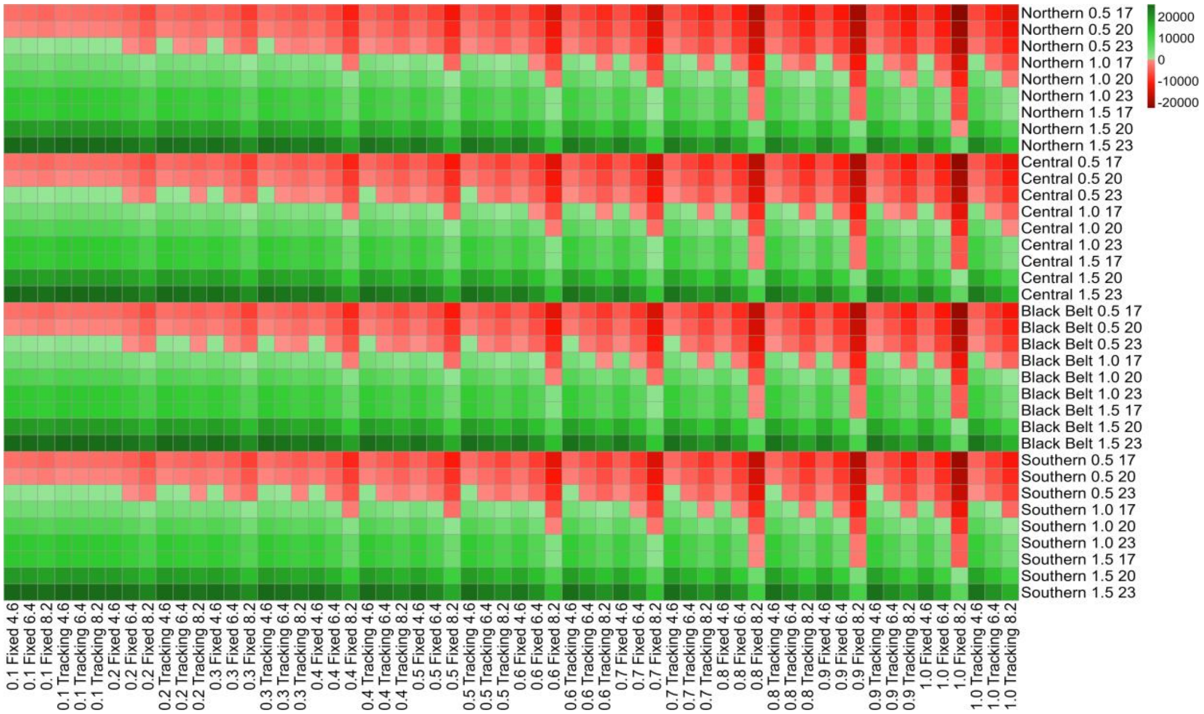
Strawberry Agrivoltaics System (SBAV)

The annual profit from 3,075 buckets of strawberries produced in an acre and sold at $6 per bucket is $4,176. At 50% REAP, profits from SBAV from an acre of land range from $4,991 to $20,524, depending upon AV configuration and geographical region (Table 3). At 50% REAP and benchmark yield and price, SBAV is

Figure 1. TAV Profits in the Four Regions of Alabama under Various PV Configurations



(a) TAV profit after 50% of total PV CAPEX is compensated through a REAP within six months of the initial investment.

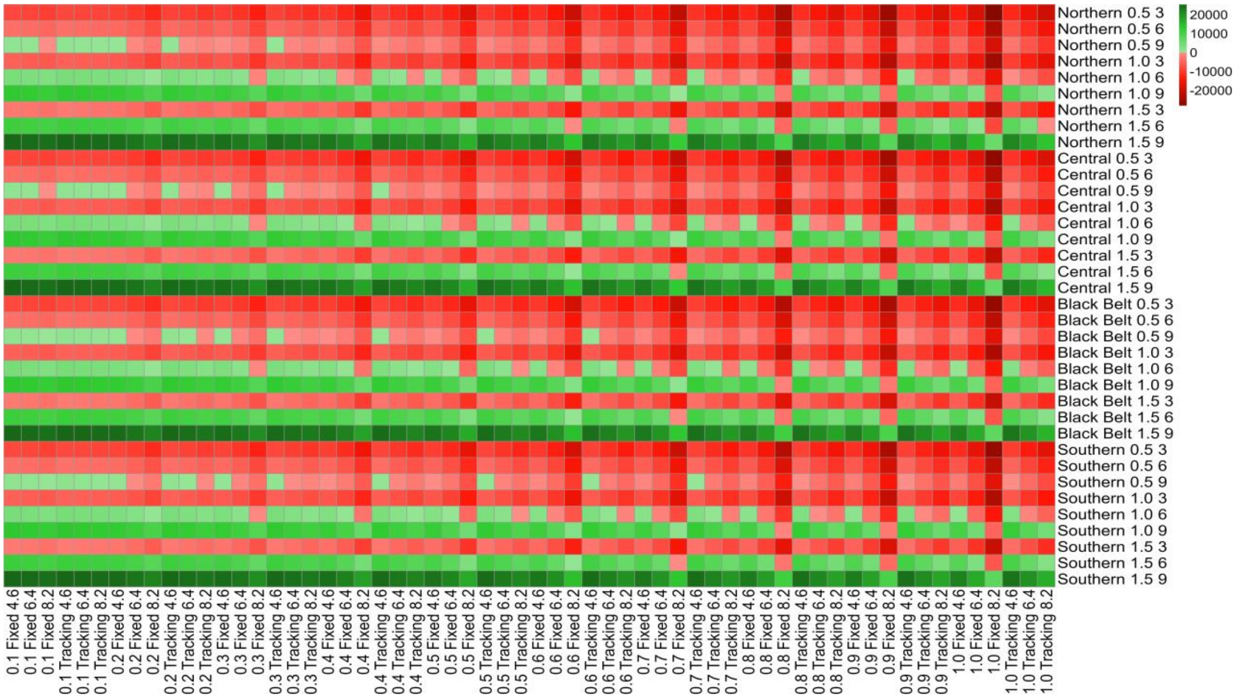


(b) TAV profit after 25% of total PV CAPEX is compensated through a REAP within six months of the initial investment.

Note: The vertical axis indicates electricity price, tomato price, tomato yield, and regions of Alabama. For example, the label “Northern 0.5 17” on the first row means the northern region of Alabama, 50% yield of 1,360 cartons of tomatoes, and $17 per carton of tomato. The horizontal axis has PV density, solar array types, and solar panel ground clearance height (ft.). For example, “0.10 Fixed 4.6” on the first column means 10% PV density, fixed-tilt solar panels mounted 4.6 ft. above the ground. Green and red colored blocks represent profits and losses from TAVs, respectively. Profits and losses increase as blocks turn darker in color. Source: Authors.

Figure 2. SBAV Profits in the Four Regions of Alabama under Various PV Configurations

(a) SBAV profit after 50% of the total PV CAPEX is compensated through a REAP within six months of the initial investment.



(b) SBAV profit after 25% of the total PV CAPEX is compensated through a REAP within six months of the initial investment.

Notes: The vertical axis has electricity prices, strawberry prices, strawberry yield, and regions of Alabama. For example, “Northern 0.5 3” on the first row represents the northern region of Alabama, with a strawberry yield of 50% of 3,075 buckets and $3 per bucket strawberry. The horizontal axis has PV density, solar panel array types, and solar panel ground clearance height (ft.). For example, the label “0.10 Fixed 4.6” on the first column represents 10% PV density, fixed-tilt solar panels mounted 4.6 ft. above the ground. Green and red colored blocks represent profits and losses from TAVs, respectively. Profits and losses increase as blocks turn darker in color. Source: Authors.

profitable across all scenarios, and the profit increases with the PV density. However, at 25% REAP, the profit from the crop alone is higher than the profit from SBAV, and the profit decreases in PV density. SBAVs observe losses throughout the state at 25% REAP, benchmark yield, and price in almost all scenarios. The SBAV profit is reduced by 72% to 417% at the benchmark yield and price depending upon PV configuration and location if REAP is reduced from 50% to 25%.

Figure 2 shows 2,160 SBAV profit outcomes at 50% REAP (Fig: 2a) and 2,160 SBAV profit outcomes at 25% REAP (Fig: 2b). SBAVs are mostly profitable at 50% REAP when PV densities are higher, panel height 6.4 feet or lower, yields remain at benchmark or higher level, and the strawberry price is $6/bucket or more (Fig: 2a). However, at lower prices and yield, the profitability of SBAVs depends upon panel heights, panel arrays, PV density, and geographical regions. A few unprofitable SBAV configurations in the north became profitable in the south for the same crop yield and prices because of the increase in solar energy production. For example, SBAV with 8.2-foot-tall tracking solar panels, 70% PV density, benchmark yield, and strawberry priced at $3 per bucket become profitable except in the northern region. However, SBAV profits are smaller than crop only in several profitable scenarios. For example, except in the northern region, SBAV profit is higher than strawberry alone at benchmark yield and $3 strawberry price, 70% PV density, and 4.6-foot tracking panels. Under the same configuration, yield, and crop prices, SBAV profit higher than strawberry profit alone across the state is achieved at 80% PV density.

However, most SBAVs become unprofitable (Figure 2b) at 25% REAP. SBAVs become unprofitable at $3 per bucket even if the strawberry production increases by 50% across all scenarios. At 25% REAP, SBAVs remained profitable at the benchmark yield and $9 strawberry price with fixed panels mounted at 6.4 feet or lower. SBAVs become unprofitable at 60% or above PV densities and 8.2-foot tracking panels with the same configurations and prices as above. For SBAVs to become profitable at 25% REAP, either strawberry yield must increase by 50% or the strawberry price must remain at the benchmark price or above in most scenarios. At 25% REAP, SBAV profit decreases in solar panel density. Only a few unprofitable scenarios at 25% REAP and lower PV densities become profitable as we progress toward the southern region from the north because of increased solar energy production.

Conclusion

We examined the profitability of TAVs and SBAVs in Alabama under two REAP scenarios varying height, array, and density of solar panels, crop yield, crop price, and geographical regions. We found that TAV and SBAV will be more attractive to producers at 50% REAP because they are mostly profitable compared to crops alone. Holding crop yield constant, the AV profits also increase in PV density at 50% REAP, which could further increase solar energy production. At 25% REAP, producing the crop alone is more profitable than AVs, even though some AV scenarios remain profitable. Reducing the REAP from 50% to 25% may make AVs less attractive because producers lose profit by allocating agricultural land to the PV. Producers further lose money by increasing PV density at 25% REAP, making AVs unattractive. It is nearly impossible to make AVs profitable without REAP or similar incentives. Decreasing the CAPEX for PV could change the outcome in the future.

Some unprofitable AV scenarios at benchmark crop yield become profitable at the higher yield for a given price and PV configuration. Higher crop prices at a given yield make AV scenarios profitable without modifying PV configurations. Increasing crop yield under the AV system may help maintain farm profit if REAP is reduced from 50% to 25%. Even though producers could maintain profit with 25% REAP by increasing crop yield by 50%, the current state of research is insufficient to predict a 50% increase in yield. More research is necessary to study the impact of AVs on tomato and strawberry yield and crop performance.

For More Information

Adeh, E., S. Good, and C. Higgins. 2019. “Solar PV Power Potential Is Greatest over Cropland.” *Scientific Reports* 9(6): 11442.

Al-agele, H.A., K. Proctor, G. Murthy, and C. Higgins. 2021. “A Case Study of Tomato (*Solanum lycopersicon* var. legend) Production and Water Productivity in Agrivoltaic Systems.” *Sustainability* 13(5).

Barron-Gafford, G.A., M.A. Pavao-Zuckerman, R.L. Minor, L.F. Sutter, I. Barnett-Moreno, D.T. Blackett, M. Thompson, K. Dimond, A.K. Gerlak, G.P. Nabhan, and J.E. Macknick. 2019. “Agrivoltaics Provide Mutual Benefits Across the Food–Energy–Water Nexus in Drylands.” *Nature Sustainability* 2:848–855.

Boswell, J., C. East, A. Majumdar, E. Sikora, and J. Kemble. 2023. “Enterprise Budgets for Horticulture Crops.” Albama A&U and Auburn Universities Extension. Available online: https://www.aces.edu/blog/ topics/farm-management/enterprise-budgets-for-horticulture-crops/ [Accessed July 26, 2024]

Cuppari, R.I., C.W. Higgins, and G.W. Characklis. 2021. “Agrivoltaics and Weather Risk: A Diversification Strategy for Landowners.” *Applied Energy* 291: 116809.

Dobos, A.P. 2014. *Pvwatts Manual Version 5*. Available online: https://doi.org/10.2172/1158421

Gomez-Casanovas, N., P. Mwebaze, M. Khanna, B. Branham, A. Time, E.H. DeLucia, C.J. Bernacchi, A.K. Knapp, M.J. Hoque, X. Du, X., et al. 2023. “Knowns, Uncertainties, and Challenges in Agrivoltaics to Sustainably Intensify Energy and Food Production.” *Cell Reports Physical Science* 4(8).

Heath, G., D. Ravikumar, S. Ovaitt, L. Walston, T. Curtis, D. Millstein, H. Mirletz, H. Hartmann, and J. McCall. 2022. *Environmental and Circular Economy Implications of Solar Energy in a Decarbonized U.S. Grid.* National Renewable Energy Laboratory Technical Report NREL/TP-6A20-80.

Heeter, J.S., and E. O’Shaughnessy. 2019. *Status and Trends in the Voluntary Market (2018 Data).* National Renewable Energy Laboratory.

Hess, T., and K. Tsai. 2024. “We Expect Solar Will Supply Almost All Growth in U.S. Electricity Generation through 2025.” *Today in Energy*. Available online: https://www.eia.gov/todayinenergy/detail.php?id=61203# [Accessed October 3, 2024]

Hodge, T. 2023. “Increasing Renewables Likely to Reduce Coal and Natural Gas Generation over Next Two Years.” *Today in Energy*. Available online: https://www.eia.gov/todayinenergy/detail.php?id=55239# [Accessed July 29, 2024]

Horowitz, K., V. Ramasany, J. Macknick, and R. Margolis. 2020. *Capital Costs for Dual-Use Photovoltaic Installations:2020 Benchmark for Ground-Mounted PV Systems with Pollinator-Friendly Vegetation, Grazing, and Crops*. National Renewable Energy Laboratory Technical Report NREL/RP-6A20-77811.

Katkar, V.V., J.A. Sward, A. Worsley, and K.M. Zhang. 2021. “Strategic Land Use Analysis for Solar Energy Development in New York State.” *Renewable Energy* 173:861–875.

Macknick, J., H. Hartmann, G. Barron-Gafford, B. Beatty, R. Burton, C. Seok-Choi, M. Davis, R. Davis, J. Figueroa, A. Garrett, et al. 2022. *The 5 Cs of Agrivoltaic Success Factors in the United States: Lessons from the Inspire Research Study*. National Renewable Energy Laboratory Technical Report NREL/TP-6A20-83566.

Majumdar, D., and M.J. Pasqualetti. 2018. “Dual Use of Agricultural Land: Introducing ‘Agrivoltaics’ in Phoenix Metropolitan Statistical Area, USA.” *Landscape and Urban Planning* 170:150–168.

Mamun, M.A.A., P. Dargusch, C. Wadley, N.A. Zulkarnain, and A.A. Aziz. 2022. “A Review of Research on Agrivoltaic Systems.” *Renewable and Sustainable Energy Reviews* 161:112351.

National Renewable Energy Laboratory. 2024. *Pvwatts Calculator*. https://pvwatts.nrel.gov/pvwatts.php [Accessed December 5, 2024]

Omer, A.A.A., W. Liu, M. Li, J. Zheng, F. Zhang, X. Zhang, S.O.H. Mohammed, L. Fan, Z. Liu, F. Chen, et al. 2022. "Water Evaporation Reduction by the Agrivoltaic Systems Development." *Solar Energy* 247:13–23.

Othman, N.F., M.E. Yaacob, A.S. Mat Su, J.N. Jaafar, H. Hizam, M.F. Shahidan, A.H. Jamaluddin, G. Chen, and A. Jalaludin. 2020. "Modeling of Stochastic Temperature and Heat Stress Directly Underneath Agrivoltaic Conditions with Orthosiphon Stamineus Crop Cultivation." *Agronomy* 10(10):1472.

Pascaris, A.S. 2021. "Examining Existing Policy to Inform a Comprehensive Legal Framework for Agrivoltaics in the U.S." *Energy Policy* 159:112620.

Pascaris, A.S., C. Schelly, L. Burnham, and J.M. Pearce. 2021. "Integrating Solar Energy with Agriculture: Industry Perspectives on the Market, Community, and Socio-Political Dimensions of Agrivoltaics." *Energy Research & Social Science* 75:102023.

Pascaris, A.S., C. Schelly, M. Rouleau, and J.M. Pearce. 2022. "Do Agrivoltaics Improve Public Support for Solar? a Survey on Perceptions, Preferences, and Priorities." *Green Technology, Resilience, and Sustainability* 2(1):8.

Sengupta, M., Y. Xie, A. Lopez, A. Habte, G. Maclaurin, and J. Shelby. 2018. "The National Solar Radiation Data Base (NSRDB)." *Renewable and Sustainable Energy Reviews* 89: 51–60.

Steinberg, D.C., M. Brown, R. Wiser, P. Donohoo-Vallett, P. Gagnon, A. Hamilton, M. Mowers, C. Murphy, and A. Prasanna. 2023. *Evaluating Impacts of the Inflation Reduction Act and Bipartisan Infrastructure Law on the U.S. Power System*. National Renewable Energy Laboratory Technical Report NREL/TP-6A20-85242

Sweet Grown Alabama. 2024. "Find Sweet-Grown Alabama Products." Available online: https://www.sweetgrownalabama.org/find-sweet-grown [Accessed July 29, 2024]

U.S. Department of Agriculture. 2024. *Rural Energy for America Program: Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans.* Available online: https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-America-program-renewabe-energy-systems-energy-efficiency-improvement-guaranteed-loans [Accessed July 26, 2024]

U.S. Department of Energy. 2023. *Investing in American Energy: Significant Impacts of the Inflation Reduction Act and Bipartisan Infrastructure Law on the U.S. Energy Economy and Emissions Reductions*. Department of Energy Office of Policy.

———. 2024. *Federal Solar Tax Credits for Businesses*. Available online: https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses [Accessed July 26, 2024]

Velasco, E. 2024. "13 Alabama Strawberry Farms and Festivals to Visit This Season." *Alabama News Center*. Available online https://alabamanewscenter.com/2024/03/17/13-Alabama-strawberry-farms-and-festivals-to-visit-this-season/ [Accessed July 29, 2024]

Walston, L.J., S.K. Mishra, H.M. Hartmann, I. Hlohowskyj, J. McCall, and J. Macknick. 2018. "Examining the Potential for Agricultural Benefits from Pollinator Habitat at Solar Facilities in the United States." *Environmental Science & Technology* 52(13):7566–7576.

Weselek, A., A. Bauerle, J. Hartung, S. Zikeli, I. Lewandowski, and P. Högy. 2021. "Agrivoltaic System Impacts on Microclimate and Yield of Different Crops Within an Organic Crop Rotation in a Temperate Climate." *Agronomy for Sustainable Development* 41(5):59.

Willockx, B., A. Kladas, C. Lavaert, U. Bert, and J. Cappelle. 2022. "How Agrivoltaics Can Be Used as a Crop Protection System." *EUROSIS Proceedings*: 130–136.

About the Authors: Bijesh Mishra (bzm0094@auburn.edu) is a Postdoctoral Fellow at the Department of Agricultural Economics and Rural Sociology at Auburn University, Auburn, AL. Ruiqing Miao (rzm0050@auburn.edu) is an Associate Professor in the Department of Agricultural Economics and Rural Sociology at Auburn University. Ngbede Musa was a Graduate Student at the Department of Agricultural Economics and Rural Sociology at Auburn University. Dennis Brothers is an Associate Extension Professor at the Department of Agricultural Economics and Rural Sociology at Auburn University. Madhu Khanna is a Distinguished Professor at the Institute for Sustainability, Energy, and Environment at the Department of Agricultural and Consumer Economics at the University of Illinois Urbana Champaign, Urbana-Champaign, IL. Adam N. Rabinowitz is an Associate Professor at the Department of Agricultural Economics and Rural Sociology at Auburn University. Paul Mwebaze is a Visiting Scholar at the Institute for Sustainability, Energy, and Environment at the Department of Agricultural and Consumer Economics at the University of Illinois Urbana Champaign. James McCall is an Environment and Energy Analyst at National Renewable Energy Lab, Golden, CO.

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