CRDI Community & Regional Development Institute
Department of Development Sociology
Cornell University

ISSUE NUMBER 84 / MARCH 2019

Research & Policy Brief Series

Energy Production on Farms: What are the Impacts & Which Farms Participate in Energy Leases[1]?

By **Travis Grout** and **Jennifer Ifft**, Cornell University

What are the Issues?

The outlook for U.S. energy production changed dramatically over the last two decades, as the "shale revolution" reversed decades of declining oil and gas production and rising returns for renewable power drove exponential growth of wind and solar generating capacity. These developments present both opportunities and risks for landowners of millions of acres of U.S. agricultural land as the land becomes attractive for energy development. To its supporters, energy development on agricultural land is a win-win proposition, offering land-rich but cash-poor farm owners a new stream of income and, potentially, the means to relieve credit constraints and reinvest in their farms. Critics, however, fret that turning productive farmland over to gas wells and solar panels will contribute to long-term loss of agricultural land and raise the costs of farming in areas attractive for energy development. The conversion of farmland for energy production has implications for a wide range of policy issues including rural economic development, farmland preservation, and even transitioning the grid to renewable electricity.

A new Cornell study uses USDA nationwide survey data to identify the impacts of energy production income on farm investment and profitability, as well as examine the characteristics of farms that choose to participate (or not) in energy leases.

Photo by Jacqueline McBride, *Lawrence Livermore National Lab*

Previous Work

This work builds on several previous studies. A nationwide 2013 study found that the average farm household receiving revenue from an energy lease gained $104,000 in net worth, mostly from property value appreciation. Energy royalty payments to farmers totaled $2.3 billion in 2011 alone. Those payments were, however, highly concentrated among farmers; the median annual payment was just $7,000. Two studies in Pennsylvania (published in 2017 and 2018) concluded that farms in counties that hosted unconventional gas drilling spent more on capital and equipment, and farmland values rose faster than in other counties. However, it also found evidence that farming in those counties was more consolidated, with fewer but larger operations. Subsequent research on gas development in the Marcellus shale play reinforced those conclusions.

Previous studies of energy production on farmland focused on particular areas or particular technologies. A 2013 California study found that farms with higher farm sales, higher per-acre land values, operators who lived off-farm, and internet access were more likely to host large wind or solar facilities. Subsequent research examined wind and solar energy adoption (mostly small-scale) by U.S. farms, concluding that farmers with greater acreage, fewer years of experience, internet access, livestock operations, or organic operations were more likely to adopt the technologies. Studies of shale gas development suggest that lease and royalty rates vary based on operator and farm characteristics, including owners' attitudes toward development risks, owner income and race, and information asymmetries between landowners and developers. A 2016 Pennsylvania study also suggested that smaller, financially marginal farms were more likely to agree to oil and gas leases. The 2018 Cornell study builds on this earlier work by considering *all* on-farm energy production income and by applying data from a unique nationwide survey.

Data and Methodology

The principal source of data for this study is the USDA's 2014 Tenure, Ownership, and Transition of Agricultural Land (TOTAL) survey. This large, rich dataset is representative of U.S. farms and provides an unprecedented perspective on agricultural landowners. In particular, TOTAL is the only survey of its kind to collect detailed data on farm energy production, leasing, and income. It also gathers extensive financial data on participating farms, including net income, capital investment, and self-reported credit constraints. This study also uses U.S. Census county data and Department of Energy estimates of production and resources.

For examining the impacts of energy production on farms, the study uses propensity score matching to compare outcomes for farms with and without energy production income in 2014. Since most energy production payments were relatively small, the study also compares farms that received substantial energy production payments (over $10,000 annually or over 50% of net farm income) to those that reported smaller or no payments. Impacts on commercial-scale farms or farms with operators primarily employed in production agriculture were also considered. These types of farms are less numerous than "residence" farms, but are responsible for the vast majority of U.S. agricultural production.

Using a series of logistic regressions, researchers tested whether farm characteristics were consistently associated with energy

production income, including a consideration of which characteristics are associated with those farms receiving *substantial* energy production payments. Finally, Cornell's team repeated its analysis while focusing on commercial- scale farms or farms with operators primarily employed in production agriculture.

Results

Impacts on Farm Production

Compared to similar operations, farms with energy income were more likely to invest in capital assets (e.g., equipment, buildings, or land improvements). However, receiving energy income did not lead farms to make larger capital investments than their peers. This suggests that, while energy income was decisive in some farmers' investment decisions, it did not noticeably influence most participating farms.

Similarly, energy production income increased the likelihood that a given farm had positive net income (earnings were equal to or greater than expenses), but had no discernable impact on the net incomes of participating farms overall. Among participating farms, the median annual income from energy production was $6,000, a small fraction of most operations' gross income.

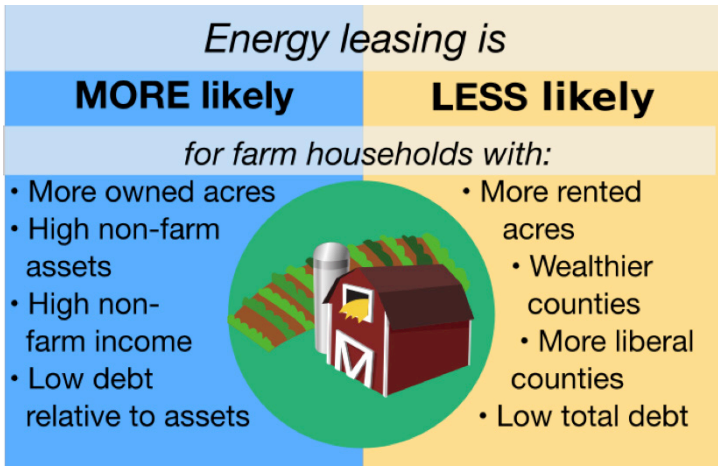
*median	Farms in Sample	% with energy income	Among farms with energy income: Income from energy production	% farm income from energy
Residence Farms	10,775	3.9%	$4,200*	12.2%*
Intermediate Farms	7,725	6.0%	$6,556*	6.8%*
Commercial Farms	11,233	5.9%	$7,116*	0.9%*
All Farms	29,733	5.2%	$6,000*	3.1%*

Finally, the study found no evidence that energy production income relieved credit constraints. For this analysis, a farm was considered credit constrained if, in the last year, the primary operator (1) applied for credit and was denied; (2) received less credit than requested; or (3) did not apply for credit because he/she expected to be denied. Consistently, farms with energy production income were no more or less likely to report difficulty borrowing.

Farm Characteristics

Energy production income is more common on operations with greater acreage, wealthier farm households, and those with high off-farm income and assets. This is consistent with prior findings linking development with farmer income and wealth. Energy development is more likely on farms with low debt-to-asset ratios, but also on those with relatively high total debt (likely because larger, more complex operations tend to assume more debt). These relationships were consistent even when controlling for a wide range of other farm attributes.

Location is important in several ways. Unsurprisingly, farms in areas with abundant energy resources are more likely to have energy income. However, local socioeconomic characteristics are also significant. Farmers in more Democratic-leaning counties were significantly less likely to report energy production income than would otherwise be expected (even controlling for population density and racial makeup). There is strong evidence of a similar relationship affecting farms in counties with higher median household income. Wealthier or more liberal communities are less willing to accept (or more effectively oppose) nearby energy development.



Interestingly, the study found no apparent relationship between energy development and several farm household characteristics found to be important in previous studies (which had narrower scopes): farmer's years of experience, hours devoted to farming, risk tolerance, or whether the principal operator lives on-farm. Several other factors were connected to energy development only in some circumstances (e.g., education was correlated with energy income only in the "larger farm" sample), suggesting a more nuanced relationship than previously appreciated.

Implications

Overall, communities and agricultural landowners considering energy development should not expect it to dramatically increase farm income or investment into farming. While some farms certainly derive substantial benefits from energy production, such stories do not reflect the average farm with energy production. Energy production income is typically a small contribution to household income with little impact on a farm's overall financial outlook. In particular, it does not seem to be a solution for farms facing limited or no access to credit. If the overall benefits to U.S. farmers are limited, though, so are the overall costs. While there may be exceptions, there is little evidence that energy development reduces net income or capital investments on host farms overall.

Farm operators' personal characteristics seem to matter less than a farm's physical characteristics and its socioeconomic surroundings. Debates over farmland energy production tend to focus on opportunities and risks for small, struggling farms, often using anecdotes of farmers betting on energy income to reinvest in their farms or pay down debt. However, energy development leases actually tend to be associated with larger operations, those with relatively manageable debt, and those with substantial off-farm income and assets. Farmland energy production is significantly more likely in politically conservative counties, and in counties with low median incomes. This study has provided a better understanding of the impacts of energy production on farms, as well as a clearer profile of which farms and farm operators participate in leasing their agricultural land for this purpose.

[1]This work is supported by Cornell University's David R. Atkinson Center for a Sustainable Future.

Cornell University

The **Research & Policy Brief Series** is a publication of Cornell University's Community & Regional Development Institute (CaRDI).