Land Competition & the Multiplier Effect

Executive Summary

The transition to renewable sources of energy, such as large-scale solar panels, can intensify the competition for land between energy production and agricultural uses. One common approach to gauge the differences in final income between the two opposing uses of agricultural land is estimating the multiplier effect by measuring the change in final income.

Highlights

- The multiplier effect from the use of land for soybean production is reflected as the producer buys inputs and supply chain workers purchase local goods and services.
- Soybean farming has a final income multiplier effect of 1.32, meaning $100 in income to a Missouri soybean farmer generates an additional $32 in income for others in the state (e.g., suppliers).

Limitations

- Detailed information of farming and solar farm operations, along with analysis, would be needed to provide more precise estimates between the two alternative uses of land (raising soybeans vs. leasing for solar panels).

Research Background

Land Competition

Production of renewable energy, such as solar panels at a large scale, can often be at odds with the agricultural uses of land. This is because farmland is typically the anticipated location for utility-scale solar facilities.[1,2] Utility-scale solar farms, which sell the produced energy directly to the electrical power grid, need to have consistent sunlight. Additionally, projects have to be built on relatively flat areas, with less than one percent slopes for easy construction and maintenance.[3] The growing transition to these sources of energy is expected to intensify the competition for land.[1,2]

Impacts on Emissions & Food Production

Land use change (LUC) refers to how human activities transform the natural landscape to make use of the functional role of land for economic activities,[4] and the changes can affect socioeconomic, energy, land, and climate systems.[1] For example, it is estimated that solar energy may occupy 0.5–5% of total land by 2050, which will likely cause a net release of carbon ranging from 0 to 50 gCO2/kWh, depending on the region, scale of expansion, solar technology

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efficiency, and land management practices in solar parks.[4] Another potential trade-off against the reductions in emissions is if energy-producing farmlands replace lands that have high carbon stocks (e.g., natural forests), or farmlands currently used for conservation of pollinators.[5]

Another indirect impact is that if cropland starts being used at one point of the country/world for energy purposes, it may indirectly increase land competition elsewhere in the country/world to meet food demand,[1] though farmland in the U.S. is already used for nonfood purposes (e.g., 40% of corn is used for ethanol production).[10]

Multiplier Effect / GDP Change

One way to measure the LUC effect is by estimating the multiplier effect. The multiplier effect refers to the proportional change in the final income that results from an injection or withdrawal (increase or decrease) of capital. The multiplier effect measures the potential impact economic activity—like investment or spending—will have on the total economic output of a capital change, such as land use.

The estimation takes into account the upstream and downstream effects of producing a product on a market. For example, producing a bushel of soybeans may cause increased demand for seed or fertilizer, and raises the producers' income, which can subsequently be spent on purchasing new equipment (e.g., pickups, clothing). By taking into account the upstream and downstream effects of both possible uses of land (e.g., soybeans versus solar panels), it can be calculated how each dollar of additional production can be associated with more than one dollar of impact on the local/state/national economy.[6] Gross Domestic Product, or final income generated from the sale of goods and services minus the cost of inputs, is the measure commonly used to analyze the economic outcomes for such changes at a county or state level.[7,8]

Multiplier Effect for Soybean Production in Missouri

The use of land for soybean production has a final income, or GDP, multiplier effect as a producer buys inputs and supply chain workers purchase local goods and services. As some items are purchased from outside the local area, spending also leaks out to other regions, states, or countries. The same is true for alternative land uses (e.g., a solar farm), if it is used for other types of production.[9]

A preliminary impact analysis of a Missouri soybean farm and a solar farm that could be operated on the same acreage, providing final income multipliers for each, is presented below for consideration. Soybean farming has a final income multiplier of 1.32, meaning $100 in income to a Missouri soybean farmer generates an additional $32 in income for others in the state (e.g., suppliers). A solar farm has a final income multiplier of 1.45, based on assumptions outlined below.[9]

The final income multipliers are based on modeling a large farm operation in northern Missouri. For a solar farm, the analysis assumes that increases in solar energy production are offset by decreases in fossil fuel energy production for a net income impact. It is also assumed that

farmers are compensated $800 per acre for solar land use. The solar farm multiplier does not include construction activity impacts that would occur temporarily as the solar farm is built. The multipliers are based on IMPLAN model input/output estimates and should be considered preliminary. Detailed soybean and solar farm production information, and subsequent analysis, would alter these estimates.[9]

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