

**Economic Impacts of Agricultural Land Conversions in Canyon County Idaho**  
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This analysis estimates the economic impacts to the agricultural base of Canyon County, Idaho from the loss of agricultural output in the county that stems from conversion of agricultural lands to non-agricultural uses. For background purposes we will first provide some background information as to the current agricultural base of Canyon County, Idaho. According to the USDA NASS there were 202,479 harvested acres in 2021 and an estimated 2,250 farms in the county. According to IMPLAN data, total output of crop farming in Canyon County in 2021 was \$373 million and animal agriculture was \$346 million. When accounting for all production agriculture, food processing, and connections through the agricultural supply chain (Watson et al. 2015), agricultural businesses contributed \$880 million of the total \$18.5 billion of the economic base of Canyon County in 2021.

To assess the economic impacts of potential conversions of lands out of agricultural uses, we employ Canyon County specific agricultural data provided by the USDA's National Agricultural Statistics Service (NASS) as well as a Canyon County input-output economic model that was derived from the commercial source, IMPLAN, Inc. and then customized with agricultural data and calculations performed by the authors. The input-output model captures the direct impacts to agricultural output that result from the loss of agricultural lands as well as the indirect effects along the agricultural supply chain as input suppliers are also affected by the change in land use (Watson et al. 2015)<sup>1</sup>. A technical description of the methods employed is presented in Appendix A.

Our initial analysis investigates the conversion of 164 acres of agricultural crop lands currently being irrigated under water right 63-3298 in Canyon County, Idaho to a residential development. This land has been rotationally cropped with a variety of cropping mixes utilized historically. To estimate the economic impacts, we first estimate the loss in agricultural output associated with

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<sup>1</sup> We employ a modification of the standard input-output model described in Steinback (2004) and Leonard & Watson (2011) that uses output shocks and forward linked value-added to assess economic impacts.

those 164 acres given an average crop mix for Canyon County. Using NASS data, we estimate that these 164 acres are expected to generate \$302,000 in gross output annually. Therefore, the direct impact of converting the 164 acres out of agricultural production would be a loss of \$302,000 of economic output in the county.

However, the loss of economic output to the county does not end at the farm gate. The input suppliers along the supply chain would also be affected as less acres are farmed and less inputs are then required. When these indirect effects are accounted for, we estimate an additional loss of \$220,000 in economic output, annually, to these agricultural input suppliers. Therefore, the total economic impact of the loss of 164 crop acres is estimated to be \$522,000 in economic output and 5.1 jobs in the county (Table 1).

*Table 1 - The annual negative economic impact of the conversion of a 164 acre parcel of crop land in Canyon County, Idaho*

| <b>Conversion of 164 Crop Acres</b> | <b>Direct Loss</b> | <b>Indirect Loss</b> | <b>Total Impact</b> |
|-------------------------------------|--------------------|----------------------|---------------------|
| Output Impact                       | -\$302,000         | -\$220,000           | -\$522,000          |
| Employment Impact (in jobs)         | -2.6               | -2.5                 | -5.1                |

Previous research has shown that agricultural land conversions present an irreversible loss of agricultural productivity and that once a region begins to convert agricultural lands, that additional surrounding lands become more likely to subsequently transition out of agricultural production (Lambin & Meyfroidt 2011; Haarsma & Qiu 2017; Lanz et al. 2018). As lands in Canyon County continue to be converted from agricultural, there is an increasing likelihood that additional agricultural lands will be converted in the future. To estimate the economic impacts of additional agricultural lands converted out of production, we calculate the economic effects of land conversion on a 100-acre basis. Therefore, we are able to then estimate the economic impacts of future land conversion based on the average cropping mix in Canyon County and the economic linkages that exist between the agricultural supply chain in the region. We find that for every additional 100 acres of crop lands taken out of production, the county loses \$184,000 in direct agricultural output and, with the indirect impacts to the supply chain, the total annual loss of economic activity is \$318,000 and 2.6 jobs (Table 2).

*Table 2 – The annual negative economic impact per 100 acres of cropland lost in Canyon County, Idaho*

| <b>Per 100 Acre Conversion of Crop Land</b> | <b>Direct Loss</b> | <b>Indirect Loss</b> | <b>Total Impact</b> |
|---------------------------------------------|--------------------|----------------------|---------------------|
| Output Impact                               | -\$184,000         | -134,000.00          | -\$318,028          |
| Employment Impact (in jobs)                 | -1.6               | -1.0                 | -2.6                |

Additional to the impacts on backward linked sectors, which are captured in the indirect impacts, previous research has also identified the potential for “stemming from” effects that impact forward linked sectors (Adelja et al. 1998; Lynch & Carpenter 2003). For example, if dairies are no longer able to source alfalfa and silage in the area, they are more likely to decide to move their operation out of the county. And if dairies were to decide to leave, then the milk processors and cheese makers are more likely to relocate out of the region. To account for these potential stemming from effects, we estimate the economic impacts of an average sized dairy producer (\$10 million in gross revenue) leaving the county, a large dairy producer (\$24 million in gross revenue) leaving the county, and the milk processing and cheese producing sector leaving the county.

The loss of an average dairy which generates about \$10 million in gross revenue annually would translate into a total economic impact of over \$16 million in lost economic output and 45.5 jobs in Canyon County (Table 3). Furthermore, a larger dairy with annual gross revenue of \$24 million, existing in proximity to lands currently under consideration for conversion away from agriculture, would result in larger negative economic impacts. The economic impact of losing a larger dairy in the county would total a loss of \$39,000,000 in economic output and 105.9 jobs to the county (Table 4).

*Table 3 - The annual negative economic impact of the loss of an average dairy in Canyon County, Idaho*

| <b>Per Loss of Average Dairy</b> | <b>Direct Loss</b> | <b>Indirect Loss</b> | <b>Total Impact</b> |
|----------------------------------|--------------------|----------------------|---------------------|
| Output Impact                    | -\$10,000,000      | -\$6,400,000         | -\$16,400,000       |
| Employment Impact (in jobs)      | -12.6              | -32.9                | -45.5               |

*Table 4 - The annual negative economic impact of the loss of a large dairy in Canyon County, Idaho*

| <b>Per Loss of Large Dairy</b> | <b>Direct Loss</b> | <b>Indirect Loss</b> | <b>Total Impact</b> |
|--------------------------------|--------------------|----------------------|---------------------|
| Output Impact                  | -\$24,000,000      | -\$15,000,000        | -\$39,000,000       |
| Employment Impact (in jobs)    | -29.3              | -76.6                | -105.9              |

Finally, there is reason to believe from previous research that the conversion of significant amounts of agricultural lands and dairy operations that the dairy processing sector could also be negatively impacted (Adelaja et al. 1998; Lynch and Carpenter 2003). If Canyon County were to lose its largest dairy processor, the county would annually lose \$250 million dollars in direct economic output. The indirect effect on the supply chain net of the milk purchased (since we

estimate those impacts separately) total \$70 million for a total economic impact (again, net of milk purchased) is estimated to be \$320 million and 769.9 jobs (Table 5).

*Table 5 - The annual negative economic impact of the loss of a large dairy processor (net of milk purchases) in Canyon County, Idaho*

| <b>Per Loss of Large Dairy Processor</b> | <b>Direct Loss</b> | <b>Indirect Loss</b> | <b>Total Impact</b> |
|------------------------------------------|--------------------|----------------------|---------------------|
| Output Impact                            | -\$250,000,000     | -\$70,000,000        | -\$320,000,000      |
| Employment Impact (in jobs)              | -235.0             | -534.9               | -769.9              |

These respective impacts represent an increasingly significant threat to the agricultural base of Canyon County. While there is not one single agreed upon definition for what constitutes an economically significant threat to an agricultural base, it is clear that these scenarios will have a measurable and tangible effect on agricultural production and the broader economy of Canyon County.

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#### **Appendix A:**

In addition to on-farm income, agriculture generates economic activity in the surrounding communities from spending associated with the operations of the farms, the capital investing associated with the farms, and farm household expenditures in the local community.

The economic activity associated with agricultural operations, capital investment, and visitor expenditures can be tracked and a measure of the economic activity that relies on these can be measured through an economic contribution analysis. When a farm makes expenditures in the local community, there is a ripple effect through the economy. For example, input suppliers to a farm are dependent on farm operations for their livelihoods. A change in farm expenditures, therefore, is multiplied throughout the economy following its linkages to businesses and payments to workers. To capture these effects, it is necessary to use an economic model that contains these linkages. A widely used application for impact assessment is the IMPLAN regional economic impact software which provides the baseline regional economic data necessary to construct an economic impact model. The model can be customized with primary data collected in the enterprise budget portion of the research to accurately reflect the local economic conditions.

The categorization of economic activity by IMPLAN can be summarized in these three areas:

- Direct effects refer to the production changes associated with a variation in final demand for the good itself. It is the initial activity supposed to occur in the economy, which is exogenous to the model.
- Indirect effects refer to secondary activity caused by changing input needs of directly affected industries (e.g., additional input purchases to produce additional output).
- Induced effects are caused by changes in household spending due to additional employment generated by direct and indirect effects.
  - For simplicity we combine the indirect and induced effects together in the indirect totals

It is immediately evident that this structure describes “backward” linkages, as some exogenous economic event affects an industry under investigation, which then creates economic activity in input supply industries and from labor income. Any economic additions found downstream in supply channels are not captured, nor are the enabled industries examined endogenously. The input-output model has the following specification:

$$X = (I - A)^{-1}Y$$

where X is a J x 1 vector of industry outputs, or sales, for each of J sectors, (I-A)<sup>-1</sup> is collectively referred to as the “Leontief inverse”, with I being an JxJ identity matrix, while Y is a J x 1 vector of final demands for all J sectors’ production. A is the matrix of technical coefficients, which describes the flow of inputs from sector i to sector j. For a simple two sector economy, the A matrix of interindustry linkages would look as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$$

with a 11 showing purchases by Industry 1 from firms in the same sector, while a 21 represents inputs that Industry 1 buys from Industry 2. The other elements are defined accordingly. (These values are usually reported per dollar of sales, so a 0.15 for a 21 would indicate that, for each dollar of sales by Sector 1, that industry would purchase \$0.15 from sector 2). The Leontief inverse of the A matrix is represented as:

$$(I - A)^{-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}$$

The cell values in the Leontief inverse matrix represent the total direct and indirect changes in output (measured in dollars) within the row industry resulting from an additional dollar’s worth of final demand initiated in the column industry. To calculate an output multiplier for a region, a change in final demand for a given sector is hypothesized, which can come from added spending by consumers, exporters, investors or government. (For simplicity, we calculate the total effect of a one-dollar change in final demand for a given industry.) This is calculated as follows:

$$\Delta X_1 = (I - A)^{-1} \Delta Y_{1j} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix}$$

where X<sub>1</sub> is a vector of changes in total industry output from a one-dollar change in final demand for sector 1, (I-A)<sup>-1</sup> is the Leontief inverse, and Y<sub>1j</sub> is a column vector that contains a 1 in the first row to show the dollar change in final demand for sector 1, and 0 in all other positions. The result is equal to the first column of the Leontief inverse. The direct effect is α<sub>11</sub> while indirect effects relate to the off-diagonal elements, which is α<sub>21</sub> in this case. The total output multiplier then is the sum of all changes in output that result from the increase in final demand for industry j, and is calculated as follows:

$$O_j = \sum_{i=1}^n \alpha_{ij}$$

where  $O_j$  is the output multiplier for industry  $j$ , which comes from the column sum of the  $\alpha_{ij}$  values in the Leontief inverse.

The difference between Type I and Type II multipliers typically reported in IMPLAN analyses depends on what parts of the economy are endogenous in the  $A$  matrix. For a Type I multiplier, only interindustry linkages are included, so, as in the example above, only direct effects of the change in final demand for industry  $j$  and the indirect effects on other sectors are included. The effects that arise as employees receive increased income and spend it are not included in the Type I multiplier. Thus, the Type I multiplier is defined as: Type I = (Direct effects + Indirect effects) / Direct effects.

Type II multipliers make household spending and wages endogenous. In this case, the modified  $A$  matrix is:

$$\bar{A} = \left[ \begin{array}{cc|c} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ \hline a_{31} & a_{32} & a_{33} \end{array} \right]$$

The new third column adds households as an endogenous sector, which demands products and services from other sectors based on their increased wages that are found in the added row. (The  $a_{33}$  value shows the hiring of laborers directly by households, which might be a variety of personal services).

The additional spending that occurs in the economy due to new household income is called an induced effect. The direct, indirect, and induced effects together yield a "Type II" multiplier. The Type II multiplier is defined as: Type II = (Direct effects + Indirect effects + Induced effects) / Direct effects. (Other multipliers, such as SAM multipliers, continue to endogenize additional sectors, such as government expenditure or other institutions.)