Guidance for County and Regional Inventories

Agriculture and Land Management

Appendix to Local Greenhouse Gas Inventory Tool: Community Module

September 2023

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Tool Overview

The Guidance for County and Regional Inventories User's Guide accompanies the Local Greenhouse Gas Inventory Tool: Community Module and Government Operations Module. It explains how to obtain agriculture and land management activity data at the county-level to support users with entering data into the Community and Government Operations Modules. For more information on using the Modules, please refer to the Local Greenhous Gas Inventory Tool User's Guides, which are available to download here: https://www.epa.gov/statelocalenergy/download-local-greenhouse-gas-inventory-tool.

Agriculture & Land Management Inventory Sheet

The agriculture & land management sheet within the Community Greenhouse Gas (GHG) Inventory Tool may be used to calculate emissions associated with fertilizer application from different sectors in your community[1]. Agricultural emissions that can be estimated with this tool include direct nitrous oxide (N_2O) associated with the application of synthetic, organic, and manure fertilizers, as shown in Table 1. Additionally, a portion of applied fertilizers volatilize into the atmosphere as indirect N_2O emissions.

Once you enter the information for each sector on the amount of fertilizer applied by fertilizer type, the total emissions from this source will be calculated.

Table 1. Required Data Inputs Agriculture & Land Management Inventory Sheet

GHG Sector	Input Data
Agriculture & Land Management	Synthetic fertilizer use (short tons)
	Organic fertilizer use (short tons)
	Manure fertilizer use (short tons)

Obtaining Input Data

Fertilizer consumption data for synthetic, organic, and manure fertilizers are typically not available at sub-state or county levels. However, fertilizer consumption data are available at the state level, such as tons consumed per state from EPA's State Inventory Tool (SIT) Agriculture Module or pounds of each fertilizer type applied per acre for each state/crop type from the U.S. Department of Agriculture's Economic Research Service. Equation 3 through Equation 5 explain how to apportion total fertilizer consumption to each fertilizer type (synthetic, organic, and manure).

Scaling State-Level Fertilizer Data

The following section details how to downscale state-level fertilizer consumption to the county-level.

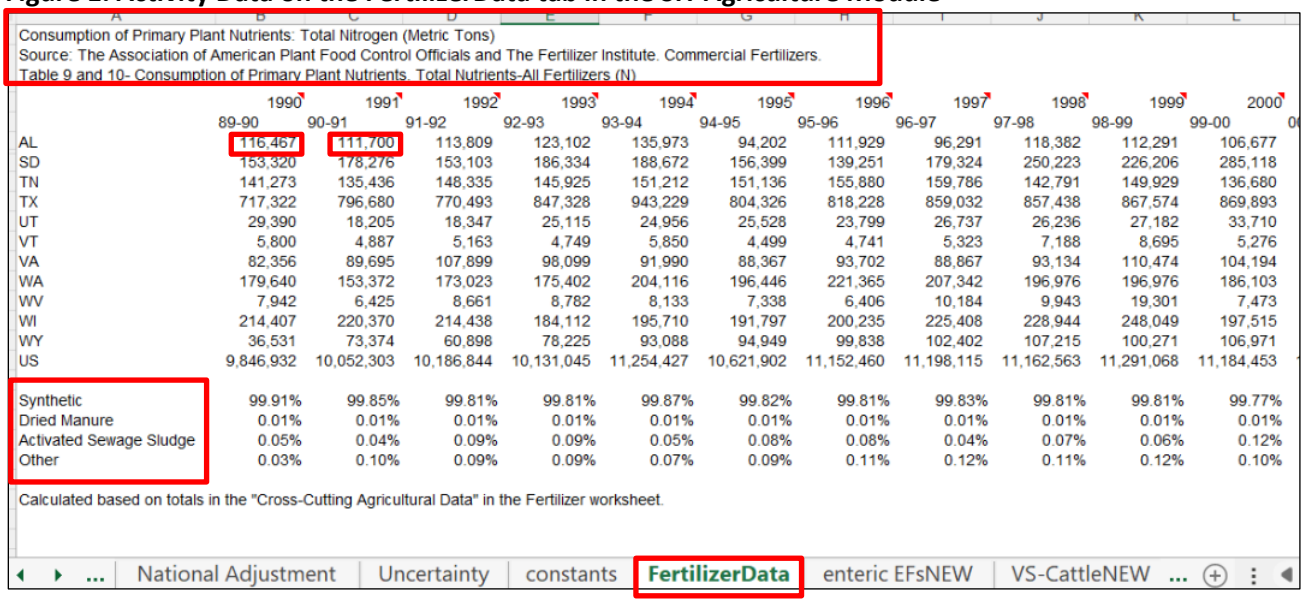
Step 1: Obtain state-level fertilizer data from the State Inventory Tool Agriculture Module

Fertilizer consumption data at the state level is available from the State Inventory Tool (SIT) Agriculture Module. The SIT Modules are available for download here:

[1] Emissions from livestock, such as enteric fermentation and manure management, are currently not estimated within this tool. If emissions from these sources are estimated elsewhere, the results can be entered on the Additional Sources Inventory Sheet, where they will be summed alongside emissions estimated by the Local Greenhouse Gas Inventory Tool Module. Please see the Local Greenhouse Gas Inventory Tool User's Guides for additional information. Other emissions from agricultural business operations, such as building and transportation energy use, are estimated in the energy sector.

https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool. Within the Agriculture Module, SIT lists total nitrogen (N) consumption in metric tons by state on the FertilizerData tab (Figure 1).

Figure 1. Activity Data on the FertilizerData tab in the SIT Agriculture Module



Consumption of Primary Plant Nutrients: Total Nitrogen (Metric Tons)
Source: The Association of American Plant Food Control Officials and The Fertilizer Institute. Commercial Fertilizers.
Table 9 and 10- Consumption of Primary Plant Nutrients. Total Nutrients-All Fertilizers (N)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00
AL	116,467	111,700	113,809	123,102	135,973	94,202	111,929	96,291	118,382	112,291	106,677
SD	153,320	178,276	153,103	186,334	188,672	156,399	139,251	179,324	250,223	226,206	285,118
TN	141,273	135,436	148,335	145,925	151,212	151,136	155,880	159,786	142,791	149,929	136,680
TX	717,322	796,680	770,493	847,328	943,229	804,326	818,228	859,032	857,438	867,574	869,893
UT	29,390	18,205	18,347	25,115	24,956	25,528	23,799	26,737	26,236	27,182	33,710
VT	5,800	4,887	5,163	4,749	5,850	4,499	4,741	5,323	7,188	8,695	5,276
VA	82,356	89,695	107,899	98,099	91,990	88,367	93,702	88,867	93,134	110,474	104,194
WA	179,640	153,372	173,023	175,402	204,116	196,446	221,365	207,342	196,976	196,976	186,103
WV	7,942	6,425	8,661	8,782	8,133	7,338	6,406	10,184	9,943	19,301	7,473
WI	214,407	220,370	214,438	184,112	195,710	191,797	200,235	225,408	228,944	248,049	197,515
WY	36,531	73,374	60,898	78,225	93,088	94,949	99,838	102,402	107,215	100,271	106,971
US	9,846,932	10,052,303	10,186,844	10,131,045	11,254,427	10,621,902	11,152,460	11,198,115	11,162,563	11,291,068	11,184,453
Synthetic	99.91%	99.85%	99.81%	99.81%	99.87%	99.82%	99.81%	99.83%	99.81%	99.81%	99.77%
Dried Manure	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Activated Sewage Sludge	0.05%	0.04%	0.09%	0.09%	0.05%	0.08%	0.08%	0.04%	0.07%	0.06%	0.12%
Other	0.03%	0.10%	0.09%	0.09%	0.07%	0.09%	0.11%	0.12%	0.11%	0.12%	0.10%

Calculated based on totals in the "Cross-Cutting Agricultural Data" in the Fertilizer worksheet.

National Adjustment | Uncertainty | constants | FertilizerData | enteric EFsNEW | VS-CattleNEW

Step 2: Convert from fertilizer year to calendar year

Note that the data included on the FertilizerData tab are reported in fertilizer years, not calendar years. The fertilizer year spans from July 1 to June 31, so total nitrogen (N) consumption must be reapportioned from the fertilizer year to the calendar year for emissions to be properly allocated to the calendar year (see Equation 1). The Tennessee Valley Authority estimates that 35% of fertilizer consumption occurs from July to December and 65% from January to June, as more fertilizer is typically applied during the spring. The 1990 fertilizer year, for example, spans from July 1, 1989 to June 31, 1990.

For example, fertilizer consumption in calendar year 1990 in Alabama would be calculated as follows:

Equation 1. Converting to Calendar Year Fertilizer Consumption

$$(\text{Year 1 Fertilizer } t_m \text{ x } 35\%) + (\text{Year 2 Fertilizer } t_m \text{ x } 65\%) = \text{Fertilizer}_{total}$$
$$(116{,}467\ t_m \times 35\%) + (111{,}700\ t_m \times 65\%) = 114{,}799\ \ t_m$$

Where:

$Fertilizer_{total}$	*total amount of fertilizer applied during the calendar year*
Year 1 Fertilizer t_m	*total amount of fertilizer applied during Year 1 fertilizer year*
Year 2 Fertilizer t_m	*total amount of fertilizer applied during Year 2 fertilizer year*
t_m	*metric tons*

Step 3: Convert from metric tons to short tons

Next, use Equation 2 to convert total N consumption to short tons by dividing by 0.9072 (0.9702 metric tons = 1 short ton).

Equation 2. Converting to Short Tons of Fertilizer

$$Fertilizer_{total} = Fertilizer\ t_m \div\ 0.9072$$

$$126{,}541\ t_s = 114{,}799\ t_m \div 0.9072$$

Where:

$Fertilizer_{total}$	*total amount of fertilizer applied, from all sources*
t_s	*short tons*
t_m	*metric tons*
0.9072	*the conversion factor for metric tons to short tons*

Step 4: Calculate the consumption of each fertilizer type

Finally, use Equations 3-6 to derive consumption of each fertilizer type by multiplying the total fertilizer in short tons by the percentage of each fertilizer type consumed as a fraction total fertilizer consumption, as listed in rows 57-60 on the Agriculture Module FertilizerData tab (Figure 1). Please see Chapter 5 Agriculture of the Inventory of U.S. Greenhouse Gas Emissions and Sinks for more information on fertilizer types.

Equation 3. Calculating Consumption of Fertilizer, Synthetic N (short tons)

$$\text{Fertilizer}_{synthetic} = \text{Fertilizer t}_s \times 99.91\%$$

$$126{,}427\ \text{t}_s = 126{,}541\ \text{t}_s \times 99.91\%$$

Where:

$Fertilizer_{synthetic}$	*amount of synthetic fertilizer applied, from total fertilizer (short tons)*
99.91%	*percentage of synthetic nitrogen fertilizer in total fertilizer*

Equation 4. Calculating Consumption of Fertilizer, Manure (short tons)

$$Fertilizer_{manure} = 126{,}541\ t_s \times 0.01\%$$

$$12.6\ t_s = 126{,}541\ t_s \times 0.01\%$$

Where:

$Fertilizer_{manure}$	*amount of manure applied, from total fertilizer*
0.01%	*percentage dried manure fertilizer in total fertilizer*

Equation 5. Calculating Consumption of Fertilizer, Activated Sewage Sludge (short tons)

$$\text{Fertilizer}_{organic} = 126{,}541\ \text{t}_s \times 0.05\%$$

$$63.3\ t_s = 126{,}541\ \text{t}_s \times 0.05\%$$

Where:

$Fertilizer_{organic}$	*amount of activated sewage sludge fertilizer applied, from total fertilizer*
0.05%	*percentage of (organic) sewage sludge in fertilizer*

Equation 6. Calculating Consumption of Fertilizer, Other Organic Materials (short tons)

$$\text{Fertilizer}_{other} = \text{t}_s \times 0.03\%$$

$$38.0\ \text{t}_s = 126{,}541\ \text{t}_s \times 0.03\%$$

Where:

$Fertilizer_{other}$ *amount of other fertilizer applied (e.g., compost), from total fertilizer*
0.03%

Step 5: Downscale state-level data to the local level

Once state-level data are calculated, it can be downscaled to the county or city level depending on data availability. For example, local fertilizer consumption can be calculated by multiplying the state-level fertilizer consumption estimates by the proportion of state cropland acreage found within the county or city, per crop type. Note that total cropland acres in each county can be downloaded from the U.S. Department of Agriculture (USDA)'s QuickStats database. See Appendix A: Using USDA NASS QuickStats Database for additional detail on how to operate QuickStats.

Equation 7 shows a sample calculation for how to scale state-level fertilizer data to the county-level using cropland acreage.

Equation 7. Scaling State-Level Fertilizer Data to the County Level

$$\text{Fertilizer}_{county} = (\text{Cropland acres}_{county} \div \text{Cropland acres}_{state}) \times \text{Fertilizer}_{state}$$

Where:

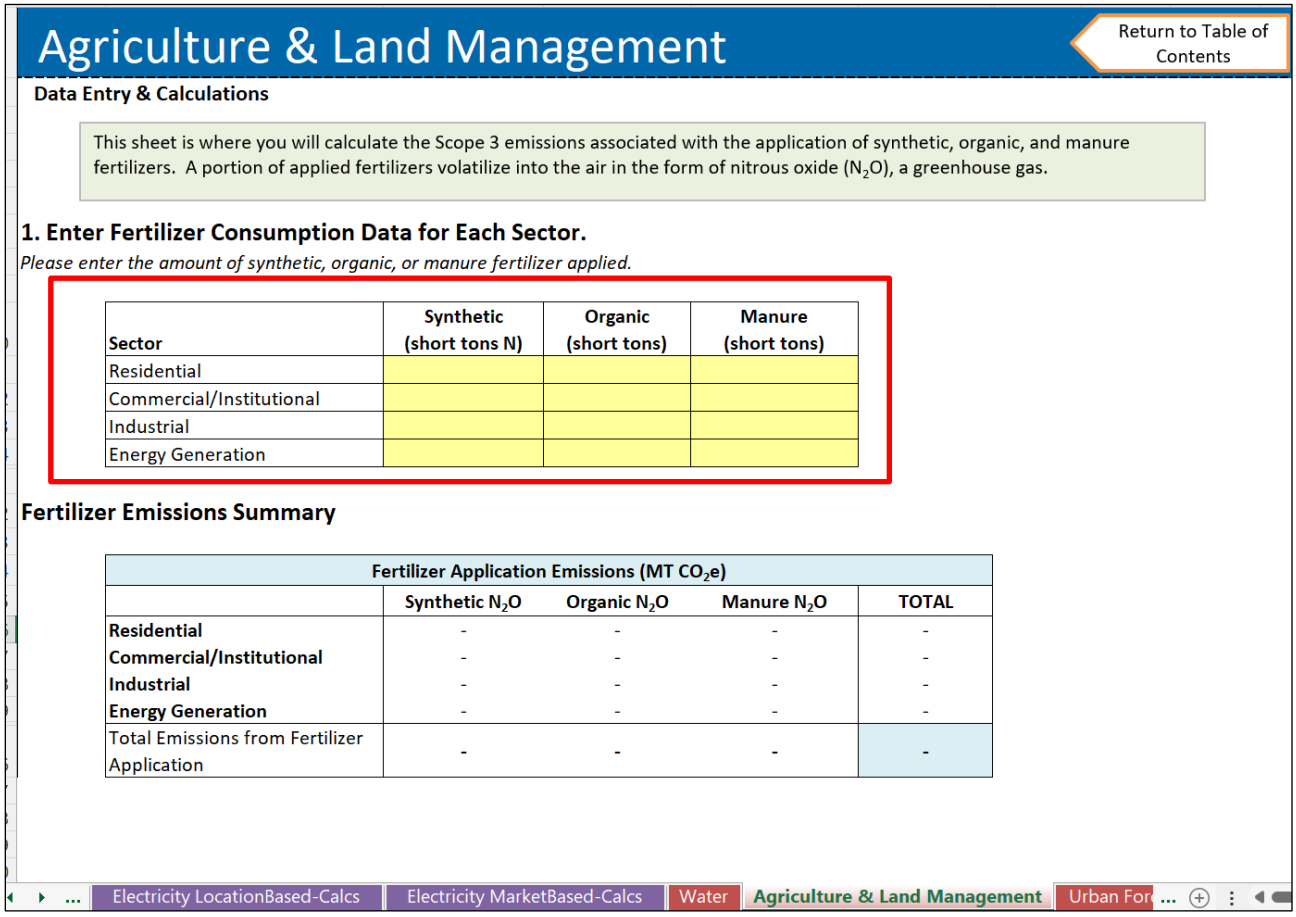
$\text{Cropland acres}_{county}$	*total cropland acreage per selected county, from USDA QuickStats*
$\text{Cropland acres}_{state}$	*total cropland acreage per selected state, from USDA QuickStats*
$Fertilizer_{state\ fertilizer\ type}$	*total fertilizer consumption per fertilizer type (synthetic, organic, manure) per selected state, from SIT Agriculture Module*

Repeat the above equation for each fertilizer type and enter the quantities into the tool following the instructions under Step 6: Enter fertilizer consumption data into the tool

Step 6: Enter fertilizer consumption data into the tool

Fertilizer consumption data can be entered into the tool by entering the Fertilizer, Synthetic N total into the Synthetic N column, the sum of the Fertilizer, Activated Sewage Sludge and Fertilizer, Other Organic Materials into the Organic column, and the Fertilizer, Dried Manure total into the Manure column on the Agriculture and Land management tab in the Module (Figure 2). The fertilizer consumption should be entered into the row that corresponds to its sector of origin. For example, synthetic N applied to turf at a school would be entered under the Commercial/Institutional sector, while synthetic N applied to agricultural fields would be entered under the Industrial sector.

Figure 2. Fertilizer Data Entry in the Agriculture & Land Management Sheet



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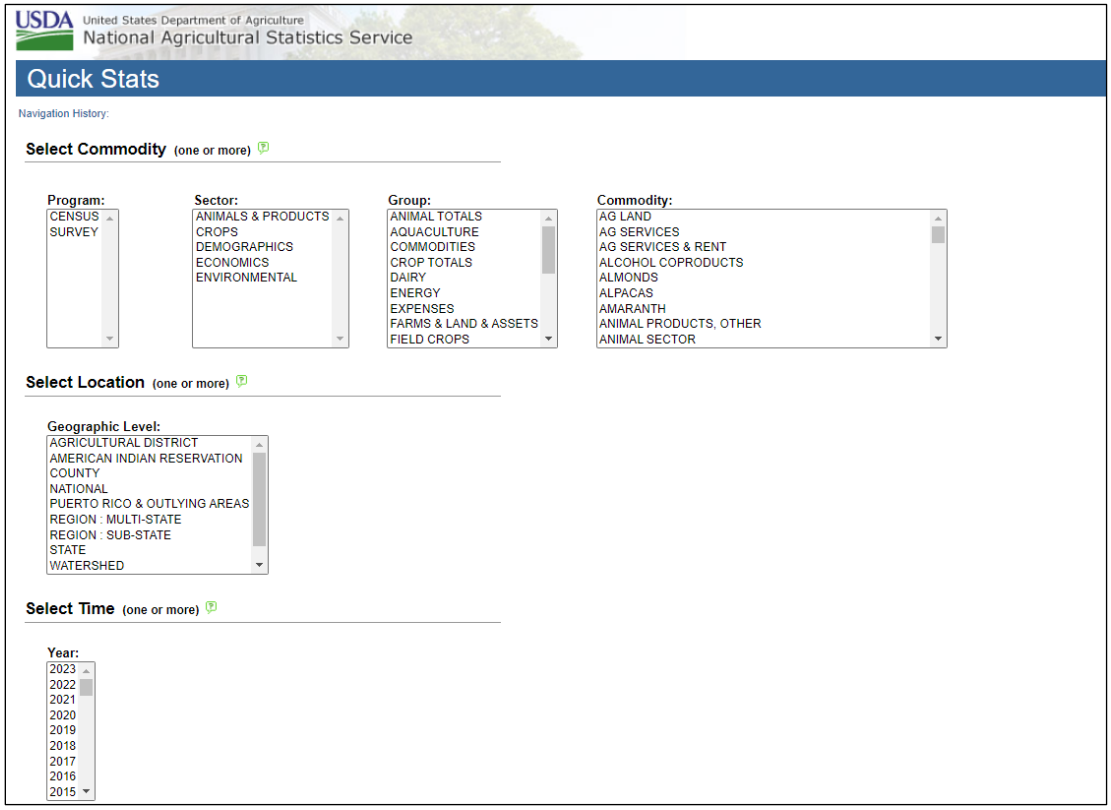
Appendix A: Using USDA NASS QuickStats Database

The USDA NASS QuickStats[2] Database has limited data on fertilizer consumption at the county-level. However, it does publish estimates of total cropland acreage by county, which can be used to scale fertilizer consumption from the state level to the county-level as described in Equation 7 under Step 5: Downscale state-level data to the local level.

The following figures show how to download cropland acreage by county from QuickStats.
To use QuickStats, first navigate to the website: https://quickstats.nass.usda.gov/(Figure 3).

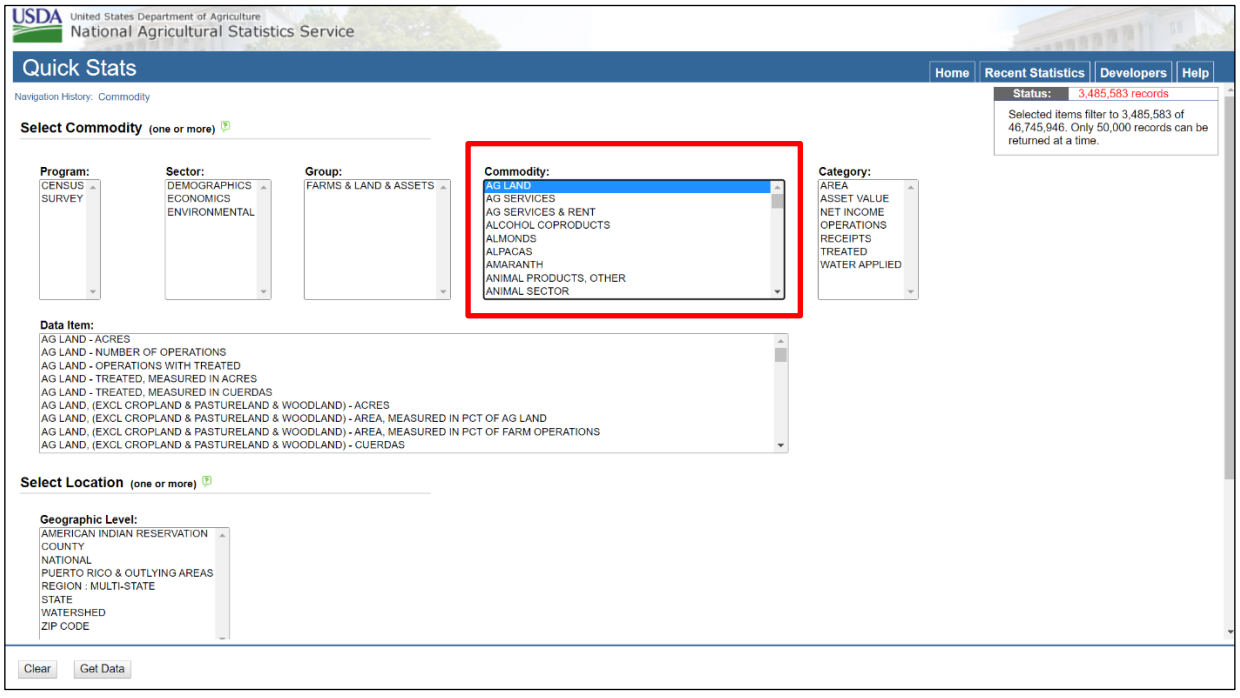
[2] The U.S. Department of Agriculture (USDA) publishes agricultural activity data on the QuickStats website. The QuickStats database is the most comprehensive tool for accessing agricultural data published by the National Agricultural Statistics Service (NASS). The tool allows the user to customize the query by commodity, location, or time period.

Figure 3. USDA NASS QuickStats Database



Next, select which commodity you are interested in examining by selecting a parameter in the Commodity field (Figure 4). Do not select parameters in the Program, Sector, or Group fields. These fields will automatically update depending on which parameter you select in the Commodity field.

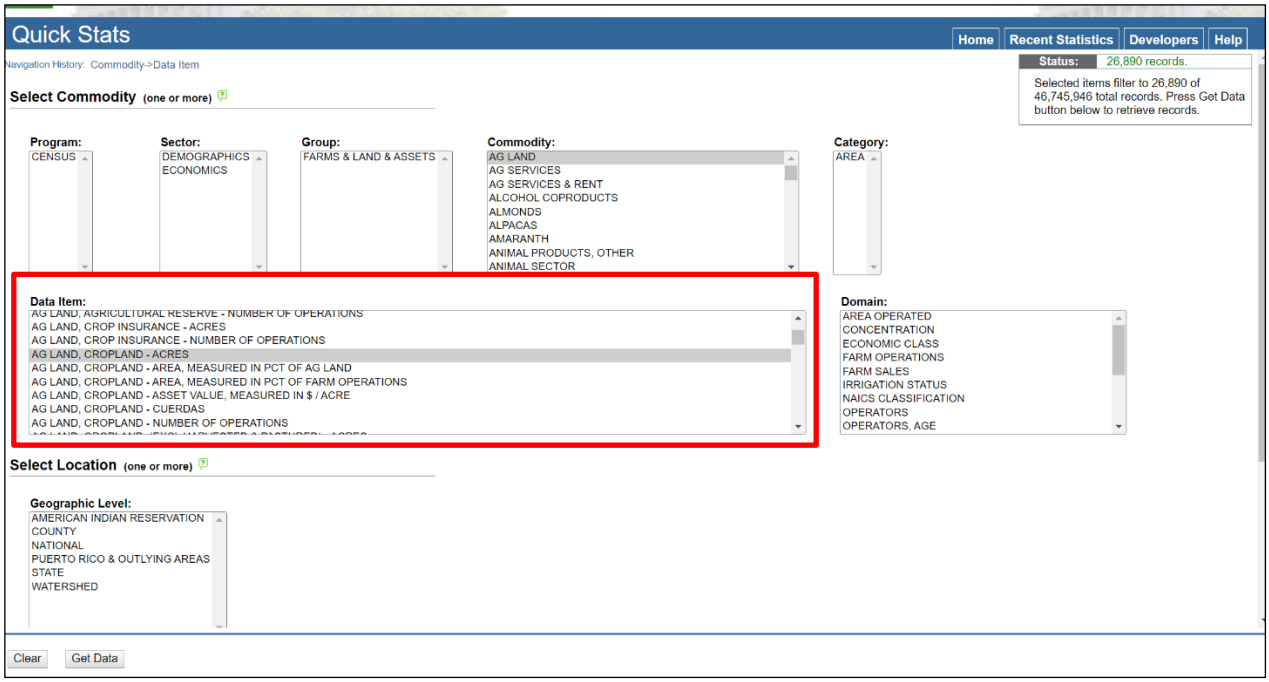
Figure 4. Selecting a Commodity



After you select a commodity, the Data Item field will appear. Select a Data Item from the list. The Data

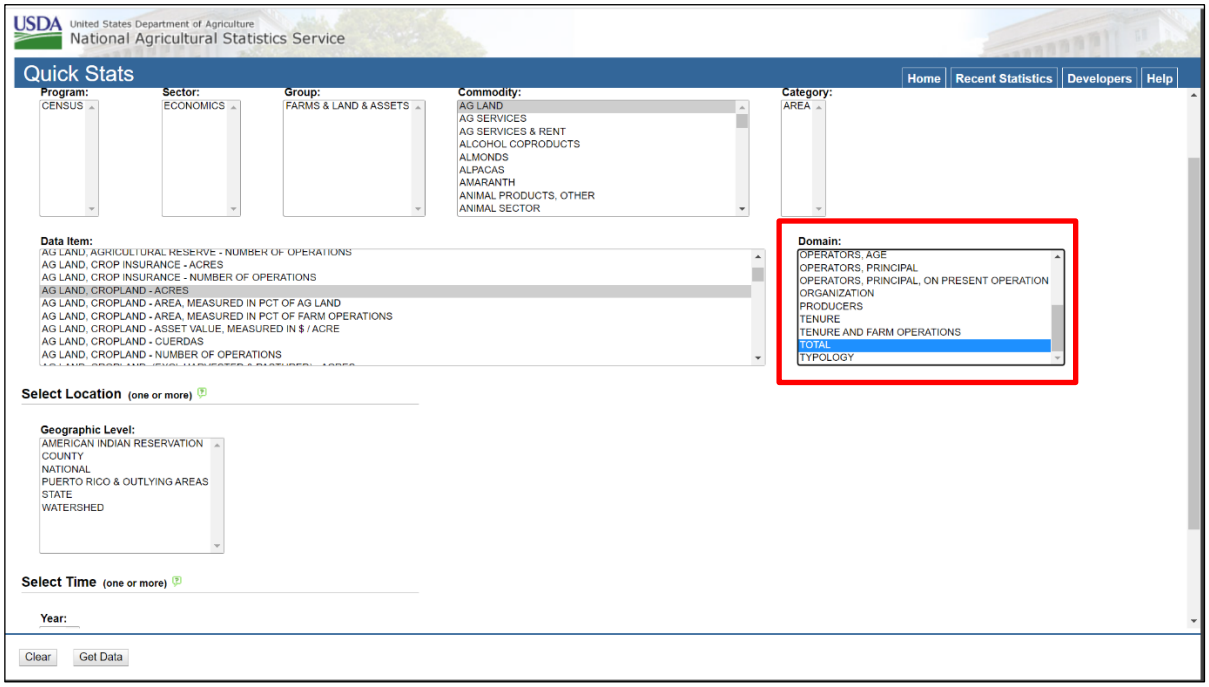
Item parameter will vary depending on the commodity. There is no need to select a Category parameter.

Figure 5. Selecting a Data Item



Once you select a Data Item, the Domain field will appear (Figure 6). The Domain field will change depending on which Data Item is selected. The Domain field is where you can select what type of information you would like to know about the selected Data Item, such as total acres, total sales, number of operations, irrigation status, etc.

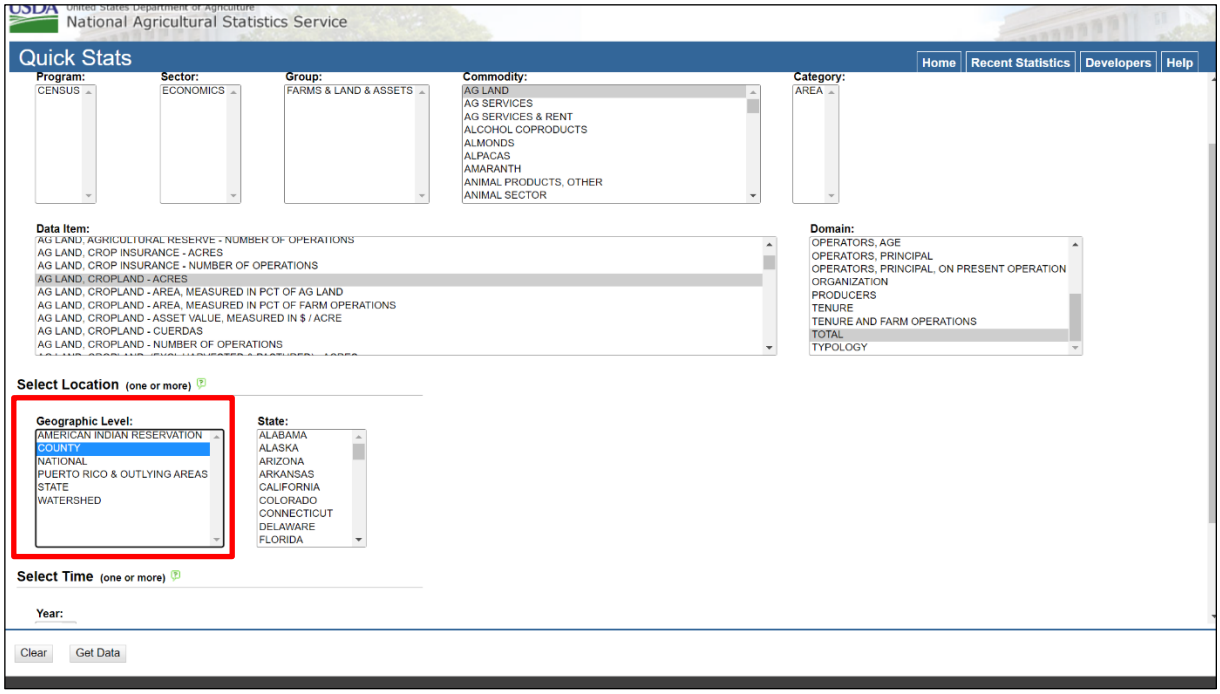
Figure 6. Selecting a Domain



Next, select the geographic area for which you would like to download data (Figure 7). Note that the

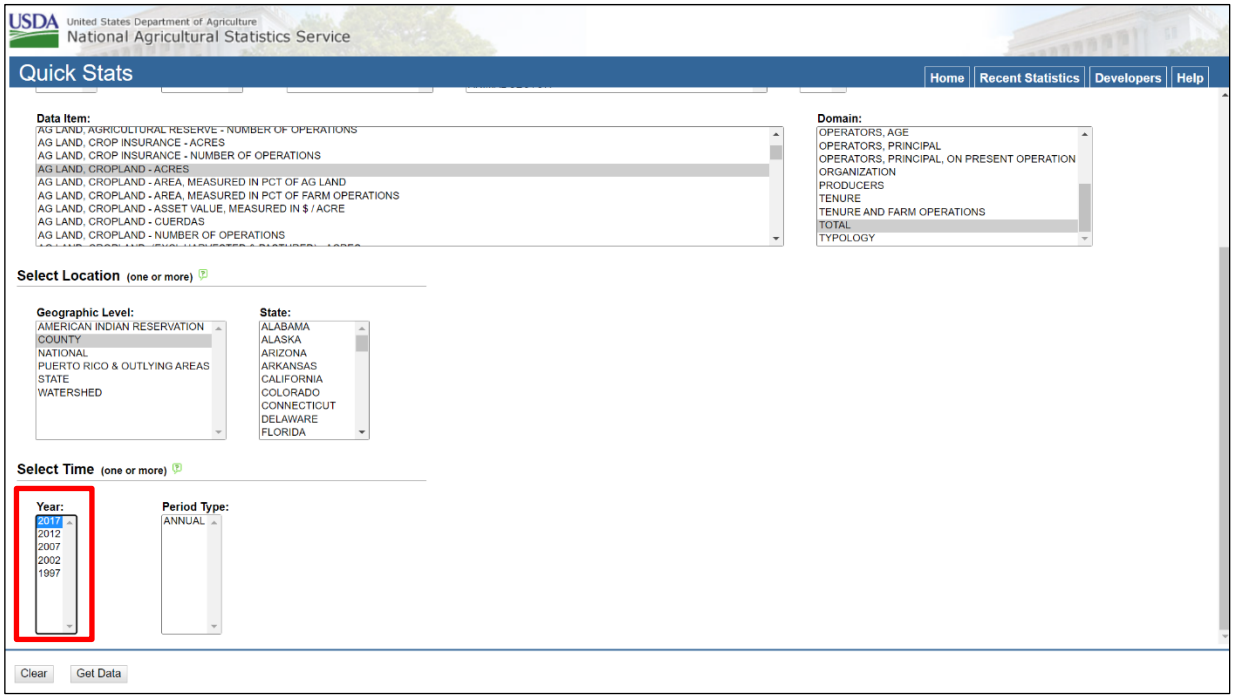
Geographic Level field will automatically update depending on what is selected in the Data Item and Domain fields. Data the county or watershed level, for example, is not available for every Data Item. The Geographic Level can be further refined by selecting a specific state in the State field. Do not select a state to download data for all states.

Figure 7. Selecting a Geographic Level



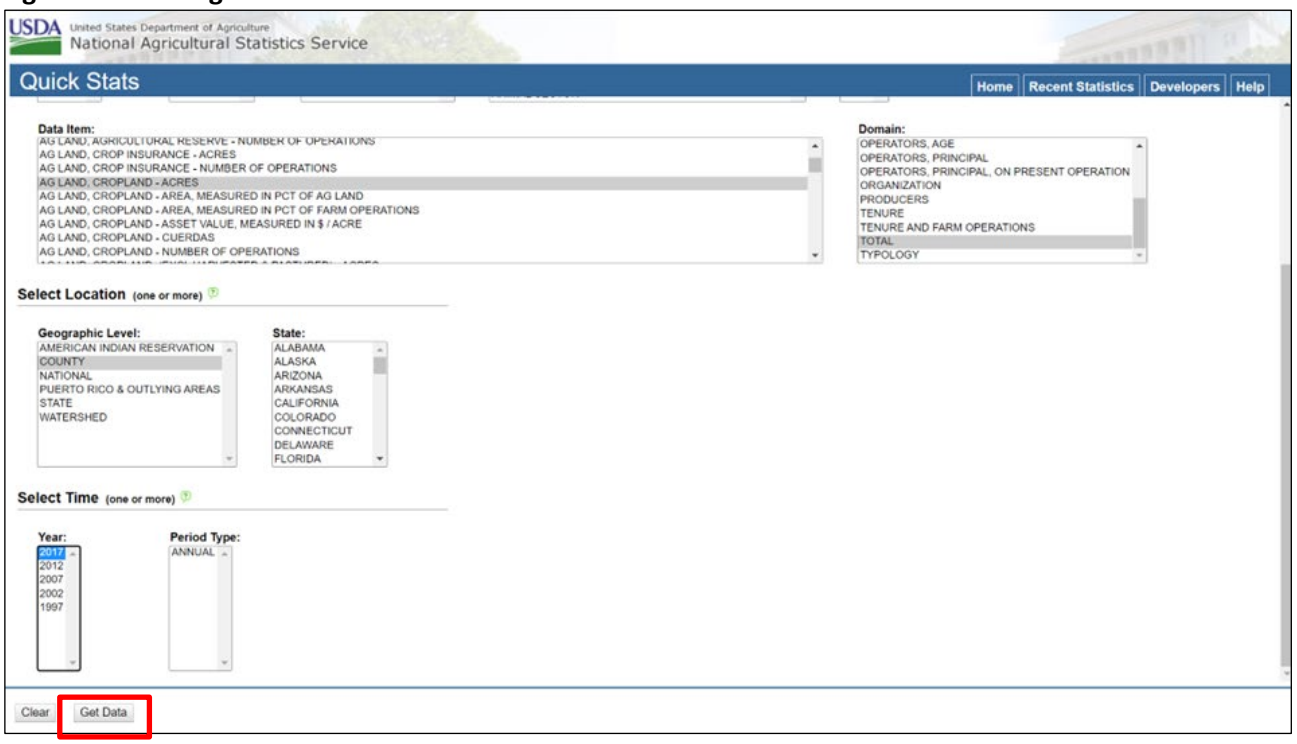
Similarly, the Year field will update depending on what Geographic Level is selected (Figure 8). County-level data are available for each year for some Data Items. For others, county-level data are only available every 5 years in each Census of Agriculture. The Program field gives insight into data availability by indicating whether the data originates from the Census of Agriculture or a survey. Surveys are typically administered annually, while the Census of Agriculture is performed every 5 years and was last conducted in 2017.

Figure 8. Selecting a Year



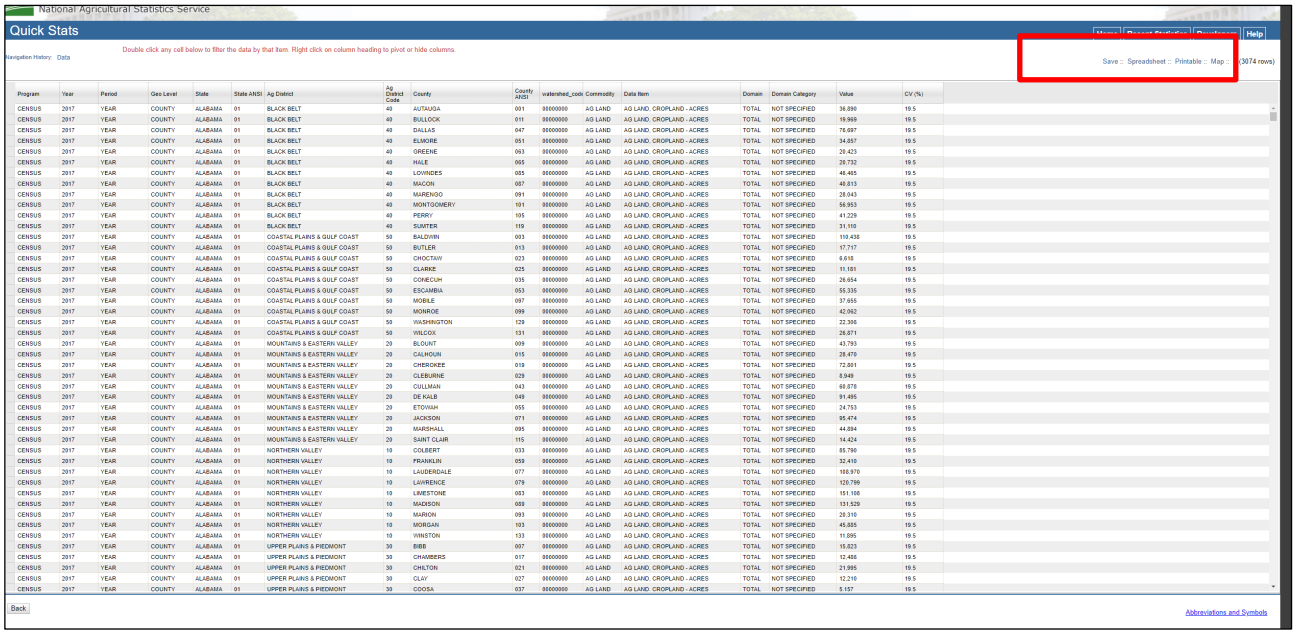
Once the desired parameters are selected, select the Get Data button at the bottom left corner of the screen (Figure 9).

Figure 9. Selecting Get Data Button



A new window will be launched that contains the results of your query. To export this data to Excel, click the Spreadsheet button in the top right corner (Figure 10).

Figure 10. Exporting Data to Excel



Selecting this button will download a CSV with the cropland acreage for your selected county, which can be used to scale fertilizer consumption to the county level following the formula in Equation 7. The QuickStats instructions can be repeated to obtain total cropland acreage by state by changing the Geographic Level to state.