



Inventory of Lost Farmland Full Report 2010 – 2022

Prepared by the Indiana State Department of Agriculture

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Introduction

The Indiana General Assembly passed House Enrolled Act 1557-2023 (HEA 1557), which tasks the Indiana State Department of Agriculture with fulfilling the following tasks:

- (1) conduct an inventory of all farmland lost in Indiana from 2010 to 2022; and
- (2) identify the primary cause of the reduction of farmland under subdivision (1).

The Indiana State Department of Agriculture (ISDA) conducted an analysis to best answer the above questions. HEA 1557 defines farmland based on IC 14-22-11-1(a)(2), “agricultural land that is (1) devoted or best adaptable for the production of crops, fruits, timber, and the raising of livestock; or (2) assessed as agricultural land for property tax purposes.” ISDA used existing datasets to estimate the quantity and the cause of farmland reduction from 2010 to 2022.

Methods and Data

Two data sources were identified as suitable for this project. Both datasets have different qualities that make them desirable for attempting to discern both the quantity of land use change, and the causes of land use change. The first was a state land parcel data set that is maintained by the Indiana Department of Local Government Finance (DLGF). This data set is a database of all property records in the state of Indiana. Counties submit parcel data annually to DLGF, which aggregates them into a single dataset. DLGF shared the parcel records datasets for years 2010 and 2022 with ISDA. The second data source that was identified was The United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL). The CDL is a classified, geo-referenced raster, land cover dataset specific to agriculture. Remote sensing data from moderate resolution satellite imagery along with extensive ground truthing data is used to estimate land cover, with agricultural land classified by specific crop type. (2)

The DLGF data was chosen for this project because it most closely matches the definition of farmland provided in HEA 1557. The DLGF parcel data is tabular data that is not recorded in spatial format. Geographic data of parcel boundaries exists, but the parcel data was unable to be reliably georeferenced for both datasets. Therefore, this dataset was used as tabular data, and was able to provide insights about the quantity of land use change but could not be used to assess any geospatial patterns in land use change.

The land use of a parcel is recorded as its Property Class Code which is indicative of that parcel’s use, or potential use, for the property tax management system. Indiana’s property class codes can be found in the Property Tax Management System Code List manual (1). Parcel data also includes the area of the parcel, as its legally deeded acreage. These two attributes were used to assess the quantity of specific land uses. Property Class Codes 100-199 all denote agricultural usage of various types, the below table outlines the various categories of agricultural land use that may be recorded.

Table 1 – Agricultural Property Class Codes

Code	VALUE
100	AGRICULTURAL - VACANT LAND
101	AGRICULTURAL - CASH GRAIN/GENERAL FARM
102	AGRICULTURAL - LIVESTOCK OTHER THAN DAIRY OR POULTRY
103	AGRICULTURAL - DAIRY FARM
104	AGRICULTURAL - POULTRY FARM
105	AGRICULTURAL - FRUIT & NUT FARM
106	AGRICULTURAL - VEGETABLE FARM
107	AGRICULTURAL - TOBACCO FARM
108	AGRICULTURAL - NURSERY
109	AGRICULTURAL - GREENHOUSES
110	AGRICULTURAL - HOG FARM
111	AGRICULTURAL - BEEF FARM
120	AGRICULTURAL - TIMBER
141	AGRICULTURAL LAND WITH MOBILE HOME
149	AGRICULTURAL LAND WITH PP MOBILE HOME
198	AGRICULTURAL BUILD LEASE LAND
199	AGRICULTURAL - OTHER AGRICULTURAL USE

The property class codes were reclassified using two schemas. This was done to simplify the results, grouping similar categories. Property class codes are already organized into blocks of 100 (i.e. the block 100-199 is agriculture), the first schema separated the data into the types denoted by the 100 level blocks; agriculture, mineral, industrial, commercial, residential, and other (see Table 3). The second reclassification schema broke down the agricultural property class codes into subtypes specific to agriculture; ‘Agricultural - Vacant Land’, ‘Agricultural – Cash Grain / General Farm’, ‘Agricultural – Livestock including dairy’, ‘Agricultural - Specialty Crop’, ‘Agricultural – Timber’, and ‘Agricultural – Other’. Table 4 shows which property class codes were included within each agricultural subtype.

Totals of land use type categories for both schemas, the general schema, and the schema with agricultural subtypes were calculated. This was accomplished by summing the total of the legally deeded acreage for each parcel that fell into a specific category.

Parcel numbers were matched between the 2010 and 2022 DLGF parcel datasets to find common parcels. Not all parcels are common between the two datasets, due to changes in parcels over the time-period, such as splitting parcels. Approximately three million of the parcels were common between both datasets, and about half a million were not. The 2010 dataset had 506,817 agricultural parcels, 428,440 of which were common among both datasets. The 2022 dataset had 514,375 agricultural parcels, 413,608 of which were common among both datasets. There was about an 85% match rate of parcels there were in both the 2010 and 2022 datasets. Using the parcels that were common to both datasets (i.e. had an unchanged parcel number from 2010 to 2022), the quantity of land that was changed from a specified use to another specified use could be calculated. This data is expressed as a land use change category (i.e. from Agricultural to Residential). These estimates are not as accurate as the statewide net figures, as they do not include land that had parcel number changes but can give an approximate quantity of a more specific land use change scenario.

The CDL was primarily used to provide more insight into the geospatial patterns in land use change across the period that could not be ascertained from the parcel data. However, estimates of land use change were also calculated. Crop specific land cover was not needed for this analysis so CDL data was reclassified into the following categories: Agriculture, Developed Land, Forest and Wetland, and Other. The specific reclassification schema is detailed in Table 5.

The CDL raster data was processed to best determine the spatial patterns of land use change. This involved generalizing the raster data to remove unnecessary details in the form of small, isolated pixels or groups of pixels that would not be indicative of an area of the size of an agricultural field. The image generalization process was done with tools within ESRI's ArcGIS Pro, a desktop geographic information system (GIS) software. This is done by a three-step process, the first step is identifying small, isolated areas or clusters of cells, these clusters may be the results of misclassification, or of irrelevant detail. These clusters are then removed and assigned values of their surrounding cells with the Set-Null and Nibble tools. This results in a more uniform, but less detailed raster that can be more easily used for qualitative analysis of land use change. (3)

After both CDL rasters were generalized they were compared with ESRI's change detection tool, which compares both rasters on pixel-by-pixel basis. The result of this is a categorical raster with pixels that have land use change categories, i.e. from Agricultural to Developed. (4) Figure 1 shows the workflow that was used for analysis of the CDL data. Figure 2 shows a comparison of sample images and change detection results with and without image generalization.

Results and Discussion

Net Land Use Change

The DLGF parcel dataset showed a total of 18,314,648 acres of land with property class codes in the agricultural range (100-199) in 2010 and a total of 17,968,966 acres in 2022 across the state of Indiana. This is a decrease of 345,682 acres, and a percent change of -1.89%. Table 2 also shows the net changes in acreage for all agricultural subtypes.

The NASS Cropland Data Layer showed a total of 14,606,334 acres of land with land classified as any type of agricultural use in 2010, and a total of 14,040,419 acres with land classified as any type of agricultural use in 2022. After an image generalization process was applied to the NASS datasets, 14,843,824 acres of land with land classified as any type of agricultural use to in 2010, and a total of 14,178,836 acres with land classified as any type of agricultural use in 2022. Remote sensing data provides estimates of actual land cover, which is more precise than administrative records like parcels, in estimating the actual land use (i.e. land that was actually utilized for growing crops in a particular years).

Estimates of total and net changes for raster data are generated via 'pixel counting' or multiplying the area of a pixel by its quantity. This method provides a raw estimate that is usually downward biased. (2) Therefore, this dataset is likely less reliable in providing accurate quantity estimates than the parcel data, because there is more error during the process. The image generalization workflow is likely to further bias quantity results, as it removes small and isolated pixels, and changes edges of regions, which will affect the accuracy of quantity estimates.

The total net changes in agricultural land from the DLGF parcel data and CDL raster data, along with total net changes of the subtypes of agricultural land use from parcel data is shown in Table 2.

Those values are the net changes in their respective categories. The best publicly available data to compare these results to is USDA’s Census of Agriculture. The closest comparison with the Census of Agriculture is to the ‘land in farms’ statistic. USDA considers a farm any place from which 1,000 dollars or more of agricultural products are produced annually. The closest Census of Agriculture years to those analyzed in this study are 2012, and 2022. USDA estimated 14,720,400 acres of land in farms in 2012, and 14,602,240 of land in farms in 2022, which is difference of 118,160 acres, or about 1 percent decrease. (5)

The three datasets (the two utilized by ISDA, and the Census of Agriculture) all yielded different estimates of both total agricultural land, and reduction of agricultural land. This is likely primarily due to each datasets category of agriculture/farmland being slightly different. A detailed explanation of what is included in each category for both the parcel data and the CLD data can be found in Tables 3 and 5.

Table 2 – Net Change in Agricultural, and Specific Agricultural Land Usage Acres Across Indiana

<i>Indiana Department of Local Government Finance Parcel Data</i>				
	Acres 2010	Acres 2022	Difference	Percent Change
Agricultural – Cash Grain / General Farm	6,466,081	4,701,361	1,764,720	-27.29%
Agricultural – Livestock including dairy	84,779	85,502	-723	0.85%
Agricultural - Other	1,737,405	1,994,398	-256,993	14.79%
Agricultural - Specialty Crop	7,033	5,635	1,398	-19.88%
Agricultural - Timber	129,075	132,511	-3,436	2.66%
Agricultural - Vacant Land	9,890,274	11,049,558	-1,159,284	11.72%
Agriculture Total (100-199) Acres	18,314,648	17,968,966	345,682	-1.89%
<i>Cropland Data Layer Raster Data</i>				
	Acres 2010	Acres 2022	Difference	Percent Change
Agriculture With Reclass	14,606,334	14,040,419	565,915	-3.87%
Agricultural With Image Generalization	14,843,824	14,178,836	664,988	-4.48%

Categorical Land Use Change

Tables 6 and 7 show the results of the analysis in which categories of land use change were calculated. Table 6 shows the acres of land use change categories for the general land use types shown in Table 3. The largest land use type that agricultural land was converted to was residential. This analysis shows about 370,000 acres of agricultural land was converted to residential land.

Table 7 shows the acres of land use change for the agricultural subtypes shown in Table 4. This includes change between agricultural subtypes, as well to non-agricultural land uses. The ‘Agricultural – Cash Grain / General Farm’ category includes corn and soybean row cropping, which makes up the primary agricultural land use in Indiana. The largest change in this category, was to ‘Agricultural –

Vacant Land'. The largest change in this category to a non-agricultural category was to residential, about 200,000 acres. All quantities of categorical land use change do not account for areas where parcels changed and therefore were not in both datasets. Categorical land use change results from parcel data are likely biased low, as they do not include any land that changed parcel numbers.

The results of the Cropland Data Layer raster change detection can be seen in Table 8. This table shows the gross, and not net changes by category, and therefore does not account for areas in which a category gained area. The 'Agricultural' class lost the most acres to developed land, about 181 thousand acres. The second largest change was to forest, at about 113 thousand acres. The results of from the Cropland Data Layer and the parcel data are related but not directly comparable, because the type of land use included in each class does not directly correlate with a class in the other dataset. Table 5 shows what specific land covers were included in in each category in the CDL data.

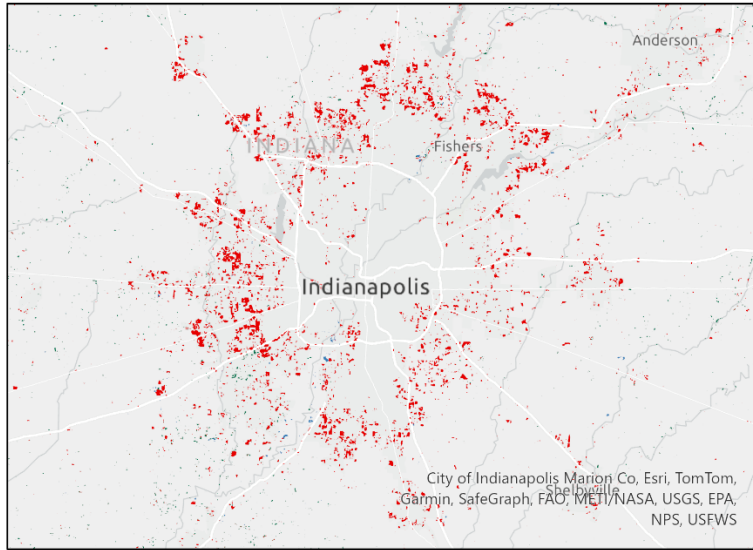
Remote sensing data is only able to differentiate between land cover types, and not specific land use types (i.e. cannot differentiate livestock facilities from other developed land use). Therefore, these datasets are best used to elucidate different aspects of land use change than as a direct comparison, and all values and figures need to be put into the context of the dataset that derived them.

The change analysis of the CDL data resulted in a categorized raster with categories for each different possible iteration of land use change. This allows for the visualization of spatial patterns of where agricultural land was lost during the period. Qualitative analysis of these results show that agricultural land was most likely to be lost in the area around the edge of cities and suburban areas. Figure 3 shows Indianapolis, Indiana's largest urban area, and Lafayette, a medium sized city in northwestern Indiana, with the surrounding land use change thematically mapped. It shows change of land use from agricultural to other types around the edges of the populated areas. This trend is consistent for many urbanized areas around the state.

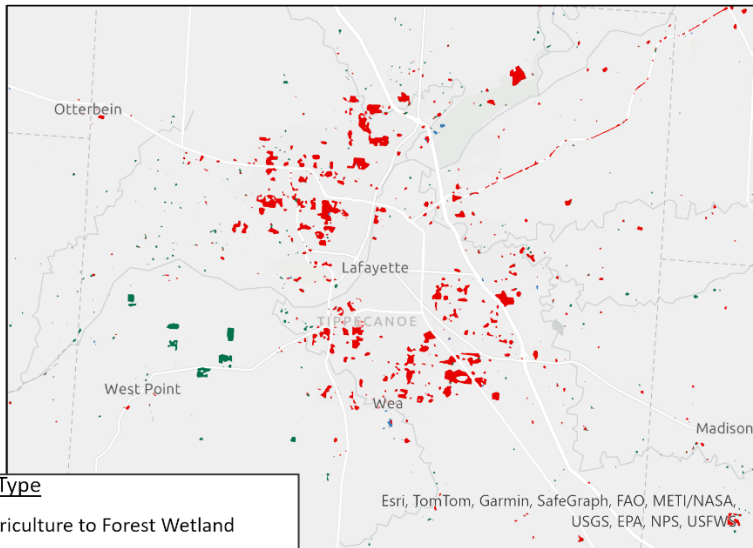
Figure 3: Area Around Example Indiana Cities That Lost Agricultural Land Cover

Area Around Indiana Cities That Lost Agricultural Land Cover
Cropland Data Layer - Change Detection 2010 - 2002

Indianapolis



Lafayette



Change Type	
■	Agriculture to Forest Wetland
■	Agriculture to Other
■	Agriculture to Developed

Conclusion

The Indiana State Department of Agriculture conducted an analysis of available data to attempt to determine the quantity and causes of farmland loss during the period of 2010 to 2022. ISDA analyzed two datasets, a land parcel dataset for Indiana that from the Indiana Department of Local Government Finance, and the United State Department of Agriculture's Cropland Data Layer, a classified raster dataset, derived from remote sensing data. Both datasets were analyzed for both 2010 and 2022.

The parcel data was analyzed in two ways; the net change in agricultural acres was determined and change in property class codes was evaluated for every parcel, to determine the type of land use change that occurred (i.e. Agricultural to Residential). The two parcel datasets had approximately an 85% match rate for parcel numbers, due to changes in parcels over the period. These estimates are not as accurate as the statewide net figures, as they do not include land that had parcel number changes but can give an approximate quantity of how land use changed.

According to the parcel data, there were about 18.3 million acres of agricultural land with property class code denoting agricultural use in 2010, and about 17.9 million acres in 2022. This is a loss of about 345 thousand acres, or a 1.89 percent decrease. The largest loss of agricultural land was to Residential at about 370 thousand acres. (Note, that this gross loss of land, and it is larger than the net loss of all agricultural land because there was also agricultural gained during this period.) The 'Agricultural - Cash Grain / General Farm' subtype, which includes the corn and soybean row crops, saw a net decrease of about 1.76 million acres or about 27%. Of the 1.76 million acres decrease in 'Cash Grain / General Farm' about 1 million acres went to 'Agricultural- Vacant Land', and about 461 thousand acres went to 'Agricultural – Other'. The largest loss of 'Agricultural - Cash Grain / General Farm' land to a non-agricultural subtype was to Residential, about 200 thousand acres.

The Cropland Data Layer raster data was processed for 2010 and 2022, and the ESRI change detection tool was used to generate a raster showing the location of land use change. The main loss of agricultural land was found to be to 'Developed' land use, which would include residential and other types of urban land use. This was found to be most concentrated around the outside of cities and other populated areas.

Based on this analysis, there was a decrease in total agricultural land use, as defined by parcel Property Tax Codes, across the State of Indiana from 2010 to 2022. The decrease was about 345 thousand acres or 1.89 percent of the about 18 million acres that are classified for agricultural use. Although there was a net loss of agricultural land, there was also land put into agricultural use. The main type of land use change that was seen was agriculture land to residential land, and this was most prevalent around edges of populated areas like cities.

Figures

Figure 1 – Cropland Data Layer Raster Processing Workflow

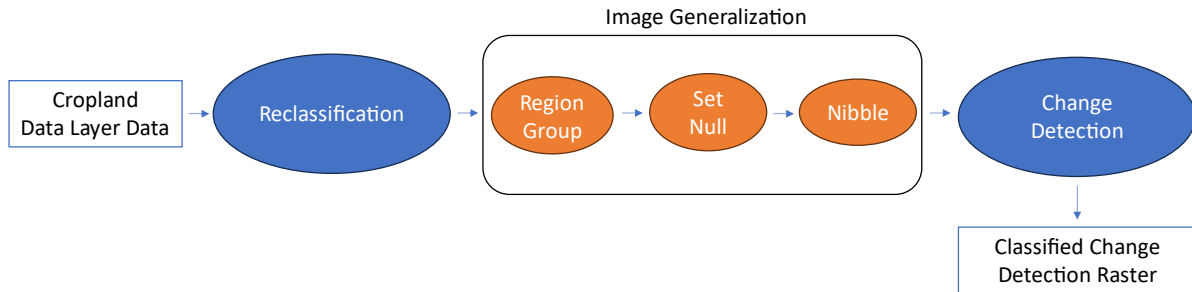


Figure 2 – Comparison of Cropland Data Layer Raster Samples Pre and Post Image Generalization

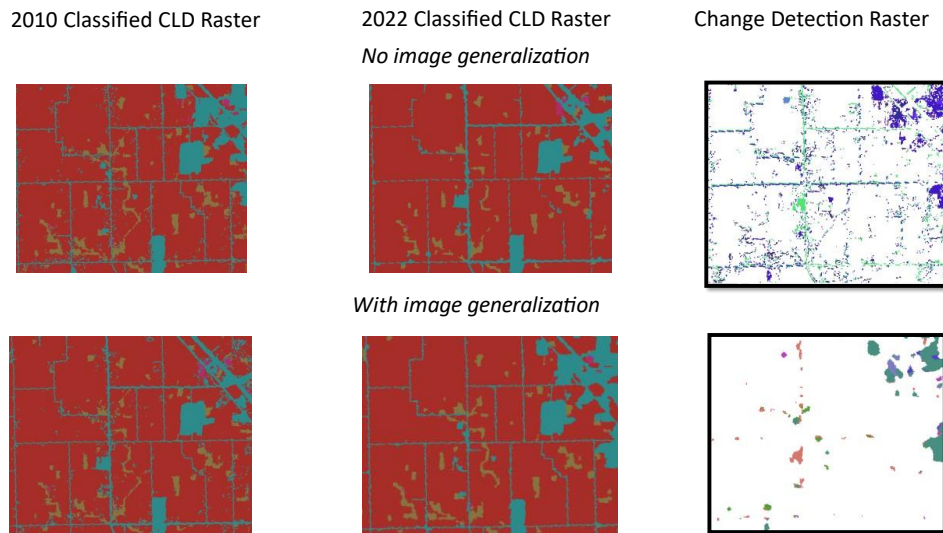
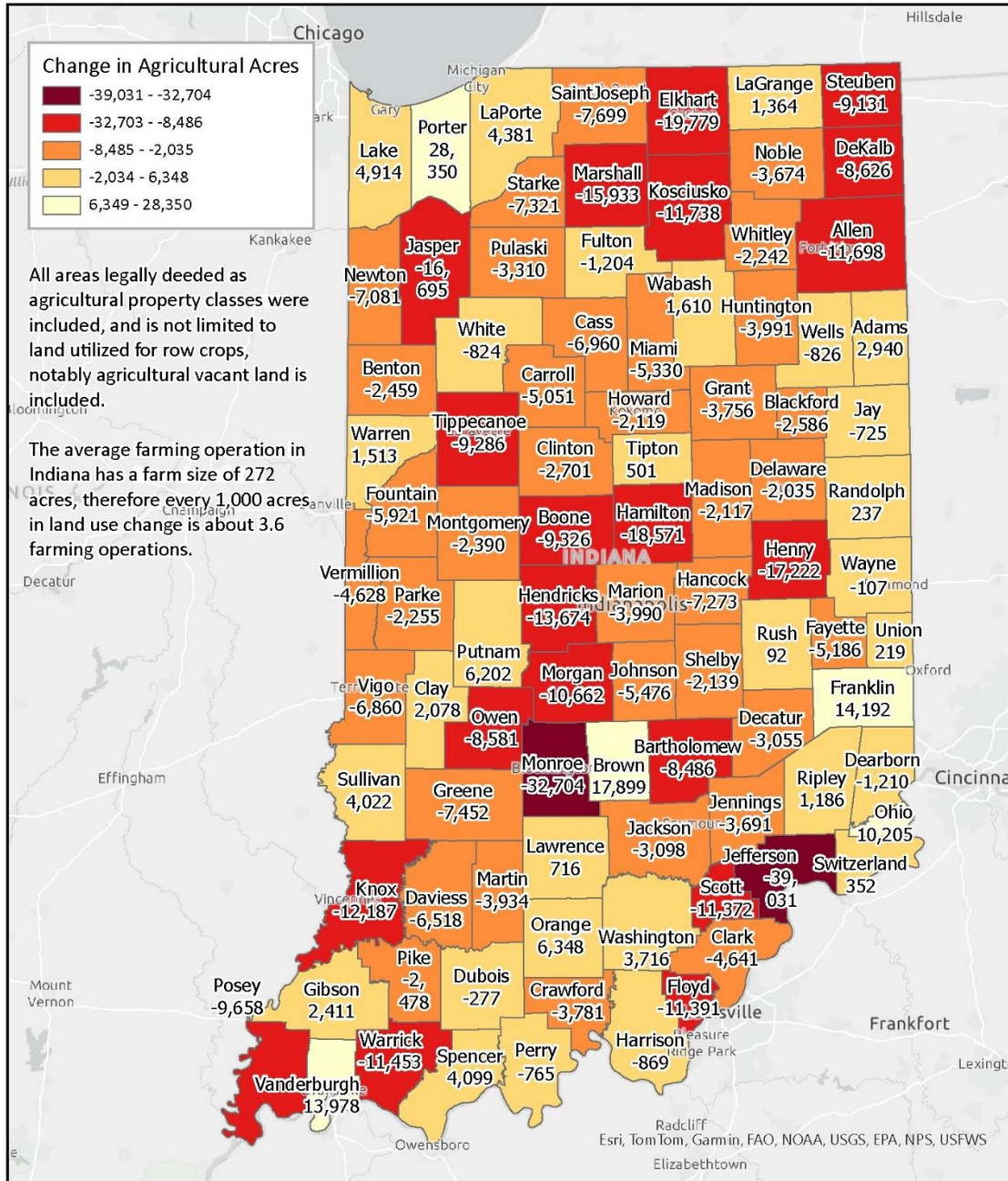


Figure 4 – County-by-County Agricultural Land Change Quantity

Agriculture Land Change Quantity 2010-2022 Parcel Data

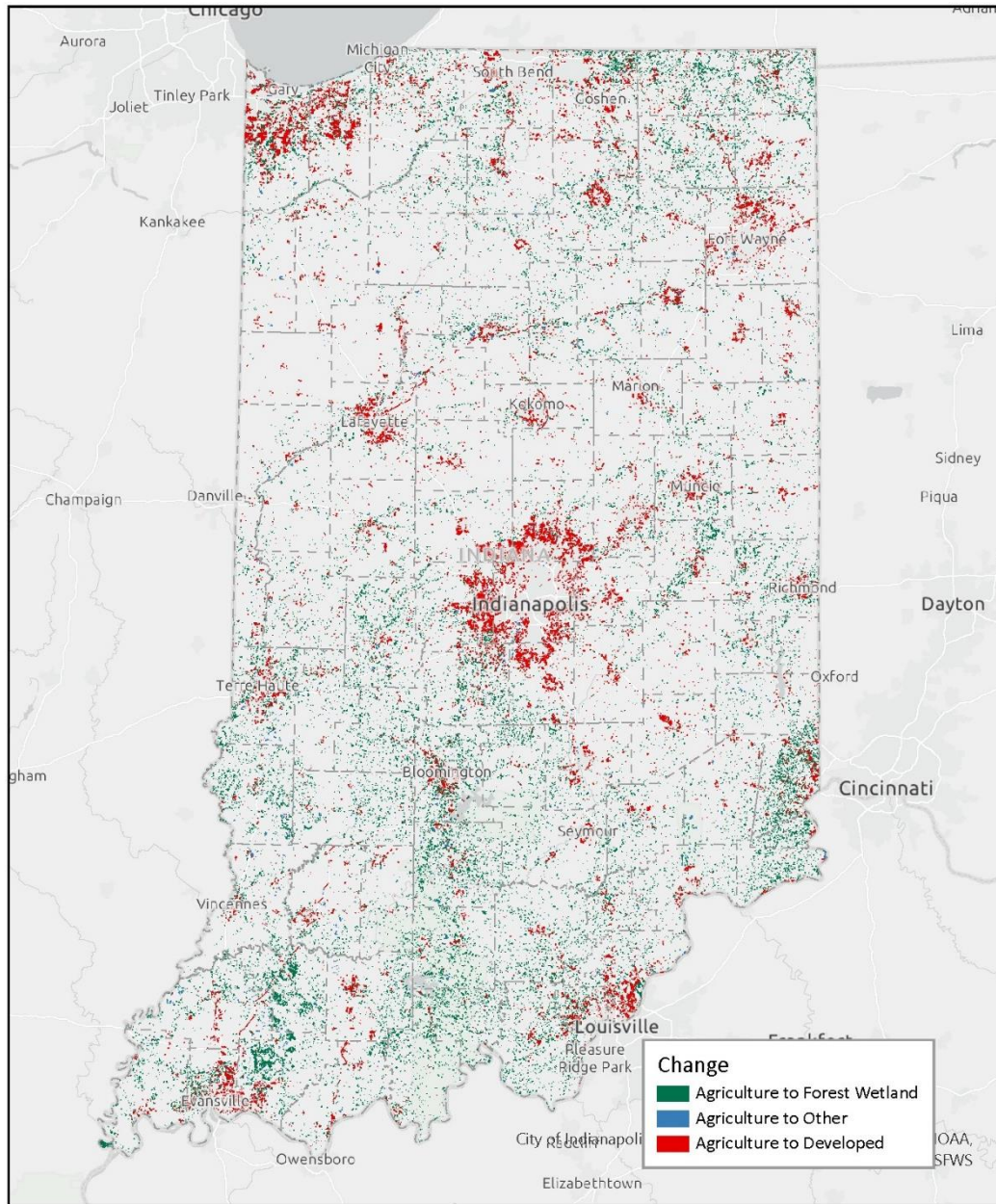


Change in county agricultural acres was calculated using the Indiana Department of Local Government Finance (DLGF) parcel data. The total amount of legally deeded acres with property class codes in agriculture (property class codes 100 – 199) was calculated for both 2010 and 2022. The value shown is the difference between the 2022 and 2010 values, therefore a negative value is a decrease in the total number of acres with property class codes in the agricultural values.

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Figure 5 – NASS CDL Land Loss Map

Agriculture Land Loss Locations 2010-2022 Cropland Data Layer



Areas of agricultural land loss were determined via the United States Department of Agriculture (USDA) National Agricultural Statistics Services (NASS) Cropland Data Layer, an annual remote sensing classified land cover dataset specific to agriculture. The ESRI ArcGIS change detection tool was used to find areas with losses of agricultural land cover from 2010 to 2022.

Tables

Reclassification Tables

TABLE 3 – Property Class Codes – Reclassification no Agricultural Sub-types

CODES	RECLASS Value
100 - 199	Agriculture
200	Mineral
300 - 399	Industrial
400 - 499	Commercial
500 - 599	Residential
600 +	Other

TABLE 4 – Property Class – Reclassification with Agricultural Sub-types

Codes	Abbreviation	Reclass Name
100	Ag-VL	Agricultural - Vacant Land
101	Ag-GF	Agricultural – Cash Grain / General Farm
103, 104, 110, 111	Ag-LS	Agricultural – Livestock including dairy
105, 106, 107, 108, 109	Ag-SC	Agricultural - Specialty Crop
120	A-T	Agricultural - Timber
141, 149, 198, 199	Ag-Other	Agricultural - Other
200	M	Mineral
300 - 399	Ind	Industrial
400 - 499	Com	Commercial
500 - 599	Res	Residential
600 +	Other	Other

TABLE 5- Cropland Data Layer Reclassification Table

Agricultural	'Corn', 'Sorghum', 'Soybeans', 'Sunflower', 'Tobacco', 'Sweet Corn', 'Pop or Orn Corn', 'Mint', 'Barley', 'Durum Wheat', 'Winter Wheat', 'Dbl Crop WinWht/Soybeans', 'Rye', 'Oats', 'Millet', 'Speltz', 'Canola', 'Alfalfa', 'Other Hay/Non Alfalfa', 'Dry Beans', 'Potatoes', 'Other Crops', 'Misc Veggies & Fruits', 'Watermelons', 'Onions', 'Cucumbers', 'Tomatoes', 'Herbs', 'Clover/Wildflowers', 'Sod/Grass Seed', 'Switchgrass', 'Fallow/Idle Cropland', 'Peaches', 'Apples', 'Grapes', 'Christmas Trees', 'Grassland/Pasture', 'Triticale', 'Cantaloupes', 'Squash', 'Dbl Crop WinWht/Corn', 'Dbl Crop Oats/Corn', 'Pumpkins', 'Dbl Crop WinWht/Sorghum', 'Dbl Crop Barley/Corn', 'Dbl Crop Soybeans/Oats', 'Dbl Crop Corn/Soybeans', 'Blueberries', 'Cabbage', 'Turnips', 'Gourds', 'Dbl Crop Triticale/Corn', 'Vetch', 'Grass/Pasture', 'Spring Wheat', 'Rape Seed', 'Walnuts', 'Cotton', 'Rice', 'Other Tree Crops', 'Pecans', 'Pears', 'Aquaculture', 'Carrots', 'Garlic', 'Plums'
Developed	'Developed/Open Space', 'Developed/Low Intensity', 'Developed/Med Intensity', 'Developed/High Intensity'
Forest and Wetland	'Deciduous Forest', 'Evergreen Forest', 'Mixed Forest', 'Woody Wetlands', 'Herbaceous Wetlands'
Other	'Open Water', 'Shrubland', 'Barren'

Results Tables

Table 6 – Parcel Data, Acres of Change by Property Class Type

Land Change by Major Types		
2010 Parcel Property Class Code	2022 Parcel Property Class Code	Acres Change
<i>Agriculture</i>		
Agriculture	Commercial	27,658
Agriculture	Industrial	41,869
Agriculture	Mineral	2,166
Agriculture	Other	68,295
Agriculture	Residential	371,266
<i>Commercial</i>		
Commercial	Agriculture	25,019
Commercial	Industrial	16,827
Commercial	Other	15,693
Commercial	Residential	7,159
<i>Industrial</i>		
Industrial	Agriculture	13,973
Industrial	Commercial	5,691
Industrial	Other	4,646
Industrial	Residential	1,407
<i>Mineral</i>		
Mineral	Agriculture	803
Mineral	Other	3,522
Mineral	Residential	5
<i>Other</i>		
Other	Agriculture	21,462
Other	Commercial	5,278
Other	Industrial	1,507
Other	Mineral	44
Other	Residential	3,133
<i>Residential</i>		
Residential	Agriculture	328,501
Residential	Commercial	9,178
Residential	Industrial	2,806
Residential	Mineral	7
Residential	Other	11,369

Table 7 – Parcel Data Agricultural Acres of Change by Agricultural Subtype

Agricultural Land Change in Property Class Codes by Subtype		
2010 Property Class Type	2022 Property Class Type	Acres Change
<i>Agricultural – Cash Grain / General Farm</i>		
Ag-GF	Ag-LS	17,694
Ag-GF	Ag-Other	461,536
Ag-GF	Ag-SC	1,316
Ag-GF	Ag-T	6,004
Ag-GF	Ag-VL	1,000,845
Ag-GF	Com	7,982
Ag-GF	Ind	9,818
Ag-GF	M	217
Ag-GF	Other	11,977
Ag-GF	Res	206,986
<i>Agricultural – Livestock including dairy</i>		
Ag-LS	Ag-GF	20,589
Ag-LS	Ag-Other	5,121
Ag-LS	Ag-T	16
Ag-LS	Ag-VL	7,469
Ag-LS	Com	141
Ag-LS	Ind	504
Ag-LS	Other	144
Ag-LS	Res	1,182
<i>Agricultural - Other</i>		
Ag-Other	Ag-GF	164,826
Ag-Other	Ag-LS	6,994
Ag-Other	Ag-SC	205
Ag-Other	Ag-T	1,598
Ag-Other	Ag-VL	337,081
Ag-Other	Com	3,839
Ag-Other	Ind	5,505
Ag-Other	M	7
Ag-Other	Other	5,349
Ag-Other	Res	25,160
<i>Agricultural - Specialty Crop</i>		
Ag-SC	Ag-GF	663
Ag-SC	Ag-Other	301
Ag-SC	Ag-T	65
Ag-SC	Ag-VL	1,722
Ag-SC	Com	348
Ag-SC	Ind	124

Table 7 (continued)

Ag-SC	Other	24
Ag-SC	Res	203
<i>Agricultural - Timber</i>		
Ag-T	Ag-GF	3,431
Ag-T	Ag-Other	1,003
Ag-T	Ag-VL	23,597
Ag-T	Com	214
Ag-T	Other	3,739
Ag-T	Res	1,752
<i>Agricultural - Vacant Land</i>		
Ag-VL	Ag-GF	145,072
Ag-VL	Ag-LS	4,976
Ag-VL	Ag-Other	251,979
Ag-VL	Ag-SC	171
Ag-VL	Ag-T	9,966
Ag-VL	Com	15,134
Ag-VL	Ind	25,918
Ag-VL	M	1,942
Ag-VL	Ag-Other	47,062
Ag-VL	Res	135,982

Table 8 – CDL Acres of Change by Land Use Type

Land Use Change		
Class 2010 CLD	Class 2022 CLD	Acres Change
Agriculture	Developed	181,232
Agriculture	Forest	113,213
Agriculture	Other	12,107
Developed	Agriculture	89,527
Developed	Forest	48,752
Developed	Other	11,469
Forest	Agriculture	62,569
Forest	Developed	117,847
Forest	Other	14,621
Other	Agriculture	8,234
Other	Developed	11,049
Other	Forest	20,545

References

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