

Reforestation Potential in New York State

Estimating Acres of Post-Agricultural Lands
That Could Be Reforested



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Saratoga tree nursery. © NYS Department of Environmental Conservation

Executive Summary

New York State’s climate mandates are some of the most ambitious in the United States and include reducing greenhouse gas emissions by 85% and reaching net zero emissions by 2050 (NYSCAC 2022). Carbon sequestration in trees through reforestation is critically important to meet the net zero mandate. We define reforestation as the act of planting ecologically appropriate tree species on non-forest lands that were once under natural forest cover. We focus on former agricultural lands because they are potentially available for reforestation without reducing food and feed production. Previous estimates of the total agricultural land area suitable for reforestation in New York State vary substantially, creating uncertainty about how much reforestation could contribute to climate mitigation goals (Cook-Patton et al. 2020, NYSEDA 2020, Wightman & Woodbury 2020). This analysis provides a new estimate of the amount of land potentially suitable for reforestation based on current agricultural land cover and land in active agricultural production.

Of the 6.54 million acres of agricultural land cover in New York State, including agricultural lands that are no longer in production, 1.67 million acres are potentially suitable for reforestation. This value should be viewed as a high-end estimate because a vast majority of the agricultural lands in New York State that are potentially suitable and available for reforestation are privately owned. Our analysis does not account for private landowners’ willingness or capacity to convert their land into forest for carbon mitigation and there are competing uses for these lands (Wightman & Woodbury 2020). Our estimate does not include areas in urban open space or developed land cover types, which have potential for additional reforestation and tree planting. There is sufficient reforestation opportunity in New York to make a significant contribution toward meeting the state’s ambitious net zero climate mitigation goal. As recommended in the New York State Climate Action Council’s Scoping Plan (NYSCAC 2022), this analysis identifies locations where reforestation efforts are the most promising.

Purpose and Background

New York State's climate mandates are some of the most ambitious in the United States and include reducing greenhouse gas emissions by 85% and reaching net zero emissions by 2050 (NYSCAC 2022). To reach this goal, we must make large reductions in emissions, and forest carbon sequestration must increase substantially. Reforestation represents the single largest opportunity to sequester more carbon in New York State. We define reforestation (sometimes called afforestation) as the act of planting ecologically appropriate trees on lands that were once under natural forest cover. This report quantifies the area of post-agricultural land that is potentially suitable for reforestation that could contribute to the state's climate mitigation mandates and identifies where land most suitable for reforestation is located throughout New York State.

Current estimates of the land suitable for reforestation in New York vary. Cook-Patton et al. (2020) and the corresponding [Reforestation Hub](#) web mapper developed by The Nature Conservancy provide estimates of acres available for reforestation at the state and county levels. The Reforestation Hub estimated a total of 5.35 million acres in New York may be suitable for reforestation. Most of the potentially suitable lands were not being used for active crop production; however, some of the area identified as suitable is in active pasture, hay, or alfalfa production. In New York State, the most common land cover with potential for reforestation is pasture, accounting for 3.66 million acres (68%) of the New York State Reforestation Hub estimate, followed by urban open space at 1.25 million acres (23%) (see Cook-Patton et al. 2020 for more detail).

Another resource, "Sources and Sinks of Major Greenhouse Gases Associated with New York State's Natural and Working Lands: Forests, Farms, and Wetlands," stated that ~1.75 million acres of underutilized or former agricultural lands in New York State could be transitioned into

bioenergy production, used for solar arrays, and/or reforested (NYSERDA 2020). This estimate was based on a Wightman et al. (2015) publication that analyzed land area available for bioenergy feedstock production, and which used only lands that were not in active commercial agriculture. The authors subtracted the area of cropland or perennial herbaceous land in use from total land area in cropland and perennial herbaceous cover. They also subtracted half of potentially suitable land to adjust for landowner willingness. These estimates were identified as the likely maximum potential areas suitable for reforestation because they do not include all land uses and landowner preferences.

The differences between these estimates have created some uncertainty regarding the extent of post-production agricultural land that could be utilized to achieve climate mitigation goals. Importantly, land uses vary greatly across the state due to historical trends of colonization, urban development, agricultural transitions, and environmental protection. These current and historical forces shape the composition of land cover, the demographic makeup of landowners and communities, and private landowners' willingness to reforest their land. Socioeconomic forces such as these will continue to shape land use into the future and influence where forest may be restored. A companion to this report will be released in late 2023 that incorporates socioeconomic factors into the reforestation suitability estimates provided here.

Goals

The goals of this analysis were to:

1. estimate the amount of land potentially suitable for reforestation based on current agricultural land cover extent, while excluding lands in active agricultural production, and
2. provide information that could be used to identify and prioritize regions and locations for reforestation efforts. These goals meet a critical information need as identified in the

New York State Climate Action Council's Scoping Plan to identify areas for reforestation to increase forest area and carbon sequestration (NYSCAC 2022).

Methods

Our estimates integrate multiple datasets that, when considered in aggregate, provide a reliable estimate of the amount of land suitable for reforestation throughout the state. Three datasets were used in this analysis: the 2016 National Landcover Database (NLCD), 2016 USDA Cropland Data Layers (CDL), and the 2017 USDA Census of Agriculture (CoA).

Both the NLCD and CDL data provide a picture of statewide land cover at a 30-meter resolution, showing the spatial extent and arrangement of cropland, natural vegetation, and other types of land cover. NLCD generally discriminates better between different categories of natural vegetation and other human development but is less able to discriminate among agricultural uses (i.e., cultivated crops vs. hay and pasture). The CDL is fine-tuned to distinguish between over 100 individual crop types and is generally more robust within the agricultural land cover classes than NLCD. Generally, in crop classes like pasture/grassland/other hay, uncertainty is higher for both data layers (Lark et al. 2017 & 2021, USDA-NASS 2020, Wickham et al. 2021).

What neither NLCD nor CDL data can do is show intended crop use, nor do these data include estimates of how much biomass was harvested or pastured compared with how much remained in a post-agricultural old field state. For that information, we turned to the CoA, which provided county-level estimates of the number of acres in active production for the various crop cover types.

We defined the areas suitable for reforestation as lands in post-agricultural cover that are not actively managed or harvested for economic value. Unsuitable lands were those in active hay

and pasture production or cultivated cropland (row crops, small grains, orchards and vineyards, Christmas tree farms). We also categorized lands as unsuitable if they were reported by the CoA as idle or summer fallow or managed for soil improvement, reasoning that these periods of planned inactivity are important to maintain soil health as part of managed crop rotation cycles.

We determined the observed acreages of various crop cover types by county and reduced the number of suitable acres by the area reported as “in production” in the CoA. We allocated in-production acres across crop cover types as needed whenever the CoA reported that acres exceeded the observed acres for any given crop cover type. The remaining unallocated acres represent post-agricultural lands.

We performed these estimates for all counties in New York State. We then added the acreage estimates for all counties together to arrive at regional estimates (based on the New York State Regional Economic Development Council regions) and a statewide estimate. A detailed description of the methods is provided in Appendix 1.

Results and Discussion

Reforestation Opportunity

We estimate that ~1.67 million acres of post-agricultural lands are potentially suitable for reforestation in New York State (Table 1). The total land in agricultural land cover was estimated to be 6.54 million acres, with 4.87 million acres of this land in active production based on the USDA Census of Agriculture (Table 1, Figures 1 and 2). These results are generally consistent with other statewide estimates, particularly those that removed active agricultural lands from consideration (Wightman and Woodbury 2020; Wightman et al. 2015). Our estimate suggests that there is enough area that reforestation could be an important strategy for climate mitigation in New York State.

The amount of land on which reforestation could occur varied by county (Figures 3 and 4, Appendix 3) and region (Table 1). Nearly half (48%) of the land with reforestation potential was located within 13 counties. Each of these counties had more than 50,000 acres of land suitable for reforestation. Jefferson County had 121,112 acres potentially available for reforestation, the most of all counties in the state and the highest percentage of total suitable lands statewide (7.6% of the total reforestation opportunity in New York State). Furthermore, Jefferson County had nearly twice as much total acreage of suitable lands as the county with the second-most acreage (Otsego County, 71,074 acres).

The Finger Lakes, Mohawk Valley, Southern Tier, Western, and Central Regions each had >200,000 acres potentially available for reforestation. Collectively, these regions make up slightly more than half of the state (52.7%) but include 76.4% of the total land suitable for reforestation. These regions also had the greatest amount of land in agricultural production (Table 1).

Accounting for Land in Agricultural Production

The USDA Census of Agriculture data on land in production was an effective information source for refining the spatial data used in the Reforestation Hub. Several counties had large estimated areas in pasture and hay land cover that were in active agricultural production. Steuben County had the greatest area in agricultural land cover (including pasture and hay): 275,122 acres. However, the total reforestation opportunity in Steuben County was relatively low at 2,069 acres. Similarly, Wyoming County had almost 179,000 acres in agriculture land cover that were mostly in active production, with only 3,281 acres of reforestation opportunity. These two county-level estimates indicate that our analysis effectively accounted for the low reforestation potential on productive agricultural lands and that our reforestation opportunity estimates were attentive to ongoing agricultural production. Two counties, Putnam and Franklin, had 622 more acres in production and 1,040 more acres in production, respectively, according to the Census of Agriculture, than were

Table 1. Potential land area suitable for reforestation in New York State

New York State regions ^a	Land cover in agriculture (ac.) ^b	Land area in agricultural production (ac.) ^c	Potential area available for reforestation (ac.)	Percentage of region available for reforestation (%)
Finger Lakes	1,462,855	1,166,849	296,006	6.8
Mohawk Valley	761,480	505,958	255,522	7.5
Southern Tier	983,997	730,792	253,205	6.3
Western New York	828,632	583,337	245,295	6.2
Central New York	777,874	552,861	225,013	8.3
North Country	909,938	737,148	173,831	2.2
Capital Region	496,508	381,019	115,489	3.4
Mid-Hudson	278,297	188,342	90,578	3.0
Long Island	37,738	24,555	13,183	0.7
New York City	392	31	361	0.1
New York State	6,537,713	4,870,892	1,668,484	4.8

^a New York State Regional Development Councils

^b Agricultural land cover derived from USDA CropScape-Cropland Data and National Land Cover Dataset

^c Derived from USDA Census of Agriculture

classified as agriculture by the NLCD. We therefore interpreted the agricultural land in those counties as fully in production (including some of the grasslands in NLCD) and unavailable for reforestation. Most of the lands for which there is reforestation opportunity were classified as non-agricultural, pastureland, or non-alfalfa hay cover (Appendices 2 and 4).

The CDL data show a mix of crop cover types occurring across both NLCD agricultural classes, including some hay and pasture and areas of uncertain agricultural use (possibly old fields) in

the NLCD cultivated crop category. This observation helps explain why most of our estimated post-agricultural acreage is contained within the NLCD pasture/hay category (1.442 M acres), although some is also contained within the NLCD cultivated crop category (227 K acres) (Appendix 4). This portion of the post-agricultural acreage within cultivated crops is of a similar magnitude as the Reforestation Hub's estimate of 136 K acres of reforestation opportunity for marginal cropland on challenging soils (Cook-Patton et al. 2020).



Measuring tree growth. © Chris Zimmerman/TNC

Prioritizing Areas for Reforestation

The New York State Climate Action Council Scoping Plan (NYSCAC 2022) calls for identifying regions where reforestation is most promising. Existing land cover is an important component of reforestation opportunity, and our report draws on land use and agricultural production data to highlight areas where reforestation activities could be successful based on suitable land cover. However, social and economic factors also have a large influence on the potential success of carbon mitigation via reforestation. When prioritizing locations for potential reforestation, land cover should be considered in combination with the following:

- The capacity and interest of local organizations that have active tree planting programs
- The potential to engage underprivileged or historically excluded people and communities in reforestation efforts
- Landowners' access to technical support, incentive programs, and knowledge about local experiences with reforestation plantings, and
- Land ownership transitions, including intergenerational transfer, housing and land affordability, and broader demographic changes.

Currently, there is no single county or region in New York State that stands out as an obvious reforestation priority, with the possible exception of Jefferson County. It is therefore critical for climate mitigation efforts to support reforestation strategies in multiple areas of the state. (See Figure 1 and Appendix 2 for potential land available by county and region.) Furthermore, achieving the state's ambitious net zero emission goal will require reforestation in as many locations and regions as possible.

Private Landowners Are Key

In New York State, a vast majority of lands potentially suitable for reforestation are privately owned. Our estimates do not account for private landowners' willingness or capacities to convert

their land into forest for carbon mitigation. Research suggests that the social acceptability of reforestation and landowners' motivations are important drivers of landowner decisions to participate in reforestation programs (Fischer and Charnley 2010, Schirmer and Bull 2014, MacDonald et al. 2020, Iversen et al. 2022). Our team is collaborating with researchers from the Center for Conservation Social Sciences at Cornell University to estimate how much private land that is suitable for reforestation could be converted into mature forest, depending on landowner preferences and interest in reforestation. Reforestation projects on lands owned by the state, municipal authorities, and nongovernmental organizations can serve as a demonstration of future forest. Engaging with private landowners is critically important to the success of reforestation efforts in New York State.

High Potential for Co-benefits

Reforestation has numerous co-benefits for nature and people. Our analysis did not cover co-benefits, such as water quality protection, wildlife habitat, and heat mitigation, but these topics are discussed briefly below.

One co-benefit of reforestation is improved water quality. The Reforestation Hub estimates that 64,400 acres of riparian buffers and 298,000 floodplains are potentially available for reforestation in New York State. Several organizations are planting trees in riparian area to improve water quality, such as the New York State Department of Environmental Conservation (NYSDEC) Trees for Tribs program, Upper Susquehanna Coalition, and Catskill Streams Buffer Initiative, among others. The [New York State Riparian Opportunity Assessment](#) (2018) provides data to further explore the potential of reforestation areas to improve water quality and increase carbon sequestration.

The Reforestation Hub also estimates that tree cover could be increased on 1.25 million acres of

urban open space. Urban open space includes areas along roads, residential areas, municipal infrastructure, schools, recreational lands, and commercial businesses. Human construction is present on <20% of the area, but the primary type of cover is vegetative, typically mowed lawn and roadside grasses. The [New York State Urban and Community Forestry Program](#) provides a general overview of opportunities in the state. The Nature Conservancy's The State of the Urban Forest in New York City (Treglia et al. 2021) report characterizes the status of the city's street trees, lists benefits of urban forest, and estimates that ~250,000 additional street trees could be planted in the city.

Restoration of forest cover within wildlife corridors represents an important strategy for biodiversity conservation. Currently only 41% of natural areas in the United States are adequately connected to allow plants and animals to track their thermal envelopes as the climate warms. Reforestation of key corridors may help preserve biodiversity by connecting these natural areas (McGuire et al. 2015). The Reforestation Hub estimates that approximately 500,000 acres in New York could be reforested to improve connectivity between core areas of wildlife habitat.

Limitations of This Analysis

Our estimates of the acreage of agricultural lands currently in production assume that the CoA's reported county acreages are accurate and that they do not fluctuate substantially year to year, particularly with regard to total cultivated crops, hay, and pasture estimates. In aggregate, these lands in production should fluctuate less than the number of acres of individual crop commodities. In addition, as discussed above, agricultural land that was reported as idle or fallow in the CoA was not included in our estimates.

Our estimates of land in agricultural production do not include acres held by small farms and individuals who receive less than \$1,000 of annual farm income, the threshold for inclusion in the CoA.

Our in-production estimates also do not account for equine operations like stables that may have associated pasture, nor for horses that are not on farms. Unless these equine operations produce all or most of their own forage, it is likely that the lands needed to produce the hay for these animals are largely being captured in the CoA. However, there may be a large amount of pastureland dedicated to horses that is not captured by the CoA.

Not all the post-agricultural lands we have identified will be appropriate for reforestation. For example, some of these areas may be important habitat for wildlife species, and others are likely already in the process of naturally regenerating into forest. NYSDEC's grassland bird habitat management plan contains goals to maintain and restore grasslands in certain areas of New York State ([NYSDEC Grassland Bird Plan](#)).

Coordination with relevant management agencies and stakeholders will be necessary to meet goals for multiple habitat types. In addition, we excluded ~ 95,000 acres of NLCD natural grassland cover from our estimate of post-agricultural lands that are potentially suitable for reforestation in order to address this management need (Appendix 2). Also, an unknown fraction of the estimate falls along field edges and in rural residential areas. As a result, our 1.67-million acres estimate of land suitable for reforestation is likely a higher end estimate, and it points to the importance of including reforestation of lands along the margins of farmland and fields as an important strategy if New York is to meet its reforestation goals.

Another potential limitation to our analysis is the assumption that lands in active agriculture will not be converted into forested land cover. This assumption is important as we consider the viability of reforestation as a climate mitigation strategy at the statewide scale. However, we recognize that private landowners may reforest portions of their productive lands. This may be particularly true for landowners who have mixed productive-inactive lands, or as part of ongoing changes in agricultural land use.



Red oak seedling protected by tree shelter from deer browse. © Chris Zimmerman/TNC

Conclusions

Of the 6.54 million acres of agricultural land cover estimated by NLCD in New York State, including agricultural lands that are no longer in production, we estimate that approximately 1.67 million acres (~25%) are potentially suitable for reforestation without impacting current production. Our analysis was undertaken in response to concerns that some lands identified as active pasture, hay, and alfalfa production are currently classified within the

Reforestation Hub as available for reforestation. Our analysis accounts for this concern and provides what we believe to be the most thorough land cover–based estimate of state and county-level reforestation opportunity in New York. Our work meets the call in the New York State Climate Action Council’s Scoping Plan (NYSCAC 2022) to identify and prioritize locations where reforestation efforts are the most promising.

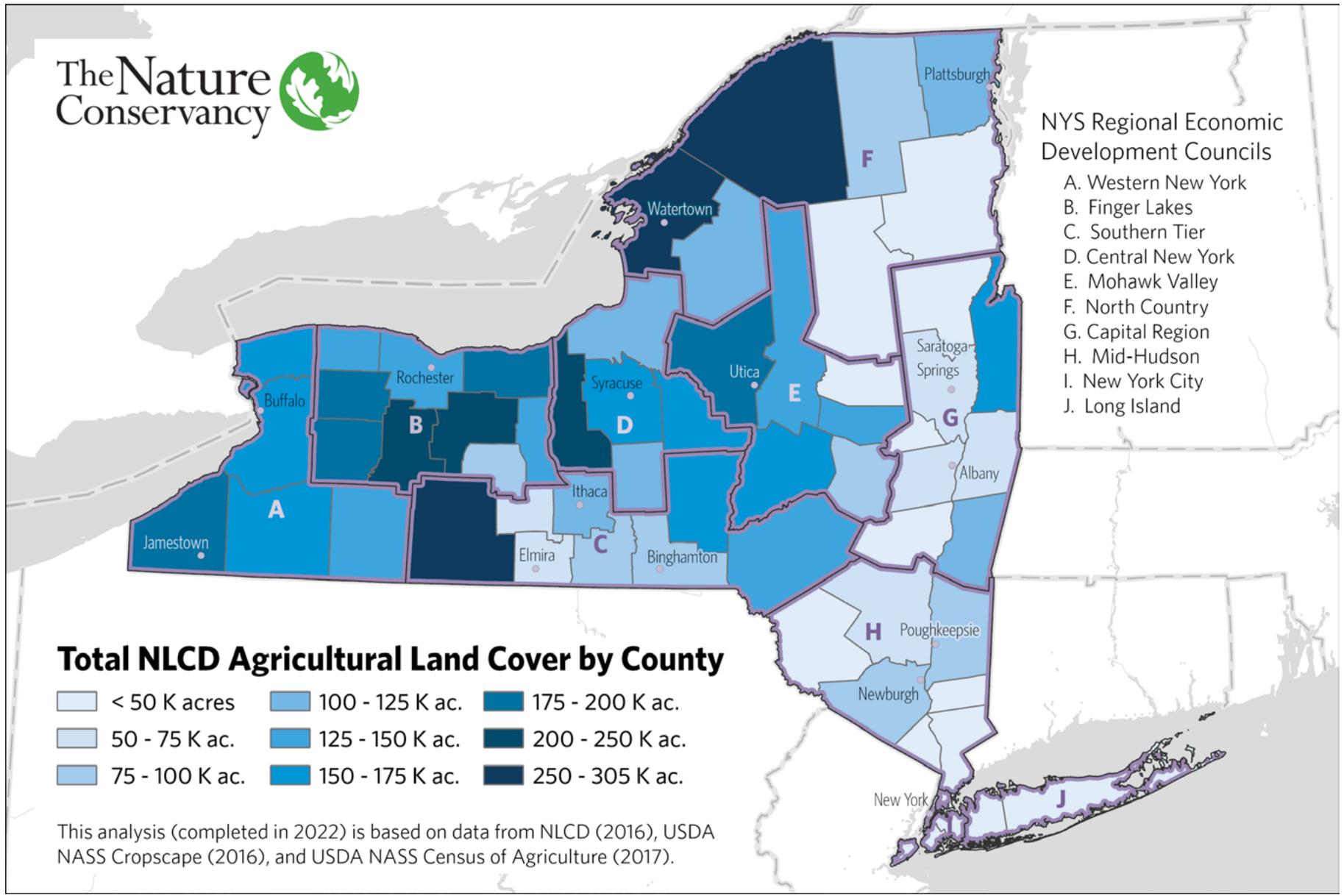


Figure 1. The total agricultural land cover (in thousands of acres) in New York State counties, derived from the National Land Cover Database (NLCD, 2016).

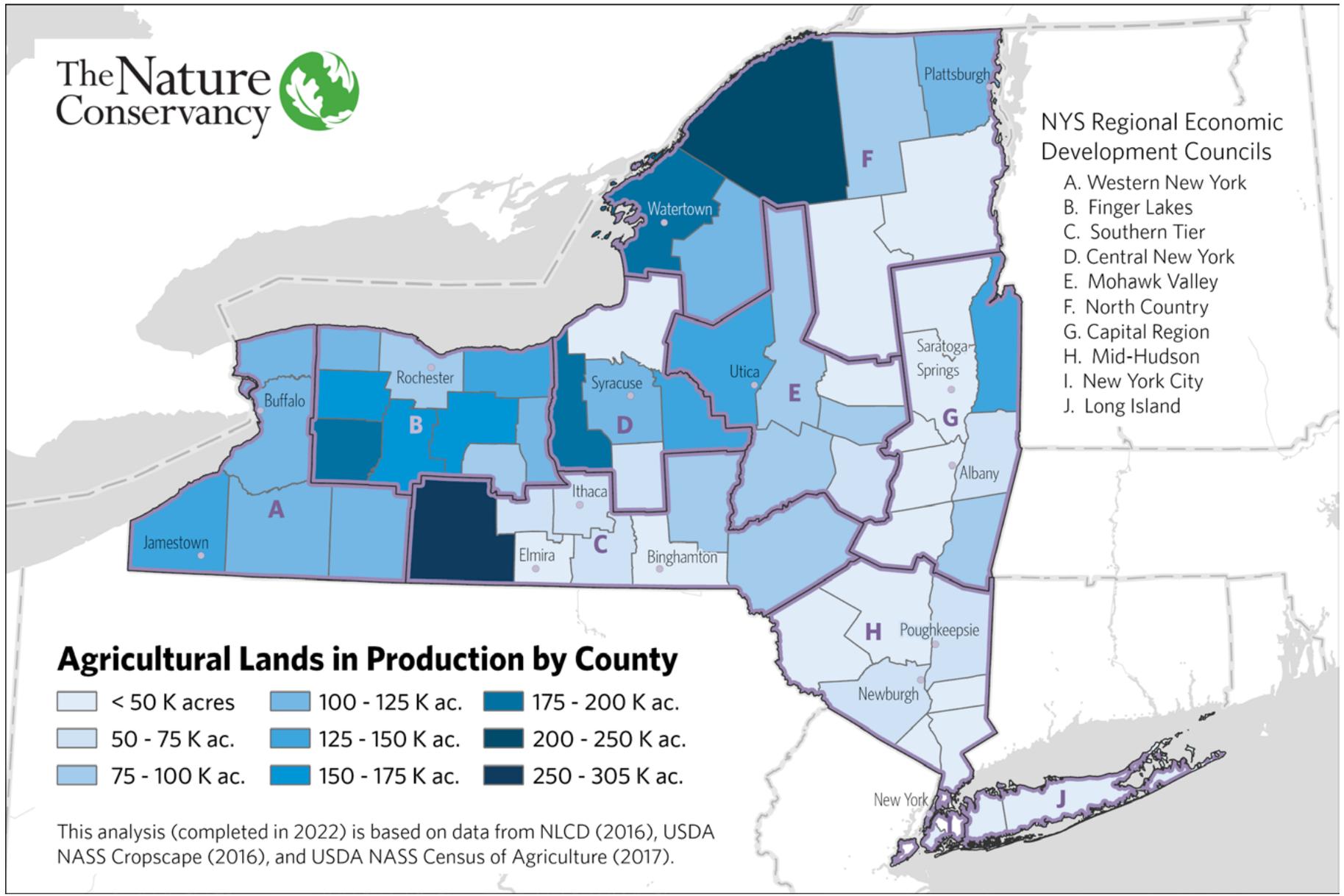


Figure 2. Total lands in agricultural production (in thousands of acres) in New York State counties, derived from the USDA Census of Agriculture (2017).

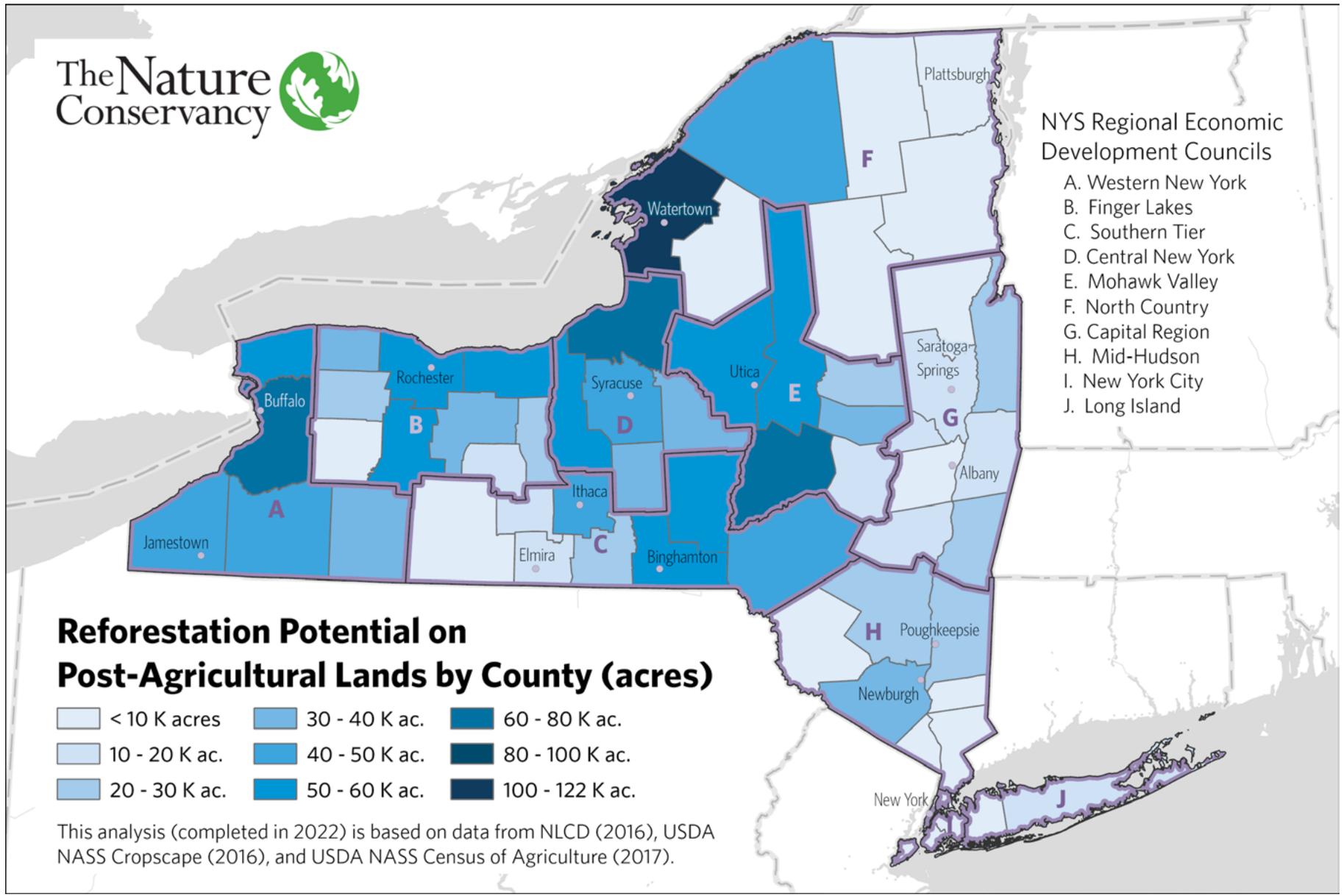


Figure 3. Lands potentially suitable for reforestation (in thousands of acres) by county in New York State.

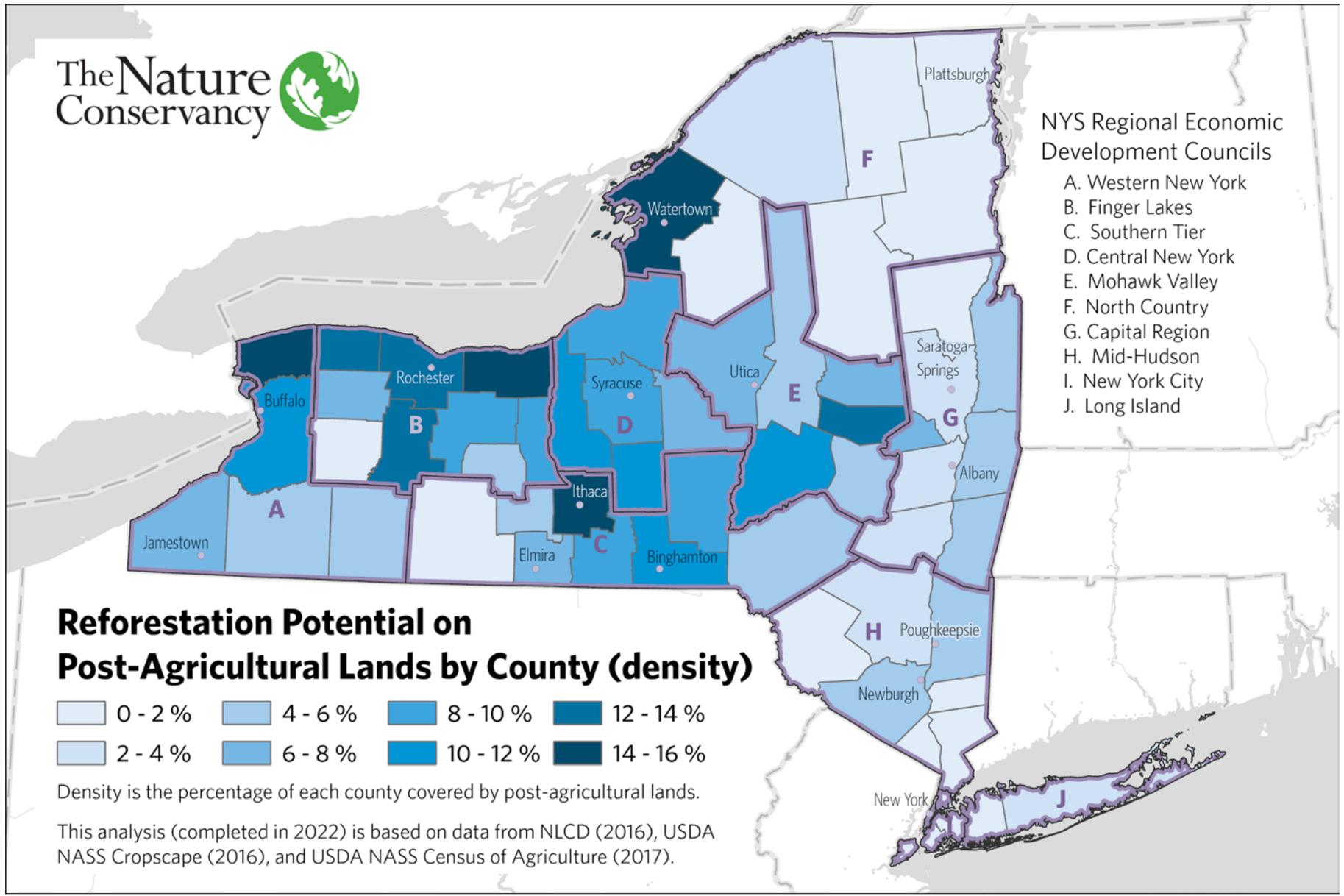


Figure 4. Percentages of land area potentially suitable for reforestation in New York State, by county.

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Appendices

Appendix 1. Detailed Methodology

We focused our analysis on agricultural land cover types using data from the 2016 National Land Cover Database (NLCD), the 2016 USDA CropScape-Cropland Data Layers (CDL), and the 2017 USDA Census of Agriculture (CoA). We chose these dates because they represent the most recent CoA available and the NLCD data that is closest in time to the CoA data. The 2016 NLCD data were matched with 2016 CDL data so that all spatial products were for the same year and represent similar conditions on the ground.

We reclassified the CDL data for individual crops into eight aggregated crop cover types, as shown in Table A1, restricting our analysis to areas shown as agriculture (classes 81 and 82) or grassland (classes 46 and 71) in the 2016 NLCD science product. We cross-tabulated the acres found within each NLCD x CDL combination by county, pooled the acres “observed” across the two NLCD agricultural classes for each CDL-derived crop cover type, and pooled all the acres,

regardless of CDL crop cover type, for the two NLCD grassland classes.

The “NONAG” crop cover type represents those areas that NLCD classified as agriculture but that CDL classified as more similar to the other non-agricultural non-grassland categories used by NLCD (shrub, forest, wetland, barren, developed, or water). We note that the NLCD grassland cover types are also non-agricultural; together with the “NONAG” crop cover type they represent the more naturalized early successional end of the herbaceous vegetation spectrum and a pool of available acres that were assigned to “in production” as necessary, in situations where the CoA reported active acres exceeds the observed acres of all other agricultural crop classes at the county scale.

To estimate the fraction of each crop cover type that might be in a post-agricultural state, we subtracted the in-production acreages for these crop cover types using the New York county values from the 2017 CoA. We extracted the acres reported as total cropland, harvested cropland, other cropland, unimproved pasture, orchards,

Table A1. Aggregated Crop and Grass Cover Types

Ranked Order	CDL Recoded	Class Abbrev	Class Description
1	12	RCG	Row crops and small grains (including sod and seed crops)
2	7	AHAY	Alfalfa hay
3	8	OHAY	Other hay
4	3	FIDLE	Fallow/idle cropland (including clover/wildflowers)
5	5	ORCH	Orchards and vineyards (including berries, tree nuts, and hops)
6	6	XMAS	Christmas trees
7	4	PASTR	Pasture
8	09	NONAG	Unknown and non-agricultural CDL cover within NLCD agriculture
9	--	PGRASS	NLCD persistent grasslands
10	--	TGRASS	NLCD transitional herbaceous-forest grasslands

Christmas trees, hay (alfalfa and other hay as hay and as haylage), pastured cropland, idle cropland, summer fallow cropland, and failed cropland. The acreage of row crops and small grains was determined as the harvested cropland minus the acres of harvested hay, orchards, and Christmas trees. Idle and summer fallow and other cropland were added together. Unimproved pasture and pastured cropland were also combined, but wooded pasture was excluded because we assumed it was classified as forested in NLCD and does not represent a reforestation opportunity. The proportion of alfalfa hay + haylage to other hay + haylage was used to estimate the fraction of the total hay and haylage acres that was alfalfa or other hay. This was necessary because while the total hay + haylage acreage reported did not allow double counting due to multiple cuttings, the individual alfalfa/other hay types of hay/haylage categories did allow such double counting, yet were the only level at which it was possible to distinguish total alfalfa from other hay acreages.

We included fallow and idle acres as still being in production, as these are often periods of planned rest or active soil improvement as part of crop rotation cycles. The CDL class for idle/fallow was also observed more often within the more-intensely managed NLCD cultivated crop class (82) than the pasture/hay class (81), which supports the assumption that these are temporarily inactive agricultural lands, not post-agricultural lands.

The CDL data did not include failed crops as a cover type, so this acreage must be added back into the crop cover types in order to account for all acres in production. Given no a priori knowledge of which crops were prone to failure in 2017, we apportioned the failed crop acres among the harvested crop classes (excluding pasture and fallow/idle land) based on their relative proportional acreages from the CDL data within the two NLCD agricultural classes only.

Once we had produced the cross-tabulated NLCD x CDL crop cover type acreages and CoA in-production acreages in matching categories, we compared the CoA acres with those observed in the CDL across the two NLCD agriculture classes. We allocated in-production and post-agricultural acres using a two-step approach. During the first step, when CoA acres for a crop cover type were fewer than the satellite-observed acres for the same crop cover type, all the CoA acres were assigned to in-production for that crop cover type and the remaining satellite-observed acres were placed in a leftover pool of available acres within that crop cover type. When the CoA acres for a crop cover type were more than the satellite-observed acres for the same crop cover type, the full number of observed acres were assigned to in-production for that crop cover type and the “excess” remaining CoA acres were placed in an excess pool for that crop cover type that would get reallocated in the second step.

During the second step, any excess acres for a crop cover type were matched with leftover acres still available for allocation in other crop cover types, iterating through the crop cover types in a ranked order that roughly corresponds to a gradient of cultivation intensity from high to low, as shown in Table A2. The ranked order also generally follows a gradient in terms of crops that are suitable to be grown in areas with increasingly challenging soil and slope limitations, similar to the USDA non-irrigated land capability classes.

In this way, the acres in the more intensely cultivated classes get fully allocated to in-production first, while the acres for crop cover types that are less likely to be confused with more active cultivation (and that appear to look more like grassy naturalized vegetation at the post-agricultural lands end of the spectrum) tend to have smaller fractions allocated to in-production and more acres retained as post-agricultural lands.

The resulting in-production and post-agricultural acres were then summarized by county and added to generate the statewide estimate and the estimates by New York State Regional Economic Development Council (REDC) region.

We did not exclude rural residential areas or agricultural land bordering primary roads and highways that may have been picked up within the NLCD and CDL agricultural land cover classes, nor did we apply any area deduction discount factors (-3% for cultivated crops, -5% for pasture/hay across New York) as was done in Cook-Patton et al. (2020).

In a further analysis not presented here, we found that when allocating between in-production and post-agricultural land, if one reasonably assumed during allocation that the nonspatial CoA acres preferentially avoided those areas with challenging soils and slopes, then only a very minor amount of in-production farmland gets allocated to those challenging soils and slopes. This equates to a negligible additional gain

beyond our current accounting for reforestation opportunity within post-agricultural lands.

The dependence of our approach on nonspatial CoA data confounds efforts to further slice the in-production and post-agricultural lands into fractions occupying floodplains and riparian areas, wildlife corridors, protected areas, and other land use overlays without needing to make explicit a priori assumptions about how these overlay areas should impact the distribution of in-production and post-agricultural lands.

Our approach relies on nonspatial information from the CoA to refine our estimates of what is in active production or in post-agricultural land and therefore is only valid when these statistics are aggregated to county, regional, or statewide levels. While the percent of a crop cover type that is post-agricultural across a county could be turned into a probability of pixels of that land cover that is not in production (when compared with other agricultural lands across the county), it is inappropriate to examine such probabilities at the scale of individual fields or farms.



Tree planting at the Neversink Preserve, New York. © Chris Zimmerman/TNC

Appendix 2. Statewide Area in Agricultural Production and Area Potentially Suitable for Reforestation by Land Cover Crop Type

Our estimate of 1.67 million acres of post-agricultural lands potentially suitable for reforestation does NOT include any acres of current persistent grassland nor transitional post-timber-harvest grassland. We assume that persistent grassland will continue to be managed as grassland habitat and that previously forested post-disturbance/post-timber-harvest lands will reforest primarily via natural regeneration.

Table A2. Area of Land Cover Crop Types and Estimated Percentages in Production and Potentially Suitable for Reforestation

Land Cover Type	Area (ac.)	Area in Agricultural Production (%)	Area Potentially Suitable (%)
Row crops/grains	1,758,993	99	1
Alfalfa hay	655,115	97	3
Other hay	1,339,151	89	11
Fallow/idle	170,650	99	1
Orchard	71,211	90	10
Christmas trees	1,350	97	3
Pasture	1,527,778	63	37
Non-agriculture ¹	1,013,464	11	89
Persistent grass ²	95,555	1	0/99*
Transitional forest ³	131,290	0	0/100*

1. Non-agriculture—Areas identified as agriculture by NLCD but that appear more similar to the other non-agricultural non-grassland categories according to CDL (shrub, forest, wetland, barren, developed, or water). Together with the two NLCD grassland types, these land cover types represent the more naturalized early successional end of the herbaceous vegetation spectrum found within agricultural settings.

2. Persistent grass—Persistent grasslands, excluding post-forest-disturbance areas (NLCD 71)

3. Transitional forest—Transitional post-timber-harvest grassland (NLCD 46)

* Grassland areas not included in estimate of suitable and available post-agricultural lands in New York (1.67 million acres)

Appendix 3. Potential Land Area Suitable for Reforestation by County in New York State

Table A3. Potential Post-Agricultural Land Area Suitable for Reforestation by County*

County	NYS REDC Region	DEC Region	Land Cover in Agriculture (ac.) ^a	Area in Ag. Production (ac.) ^b	Area Suitable for Reforestation (ac.)	Percentage of Ag. Cover Suitable (%)	Percentage of Total County Area Suitable (%)	Percentage of Total NYS Opportunity (%)
ALBANY	Capital Region	4	50,329		7,643	15	2	0.5
ALLEGANY	Western New York	9	141,315	104,470	36,845	26	6	2.2
BRONX	New York City	2	26	0	26	100	0	0
BROOME	Southern Tier	7	91,319	40,210	51,109	56	11	3.1
CATTARAUGUS	Western New York	9	150,157	109,049	41,108	27	5	2.5
CAYUGA	Central New York	7	238,170	186,103	52,067	22	9	3.1
CHAUTAUQUA	Western New York	9	192,912	146,197	46,715	24	5	2.8
CHEMUNG	Southern Tier	8	60,733	42,421	18,312	30	7	1.1
CHENANGO	Southern Tier	7	147,967	94,664	53,303	36	9	3.2
CLINTON	North Country	5	97,405	97,236	169	0	0	0
COLUMBIA	Capital Region	4	101,175	77,772	23,403	23	6	1.4
CORTLAND	Central New York	7	106,176	72,516	33,660	32	10	2.0
DELAWARE	Southern Tier	4	130,357	89,536	40,821	31	4	2.4
DUTCHESS	Mid-Hudson	3	86,736	57,073	29,663	34	6	1.8
ERIE	Western New York	9	174,048	104,087	69,961	40	9	4.2
ESSEX	North Country	5	37,409	29,947	7,462	20	1	0.4
FRANKLIN†	North Country	5	87,124	88,165	0	0	0	0
FULTON	Mohawk Valley	5	35,389	14,934	20,455	58	6	1.2
GENESEE	Finger Lakes	8	174,630	153,234	21,396	12	7	1.3
GREENE	Capital Region	4	31,537	18,756	12,781	41	3	0.8
HAMILTON	North Country	5	699	51	648	93	0	0

County	NYS REDC Region	DEC Region	Land Cover in Agriculture (ac.) ^a	Area in Ag. Production (ac.) ^b	Area Suitable for Reforestation (ac.)	Percentage of Ag. Cover Suitable (%)	Percentage of Total County Area Suitable (%)	Percentage of Total NYS Opportunity (%)
HERKIMER	Mohawk Valley	6	135,599	85,343	50,256	37	5	3.0
JEFFERSON	North Country	6	312,796	191,684	121,112	39	11	7.3
KINGS	New York City	2	73	23	50	68	0	0
LEWIS	North Country	6	119,370	116,735	2,635	2	0	0.2
LIVINGSTON	Finger Lakes	8	208,803	156,109	52,694	25	13	3.2
MADISON	Central New York	7	154,942	123,887	31,055	20	7	1.9
MONROE	Finger Lakes	8	147,069	90,357	56,712	39	6	3.4
MONTGOMERY	Mohawk Valley	4	131,252	94,806	36,446	28	14	2.2
NASSAU	Long Island	1	601	190	411	68	0	0
NEW YORK	New York City	2	40	7	33	83	0	0
NIAGARA	Western New York	9	170,200	119,534	50,666	30	7	3.0
ONEIDA	Mohawk Valley	6	196,242	136,453	59,789	30	7	3.6
ONONDAGA	Central New York	7	170,085	122,900	47,185	28	9	2.8
ONTARIO	Finger Lakes	8	205,597	168,798	36,799	18	9	2.2
ORANGE	Mid-Hudson	3	89,938	59,575	30,363	34	6	1.8
ORLEANS	Finger Lakes	8	145,468	110,976	34,492	24	7	2.1
OSWEGO	Central New York	7	108,501	47,455	61,046	56	7	3.7
OTSEGO	Mohawk Valley	4	173,082	102,008	71,074	41	11	4.3
PUTNAM†	Mid-Hudson	3	2,993	3,615	0	0	0	0
QUEENS	New York City	2	159	1	158	99	0	0
RENSSELAER	Capital Region	4	73,691	54,652	19,039	26	4	1.1
RICHMOND	New York City	2	94	0	94	100	0	0
ROCKLAND	Mid-Hudson	3	951	334	617	65	0	0
SARATOGA	Capital Region	5	66,247	50,062	16,185	24	3	1.0

County	NYS REDC Region	DEC Region	Land Cover in Agriculture (ac.) ^a	Area in Ag. Production (ac.) ^b	Area Suitable for Reforestation (ac.)	Percentage of Ag. Cover Suitable (%)	Percentage of Total County Area Suitable (%)	Percentage of Total NYS Opportunity (%)
SCHENECTADY	Capital Region	4	20,556	10,526	10,030	49	7	0.6
SCHOHARIE	Mohawk Valley	4	89,915	72,414	17,501	19	4	1.0
SCHUYLER	Southern Tier	8	68,230	55,728	12,502	18	6	0.7
SENECA	Finger Lakes	8	126,329	101,929	24,400	19	10	1.5
ST LAWRENCE	North Country	6	255,135	213,330	41,805	16	2	2.5
STEUBEN	Southern Tier	8	275,122	273,053	2,069	1	0	0.1
SUFFOLK	Long Island	1	37,137	24,365	12,772	34	1	0.8
SULLIVAN	Mid-Hudson	3	37,080	33,323	3,757	10	1	0.2
TIOGA	Southern Tier	7	96,572	66,823	29,749	31	9	1.8
TOMPKINS	Southern Tier	7	113,698	68,357	45,341	40	14	2.7
ULSTER	Mid-Hudson	3	55,268	30,362	24,906	45	3	1.5
WARREN	Capital Region	5	6,421	1,561	4,860	76	1	0.3
WASHINGTON	Capital Region	5	146,552	125,004	21,548	15	4	1.3
WAYNE	Finger Lakes	8	175,276	120,247	55,029	31	6	3.3
WESTCHESTER	Mid-Hudson	3	5,331	4,060	1,271	24	0	0.1
WYOMING	Finger Lakes	9	178,984	175,703	3,281	2	1	0.2
YATES	Finger Lakes	8	100,700	89,496	11,204	11	5	0.7

* Counties highlighted in blue have >50,000 acres potentially suitable for reforestation.

† Franklin and Putnam counties have all of their NLCD agricultural land cover (100%) allocated to currently in-production lands and require an additional amount of land that is in NLCD grassland (1,040 acres for Franklin, 622 acres for Putnam) to be in production in order to match the in-production acreages reported in the 2017 Census of Agriculture.

Appendix 4. Area of Agricultural Land Cover Types and Estimated Acres in Production

Table A4. Potential Land Area Suitable for Reforestation Estimated to Occur in the 2016 National Land Cover Database (NLCD) and 2016 USDA CropScape-Cropland Data Layers (CDL) Land Cover Types

The CDL acreage only covers areas that were classified as agriculture in the NLCD. Adding NLCD columns 81 and 82 yields the total land area potentially suitable for reforestation in each county (Table A3, column 6). The same is true for adding the CDL columns. For New York State, this sum equals 1,668,484 acres.

COUNTY	NATIONAL LAND COVER DATABASE (NLCD)		USDA CROPSCAPE-CROPLAND DATA LAYERS (CDL)							
	Cultivated Crops (82)	Pasture/ Hay (81)	Row Crops & Grains	Alfalfa Hay	Other Hay	Idle & Fallow	Orchard	Christmas Trees	Pasture	Non-Ag
NEW YORK STATE TOTAL	226,873	1,441,610	23,412	18,835	145,454	2,447	6,885	45	571,598	899,810
ALBANY	251	7,391	0	0	0	0	0	0	0	7,643
ALLEGANY	1,497	35,348	0	0	0	0	0	0	12,643	24,202
BRONX	10	16	0	0	0	3	0	0	4	19
BROOME	667	50,442	0	0	0	0	0	0	28,072	23,037
CATTARAUGUS	2,303	38,805	0	0	9,317	0	46	0	5,060	26,686
CAYUGA	18,456	33,611	4,032	0	0	0	0	0	18,907	29,127
CHAUTAUQUA	10,858	35,857	0	0	719	0	3,019	0	11,034	31,943
CHEMUNG	836	17,475	0	0	0	0	0	0	0	18,312
CHENANGO	1,637	51,665	0	0	0	0	0	0	24,435	28,868
CLINTON	14	155	0	0	0	0	0	0	0	169
COLUMBIA	1,078	22,325	0	0	0	0	0	0	9,693	13,710
CORTLAND	2,594	31,066	0	849	3,684	0	6	0	9,563	19,559
DELAWARE	282	40,540	0	0	2,952	0	0	0	21,542	16,327
DUTCHESS	733	28,930	0	0	0	0	0	0	15,038	14,625
ERIE	9,982	59,978	0	0	9,150	0	516	0	30,131	30,163
ESSEX	202	7,260	0	0	0	0	0	0	0	7,462

COUNTY	NATIONAL LAND COVER DATABASE (NLCD)		USDA CROPSCAPE-CROPLAND DATA LAYERS (CDL)							
	Cultivated Crops (82)	Pasture/Hay (81)	Row Crops & Grains	Alfalfa Hay	Other Hay	Idle & Fallow	Orchard	Christmas Trees	Pasture	Non-Ag
FRANKLIN	0	0	0	0	0	0	0	0	0	0
FULTON	753	19,702	0	0	9,452	0	0	0	4,067	6,936
GENESEE	8,778	12,618	0	0	0	0	0	0	6,400	14,996
GREENE	725	12,056	0	0	4,094	600	0	0	1,167	6,920
HAMILTON	77	571	9	4	34	6	0	0	36	560
HERKIMER	3,234	47,022	0	0	20,862	0	0	0	14,950	14,444
JEFFERSON	6,322	114,790	0	0	25,303	0	0	0	39,398	56,412
KINGS	8	41	0	0	0	0	0	0	0	50
LEWIS	346	2,288	0	0	0	0	0	0	0	2,635
LIVINGSTON	25,110	27,583	10,525	4,371	2,015	0	23	0	19,434	16,326
MADISON	3,644	27,412	0	0	0	0	0	0	5,894	25,161
MONROE	10,790	45,922	0	0	2,377	0	620	0	34,781	18,934
MONTGOMERY	3,339	33,107	0	0	17,717	0	0	45	7,415	11,269
NASSAU	19	392	0	0	0	0	0	0	0	411
NEW YORK	5	28	0	0	0	0	0	0	0	33
NIAGARA	19,247	31,418	0	6,430	0	0	0	0	23,760	20,476
ONEIDA	5,543	54,246	0	0	0	0	0	0	28,025	31,764
ONONDAGA	9,204	37,982	0	0	0	0	0	0	12,180	35,006
ONTARIO	11,814	24,985	0	0	0	0	0	0	18,690	18,109
ORANGE	1,587	28,776	0	0	9,806	0	0	0	2,643	17,914
ORLEANS	18,183	16,309	2,984	5,042	0	0	1,119	0	13,755	11,592
OSWEGO	9,071	51,975	5,818	0	4,500	87	0	0	22,663	27,979
OTSEGO	1,777	69,297	0	0	14,268	0	0	0	36,103	20,704

COUNTY	NATIONAL LAND COVER DATABASE (NLCD)		USDA CROPSCAPE-CROPLAND DATA LAYERS (CDL)							
	Cultivated Crops (82)	Pasture/Hay (81)	Row Crops & Grains	Alfalfa Hay	Other Hay	Idle & Fallow	Orchard	Christmas Trees	Pasture	Non-Ag
PUTNAM	0	0	0	0	0	0	0	0	0	0
QUEENS	81	77	0	0	12	0	0	0	16	131
RENSSELAER	1,161	17,877	0	0	0	0	0	0	5,377	13,662
RICHMOND	37	58	1	0	1	0	0	0	8	84
ROCKLAND	13	604	0	0	0	0	0	0	0	617
ST LAWRENCE	1,790	40,015	0	0	0	0	0	0	0	41,805
SARATOGA	1,165	15,020	0	0	0	0	0	0	0	16,185
SCHENECTADY	265	9,765	0	0	2,794	0	6	0	2,246	4,983
SCHOHARIE	472	17,030	0	0	731	0	0	0	4,702	12,068
SCHUYLER	794	11,708	0	0	0	0	0	0	0	12,502
SENECA	10,200	14,200	0	1,919	0	0	0	0	11,385	11,096
STEUBEN	212	1,858	0	0	0	0	0	0	0	2,069
SUFFOLK	1,882	10,890	0	0	0	0	0	0	3,865	8,907
SULLIVAN	44	3,713	0	0	0	0	0	0	0	3,757
TIOGA	1,086	28,662	0	0	0	0	0	0	6,637	23,112
TOMPKINS	2,276	43,065	0	97	0	0	0	0	19,514	25,730
ULSTER	1,722	23,185	0	0	5,397	1,751	1,531	0	4,426	11,800
WARREN	142	4,718	43	122	268	0	0	0	389	4,038
WASHINGTON	1,894	19,655	0	0	0	0	0	0	0	21,548
WAYNE	19,262	35,766	0	0	0	0	0	0	32,991	22,037
WESTCHESTER	11	1,260	0	0	0	0	0	0	0	1,271
WYOMING	1,580	1,701	0	0	0	0	0	0	0	3,281
YATES	4,857	6,347	0	0	0	0	0	0	2,560	8,644



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