Topic: Assessment of Reforestation Opportunity Through Federal Programs and Partnerships
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Issue Summary: This briefing paper provides a Forest Service Research and Development assessment of reforestation opportunity on nonfederal lands across the United States.

Background: As a component of Executive Order 14072 – Strengthening the Nation's Forests, Communities, and Local Economies – the Secretary of the Interior and the Secretary of Agriculture were charged to develop an assessment of reforestation opportunities through existing Federal programs and partnerships (Sec 2(d)(i)). The joint Reforestation Working Group, convened by USDA (Natural Resources and Environment) and Department of Interior, asked Forest Service Research and Development to estimate reforestation opportunities in support of a joint Secretary response.

Recommendation: Forest Service Research and Development estimates of reforestation opportunity on nonfederal lands are provided here for the United States[1]. Appendices provide full and replicable methodologies for State/Private lands (Forest Inventory and Analysis data; analyses conducted by Dr. Katherine Renwick) and Urban land (National Land Cover Database; analyses conducted by Dr. Alexis Ellis). These estimates are not recommendations, but rather represent lands that could support reforestation efforts.

Program/Funding Stream	Estimation of Reforestation Opportunity[2] (millions of acres)		Notes on opportunities for growth/expansion
	Non-stocked	Poorly stocked (supplemental)	Reforestation and supplemental planting in areas with recent disturbances and afforestation of non-timberland areas offer considerable additional opportunities.
States	0.7	4.4	
Private[3]	5.9	45.5	
Urban Land	7.8		Conservative estimate would be enhanced by replacing 30meter with high resolution 1meter data

Appendices Attached: 2

[1] Estimates of Urban land reforestation opportunities in this analysis did not include Alaska, Hawaii, Puerto Rico, and the islands (NLCD is available from 2011 for AK/HI; and 2001 for PR; preliminary analysis showed close to 100,000 acres total additional opportunity).
[2] FIA plots that meet the definition of forest land but have < 10% cover of trees, saplings, and seedlings at the time of sampling are classified as "nonstocked", and those with 10-34% cover are classified as "poorly stocked" (USDA Forest Service 2018).
[3] The FIA ownership class for undifferentiated private land (OWNCD 46) includes corporate, non-governmental organization, local association, Native American, and individual and family lands.

Appendix 1: Potential opportunities for reforestation and supplemental planting on state and private timberland

Estimates (in millions of acres) of potential reforestation opportunity on timberlands (productive forestland available for timber production).

	Nonstocked	Poorly stocked	Total understocked
State	0.7	4.4	5.1
Private[4]	5.9	45.5	51.4

Methodology

Timberland

The Forest Inventory and Analysis (FIA) program defines timberland as forest land that is *not reserved* (not permanently prohibited from timber production) and *productive* (capable of producing at least 20 cubic feet of wood per acre per year). Forest land includes all land that has at least 10 percent canopy cover of live trees or that has had at least 10 percent canopy cover in the past (USDA Forest Service 2018). There are 385.7 million acres of timberland on state and private lands.

Analysis

This analysis used the most recent publicly available FIA data to estimate the acres of potential opportunity for reforestation or supplemental planting on state and private land across all US states and territories[5]. Two forest stocking classes were considered: nonstocked, which may provide an opportunity of reforestation, and poorly stocked, which may benefit from supplemental planting. FIA plots that meet the definition of forest land but have < 10% cover of trees, saplings, and seedlings at the time of sampling are classified as "nonstocked", and those with 10-34% cover are classified as “poorly stocked” (USDA Forest Service 2018). Some nonstocked areas may regenerate naturally in time, and poorly stocked areas may similarly experience a natural increase in tree cover. Other areas may require planting or seeding to reestablish tree cover or increase the rate of recovery.

Data for this analysis were collected from 2006-2022. There may be additional reforestation and supplemental planting opportunities in areas with recent disturbances, as well as opportunities for afforestation of areas that are not currently considered forest land.

Publications supporting methodology

Domke, G. M., S. N. Oswalt, B. F. Walters, and R. S. Morin. 2020. Tree planting has the potential to increase carbon sequestration capacity of forests in the United States. Proceedings of the National Academy of Sciences 117:24649–24651. https://www.pnas.org/doi/10.1073/pnas.2010840117

USDA Forest Service. 2018. Forest Inventory and Analysis national core field guide. Vol. 1: Field data collection procedures for Phase 2 plots, version 8.0. https://www.fia.fs.usda.gov/library/field-guides-methods-proc/docs/2018/core_ver8-0_10_2018_final.pdf.

USDA Forest Service, The Forest Inventory and Analysis Database. EVALIDator Version 2.0.5. www.fia.fs.usda.gov/tools-data/. Accessed 22 February 2023.

[4] The FIA ownership class for undifferentiated private land (OWNCD 46) includes corporate, non-governmental organization, local association, Native American, and individual and family lands.
[5] Analysis does not include the District of Columbia.

Appendix 2: Potential opportunities for reforestation on urban land in the United States

Estimated urban available green space: **25.8 million acres**
Estimated potential opportunity for reforestation: **7.8 million acres**

Methodology

Urban Areas

Urban land is delimited based on 2020 US Census Bureau definitions (US Census Bureau. 2022). An area must encompass at least 5,000 people or at least 2,000 housing units to qualify as a census urban area. In the continental US there is 67.5 million acres of census defined urban land.

Tree Canopy Cover, Impervious Surface Cover and Land Cover Characteristics

To assess tree cover, impervious cover and land cover characteristics, the Multi-Resolution Land Characteristics (MRLC) consortium's National Land Cover Database (NLCD) was used. These data contain percent tree canopy and impervious cover estimates and land cover class designations, as a continuous variable, for each 30pixel across all land covers and types. The 2016 NLCD data was used in the continental United States. Estimates of Urban land reforestation opportunities in this analysis did not include Alaska, Hawaii, Puerto Rico, and the islands (NLCD landcover is available from 2011 for AK/HI; and 2001 for PR).

Analysis

For this analysis urban available green space is defined as the amount of grass and soil area not covered with tree canopies and potentially available for planting. The acreage is calculated using the land area (not including water) of the geopolitical units derived from the U.S. Census cartographic boundary data and NLCD. This value is determined by subtracting the acres of tree canopy cover from the total green space. Total green space is an estimate of pervious cover (i.e., grass, soil, or tree-covered areas) and was derived by taking the total area minus impervious and water cover (ac).

The area of potential reforestation opportunity is estimated by adjusting available green space based on NLCD (2016) land cover class. Land that is classified as agriculture or wetland is assumed to have 0 acres of reforestation potential. Similarly, land that is medium and high density developed is assumed to have 0 acres of reforestation potential since this land is highly impervious. In urban land classified as forest or shrub/scrub, 77.3% of the total available green space is assumed to be able to be planted (Nowak, 2022). For all other land cover classes (low intensity/open space developed, barren & grass/herbaceous), 27% of the total land area is classified as having no reforestation potential; this is based on research that suggests that in urban areas, regardless of the amount of impervious surface, on average 27% of the total land area is left as unplanted open space (Nowak, 2022).

Potential Areas of Expansion

- Improved land area estimates by replacing NLCD (30m) data with high resolution (1 m) urban tree cover data and impervious surface dataset where available.
- Refined definition of urban reforestation potential to produce estimates that exclude areas where reforestation opportunities are limited or not possible.
- Preliminary analysis showed close to 100,000 acres total additional opportunity in AK/HI.

Analysis by land cover class in urban land areas

NLCD Landcover Class	Total Acres	Urban Available Green Space	Potential Reforestation Opportunity
Developed Open	11,754,000	1,405,000	0
Developed Low	15,713,000	8,061,000	3,819,000
Developed Medium	13,552,000	4,499,000	0
Developed High	5,633,000	565,000	0
Barren	232,000	224,000	162,000
Forest	8,440,000	2,482,000	1,919,000
Grass/Herbaceous	1,392,000	1,263,000	887,000
Scrub/Shrub	1,454,000	1,321,000	1,021,000
Agriculture	4,905,000	4,628,000	0
Wetland	3,099,000	1,405,000	0
Water	1,633,000	0	0
Total	*67,806,000*	*25,855,000*	*7,808,000*

Publications supporting methodology

Nowak, David J.; Ellis, Alexis; Greenfield, Eric J. 2022. The disparity in tree cover and ecosystem service values among redlining classes in the United States. Landscape and Urban Planning, Volume 221, May 2022.

Greenfield, Eric J. 2010. Urban and community forests of the North Central East region: Illinois, Indiana, Michigan, Ohio, Wisconsin. Gen. Tech. Rep. NRS-54. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 54 p.