Duke Farms

Project Impacts:

CO2 Sequestration and Carbon Footprint Improvements

Duke Farms Goals: Climate Neutrality

Agriculture, Ecology, Engineering, Education, Tourism

Carbon Negative Status

*Goal # 12: Foster Climate Change Mitigation (includes 3 subgoals) • Subgoals include reduce carbon emissions from stewardship vehicles and equipment, explore feasibility of utilizing "waste" biomass from stewardship activities to provide a fuel for space heating and develop carbon sequestration research project

Status: Began in March

Model for Society

*Goal # 10: Integrate Stewardship and Related Programmatic Goals (includes 4 subgoals) • Subgoals include Foster community support for stewardship; Foster recreational opportunities; Provide outreach/education, professional training, and volunteer opportunities; Establish Duke Farms as a leader in ecological gardening/landscaping

*Duke Farms Land Stewardship Plan, May 2017

3 Projects; One Common Goal

Tree: Increasing Sink Capacity

Meadow: Maximizing Sinks, Reducing Carbon Footprint

Greenhouse Education of Sequestration Techniques, Energy Efficiency Practices, Adaptive Reuse of Materials, Pilot Projects for Maximizing Sinks Through Soil and Fungi

Tree Allée Project Impacts:

Total Sink Capacity Increase: 7,344,549.70 lbs (over 99 years) *433 Trees Planted

Species Matter: American Sycamore vs Zelkova
*Sycamore stores 5x the amount of Carbon

Reduction of Emissions: Local Sourcing- Less Transportation- Supply Chain Management within CO2 Emission Framework
Native Species (More Likely to Thrive)

Co-Benefits: Shade / Natural Cooling, Air Quality, Rain Water Consumption

*Via i-Tree tool; Over 50 Years:

Location		CO_2 Benefits			
Group Identifier	Tree Group Characteristics	CO_2 Avoided (pounds)	CO_2 Avoided ($)	CO_2 Sequestered (pounds)	CO_2 Sequestered ($)
1	• (433) Zelkova (Zelkova species) at 1 inch DBH. • Planted 0-19 feet and north (0°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	3,492,572.9	$81,226.48	615,691.6	$14,319.09

Location		CO_2 Benefits			
Group Identifier	Tree Group Characteristics	CO_2 Avoided (pounds)	CO_2 Avoided ($)	CO_2 Sequestered (pounds)	CO_2 Sequestered ($)
1	• (433) Sycamore, American (Platanus occidentalis) at 1 inch DBH. • Planted 0-19 feet and north (0°) of buildings that were built post-1980 with heat and A/C. • Trees are in excellent condition and planted in full sun.	5,027,577.0	$116,925.95	3,263,597.0	$75,901.21

Meadow Project Installation Impacts:

3 Acres of Meadow Conversion

CO_2 output reduction and CO_2 sink capacity increase

Turf Requires: Mowing 1x a week- Irrigating- Fertilizing

Meadow: Reduced mowing; 12x a month first 2 years, then further reduction, irrigation and fertilizer reduction

*17.7 pounds of CO_2 emitted per gallon of gasoline consumption

*Sciencing.com , carbonfootprint.com USDA Forest Service

Greenhouse Redevelopment Impacts:

Use soil and fungi demonstration plots and laboratory space for testing and comparing:

1) Best practices in soil and agricultural management on different plants, lawns, shrubs, trees

2) Mycorrhizal commercial products

Goal: Increase soil carbon capacity by 0.4% every year by 2020 (4 per 1,000 Initiative is trying to do this)

Greenhouse Redevelopment Impacts:

Change in carbon sequestration with 0.4% increase/year in soil capture

	Year 5	Year 10	Year 20	Year 50	Year 100
Additional increase ir carbon (lbs)	148,071	299,127	610,436	1,622,525	3,603,492
% carbon vs. baseline year	2%	4%	8%	22%	49%

In 100 years, the carbon storage capacity of the original 433 trees will be increased nearly 50%

In 100 years: equivalent of adding 216 trees

In 50 years: adding 95 trees

Cumulative Impacts

Sink Capacity Increases

- 460 trees planted
- *8 million lbs. of carbon sequestered over 99 years
- 3 acres of meadow conversion
- +3.6 million lbs. of carbon sequestered with 0.4% increase in soil capture

CO2 Emission Reduction

- Reduction of Mowing
- Reduction of Fuel Consumption: (mowers, transportation, heating / cooling)
- Energy Consumption Efficiency for Greenhouse

Co-Benefits

- Water Management
- Shade - Cooling
- Air Quality
- Pollinators
- Agricultural Output
- Mushroom Cultivation
- Plant/Tree Growth

Model for Societal Integration

- **CO2 Sink Capacity Framework:** Selection of Tree Species, Vacant Land Uses, Surface Mixes, Incorporation of CO2 Framework into Spatial Planning
- **Best Practices for CO2 Neutrality:** Tree Planting, Tree Sourcing, Land Management- Meadow Conversions, Supply Chain Emission Reductions
- **Integration of Best Practices in Soil Management & Fungi**

Future

Establishing sequestration baselines for trees, meadows, shrubs and wetlands

Continue to improve best practices in soil management and fungi growth to all land types (increases carbon sink despite LU constraints)

Use & share soil research with region & beyond

Set aspirational sequestration goal

Credits

1. i-Tree Tool from USDA Forest Service

1. Sciencing.com - gas powered mowing formula

1. Carbon Plus Calculator - US Forest Service

2. Duke Farms Land Stewardship Plan, May 2017
   Prepared by Michael Van Clef, Ph.D. Ecological Solutions, LLC,
   Thomas Almendinger, Charles Barreca, Michael Bellaus, Michael Catania, James Hanson, Jon Wagar

1. 4 Per 1000 Initiative - 4p1000.org

Thank You