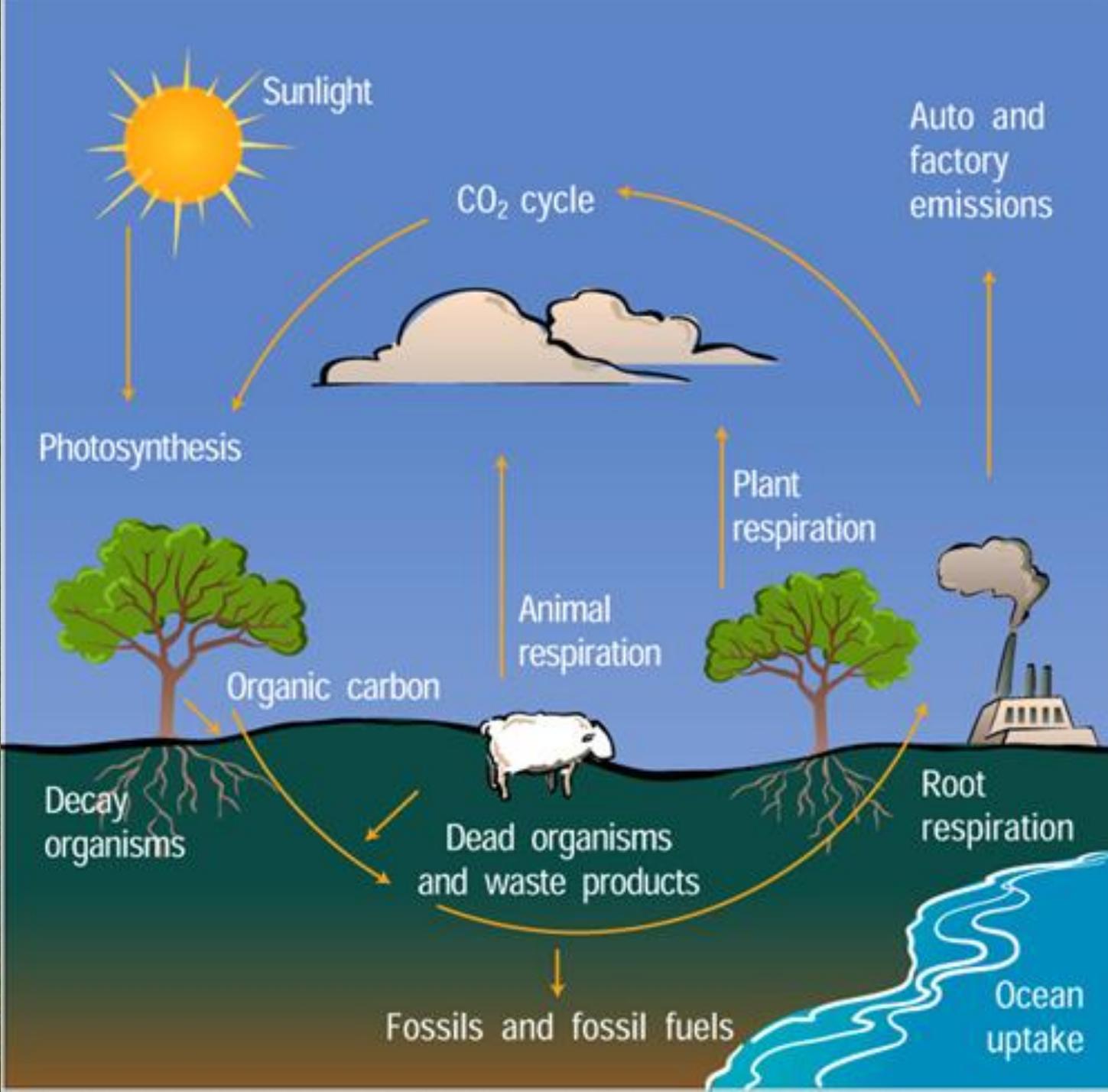


# Carbon Balance in Forestry and Agricultural Soils

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Current and potential storage and  
sequestration



Source:  
<http://www.forestthreats.org/news-events/newsletter/newsletter-winter-2008-1/newsletter-photos/carbon%20cycle.jpg>

# Forestry

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Carbon Balance

# Forest Carbon Cycle

## Storage

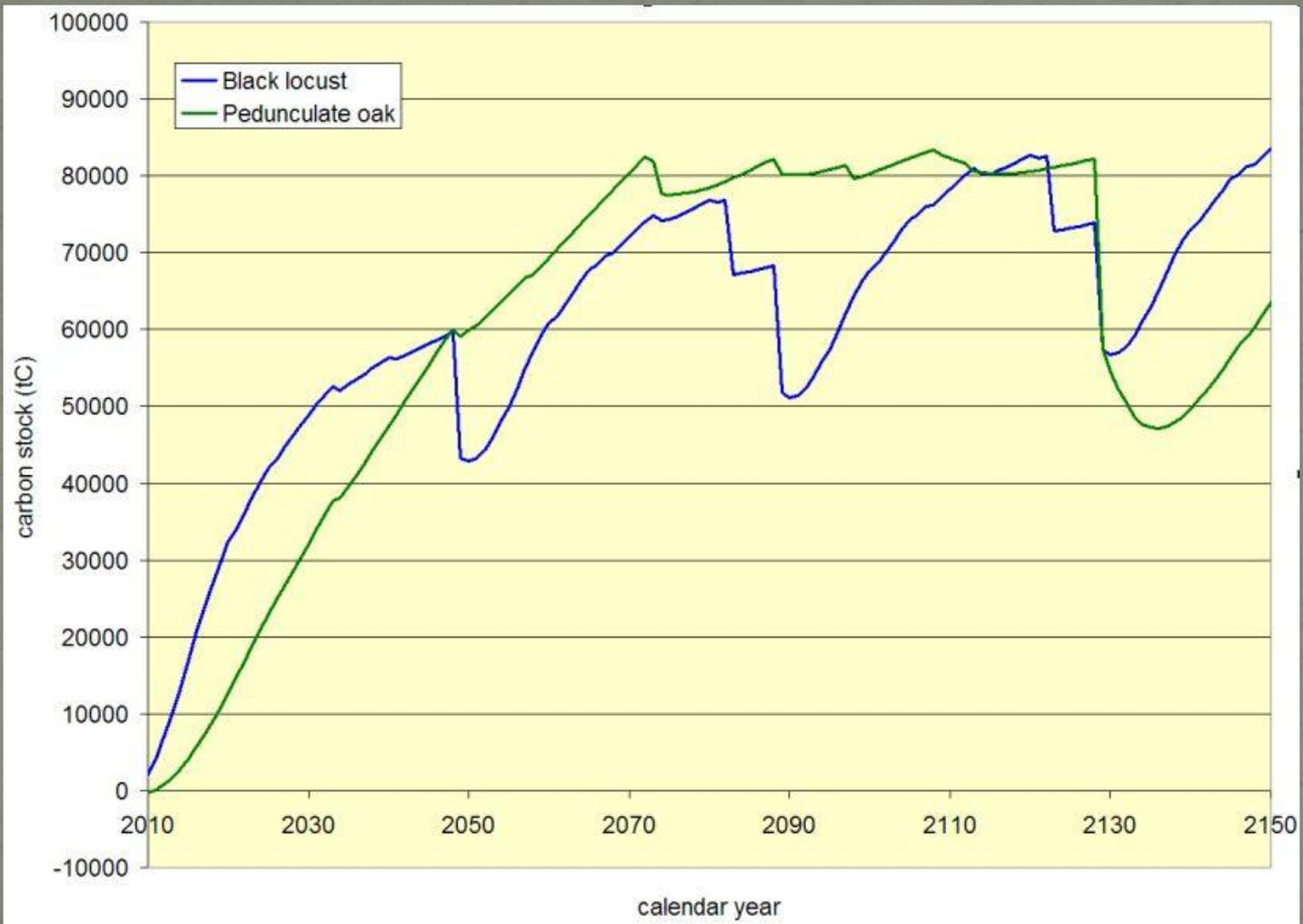
- Biomass—  
trunk, leaves, branches
- Dead matter
- Soils

## Release

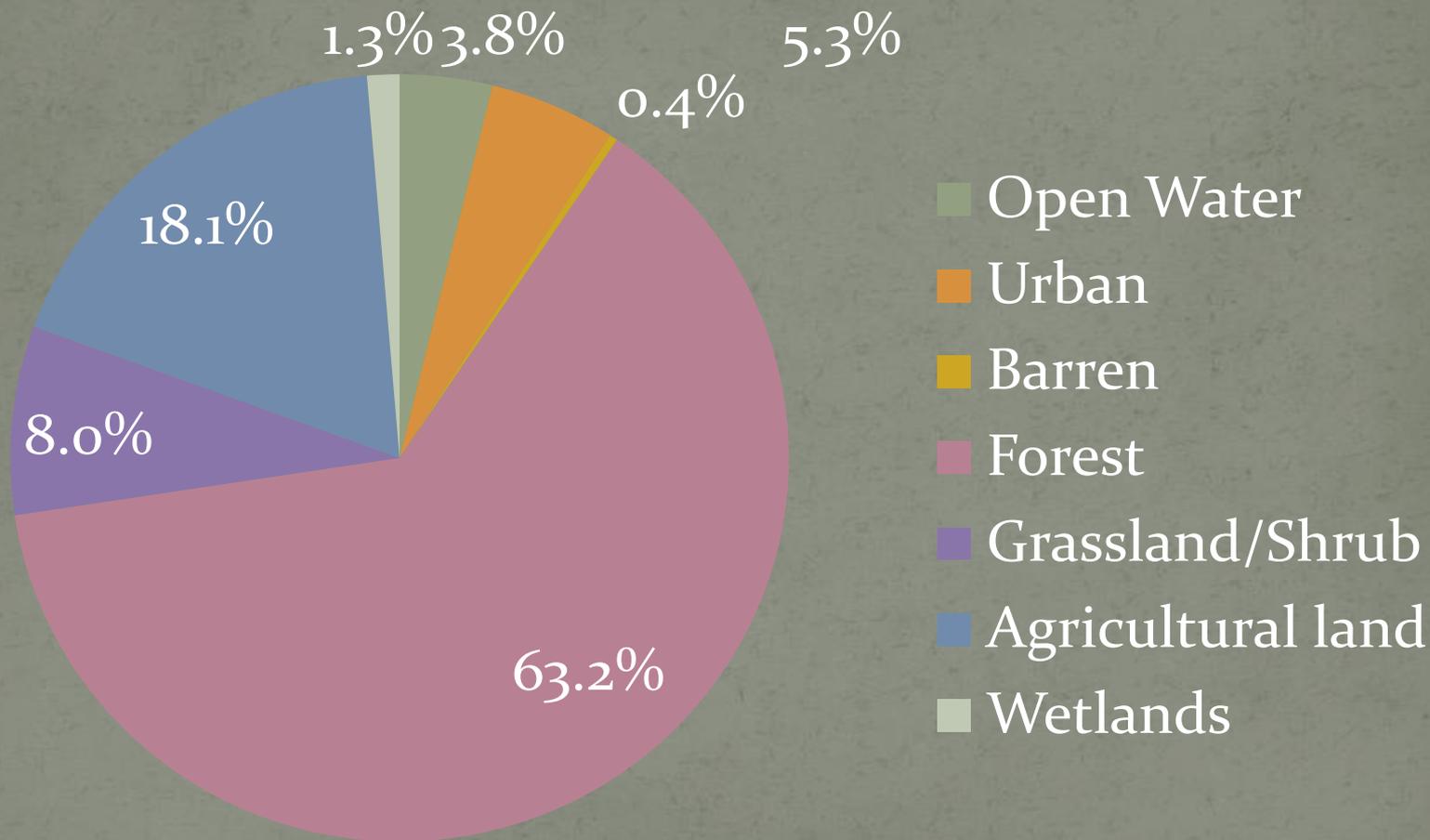
- Decomposition
- Fire
- Harvest\*

\*Depends on use; i.e. furniture stores carbon for a long time

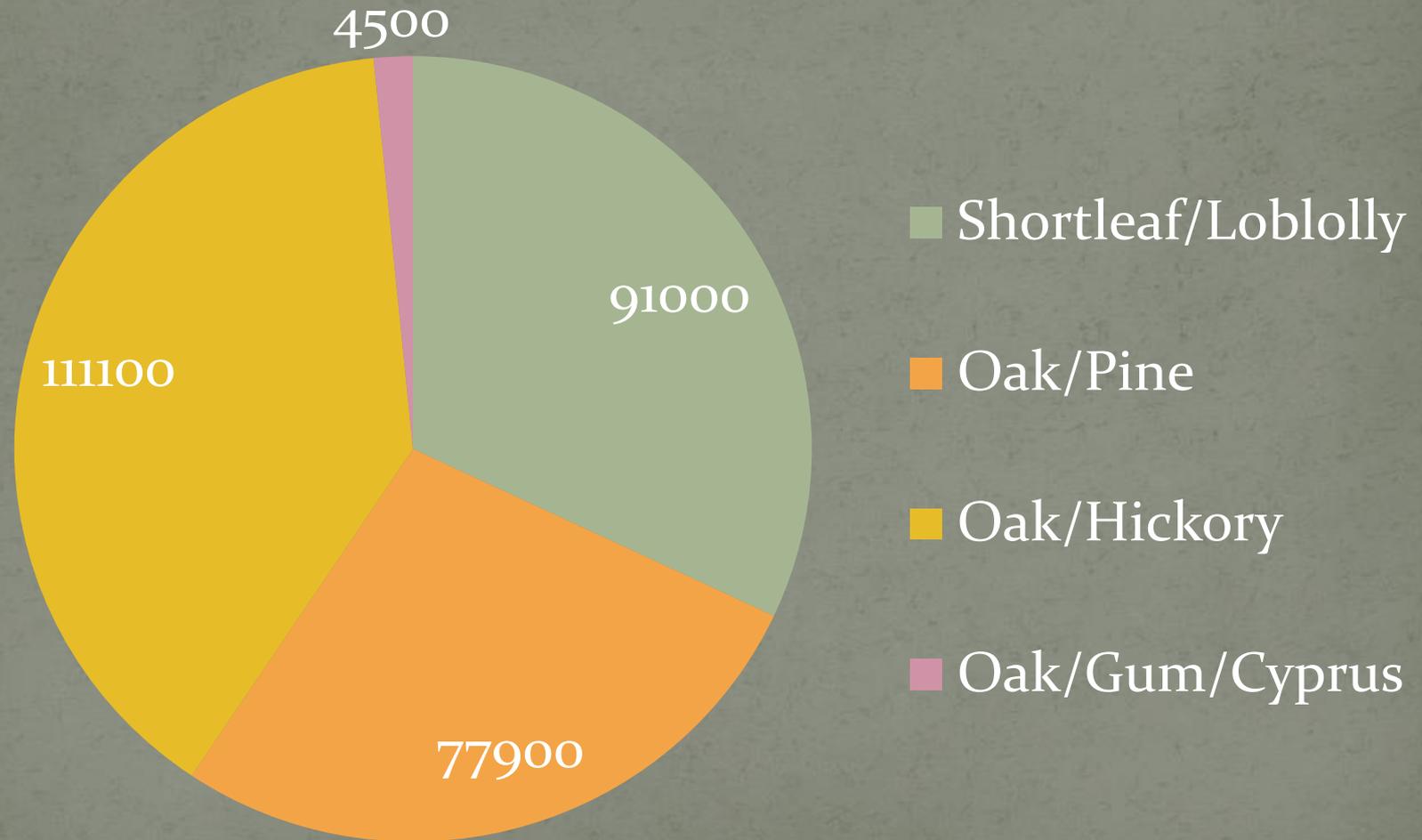
# Growth and Carbon



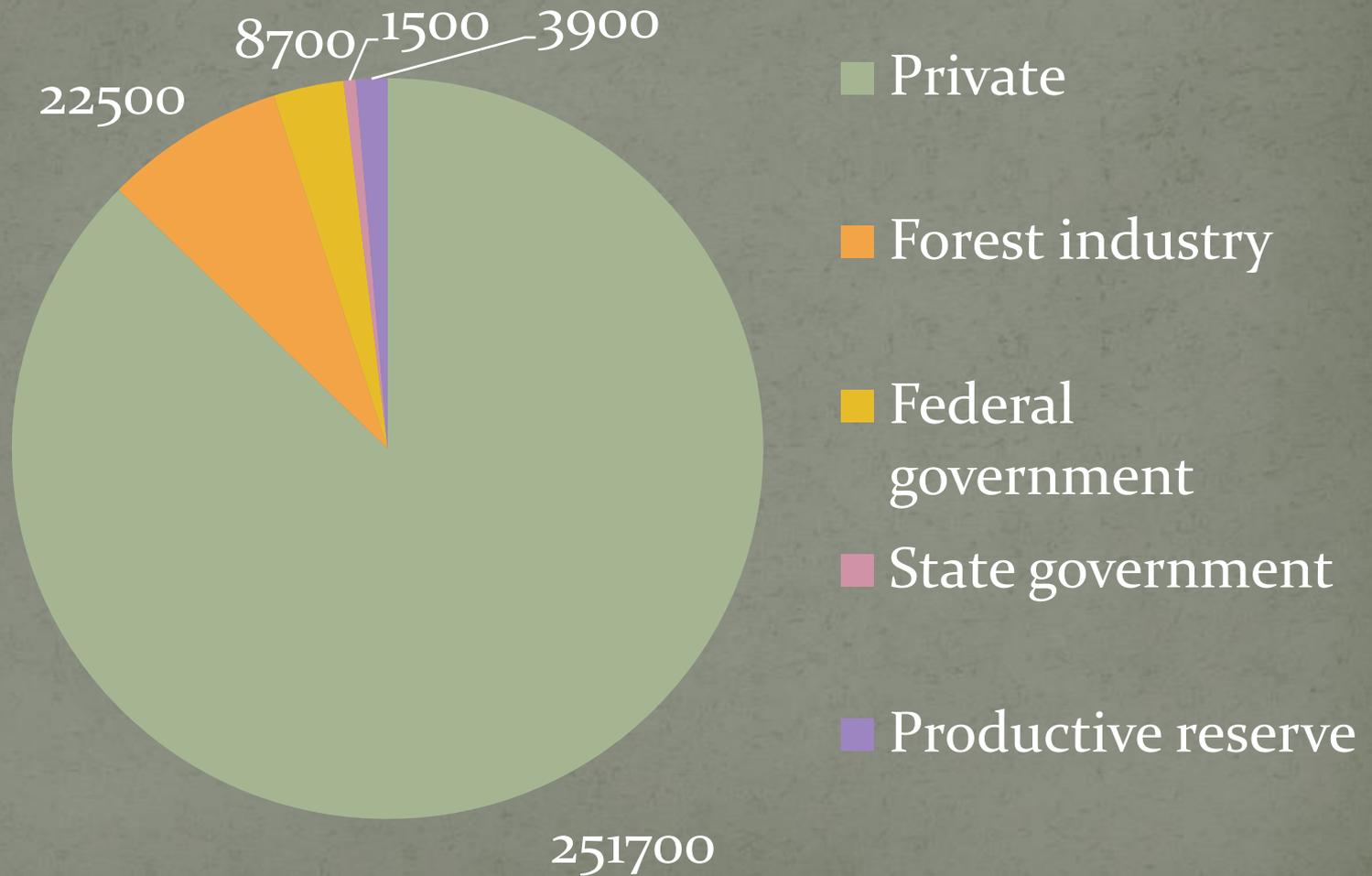
# Chatham County Land Use (2001)



# Chatham Forest Types (acres)

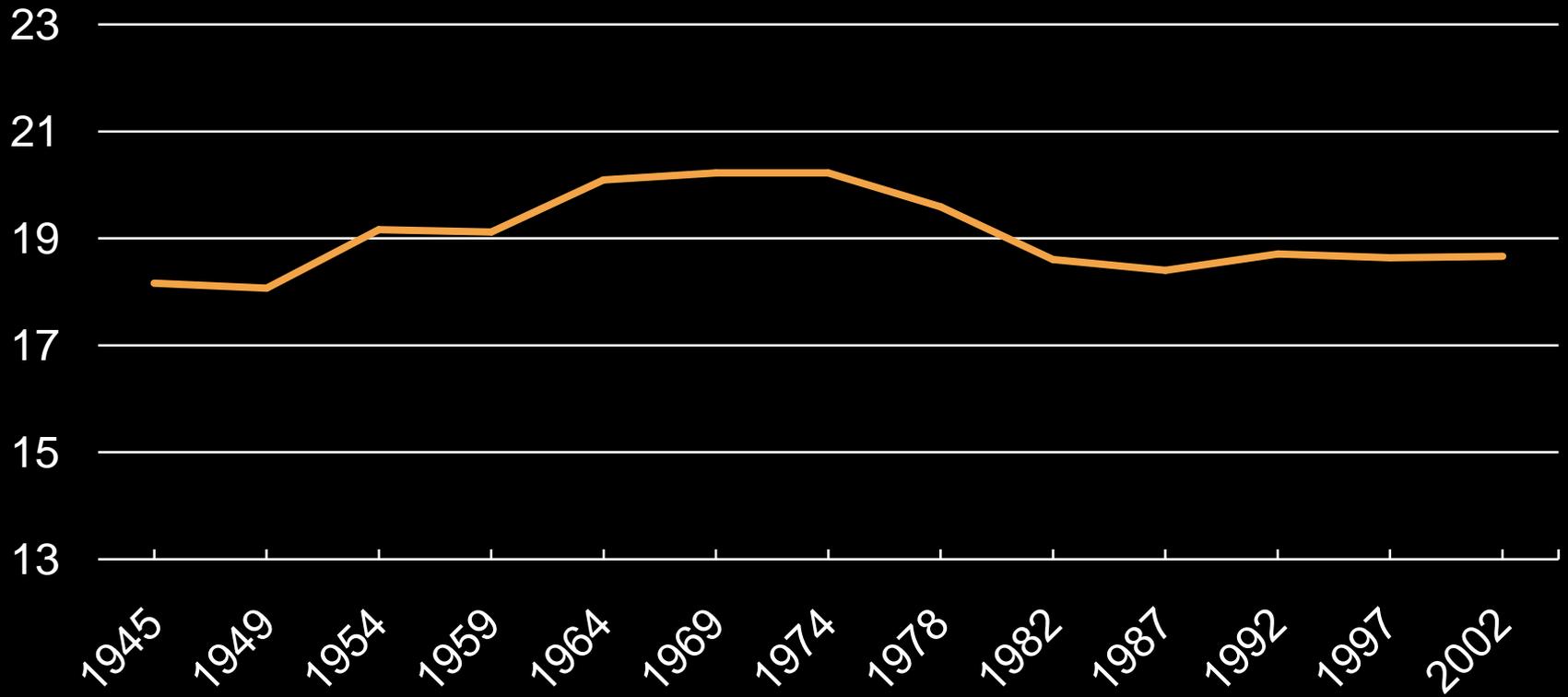


# Chatham Forest Ownership

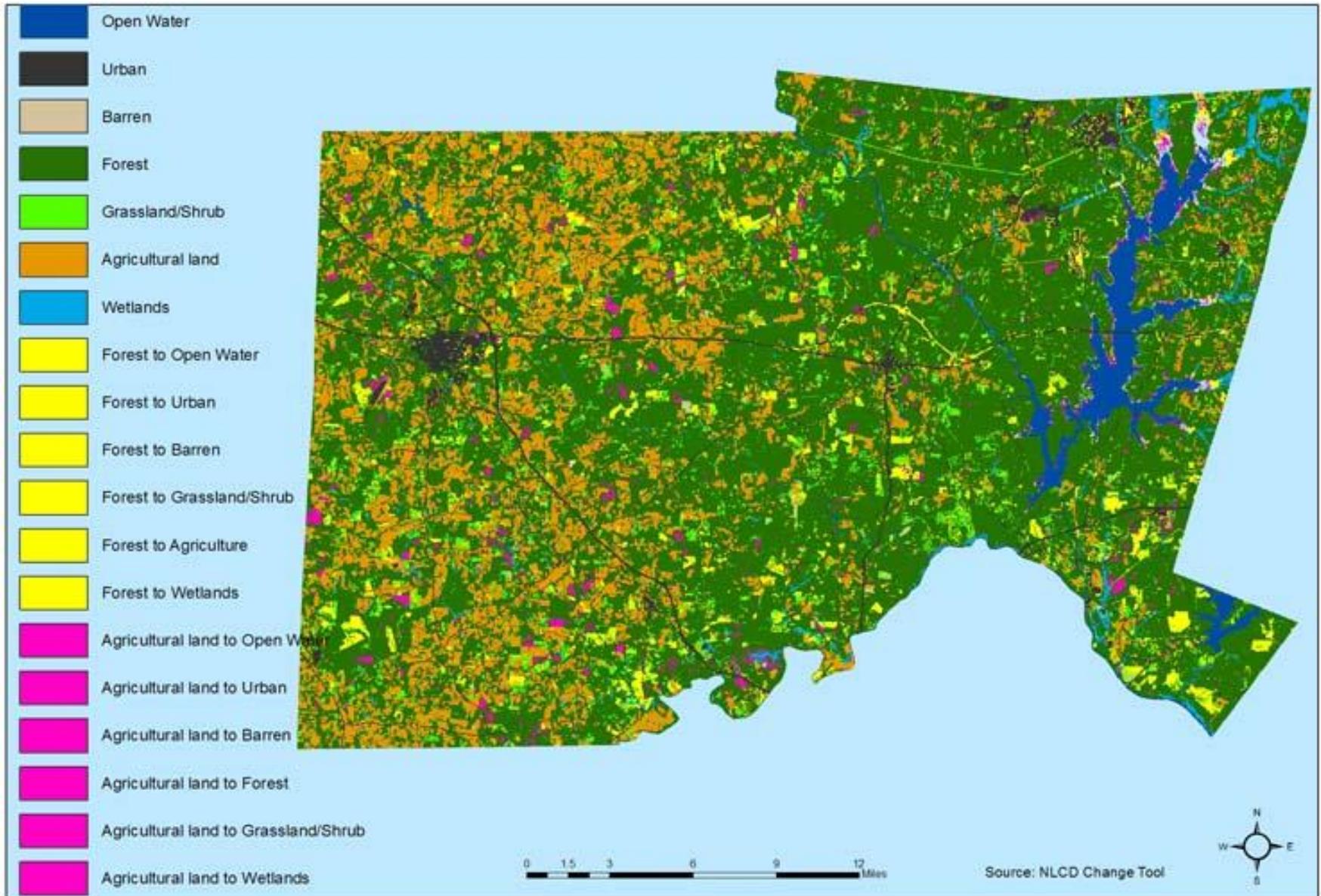


# Forest Baseline

**Total NC Forest Acreage (in millions)**



# Chatham County Land Cover Change 1992-2001



# Chatham Agriculture Change, 1992-2001

(Net Change -3.2%)

-0.3% Grassland/Shrub

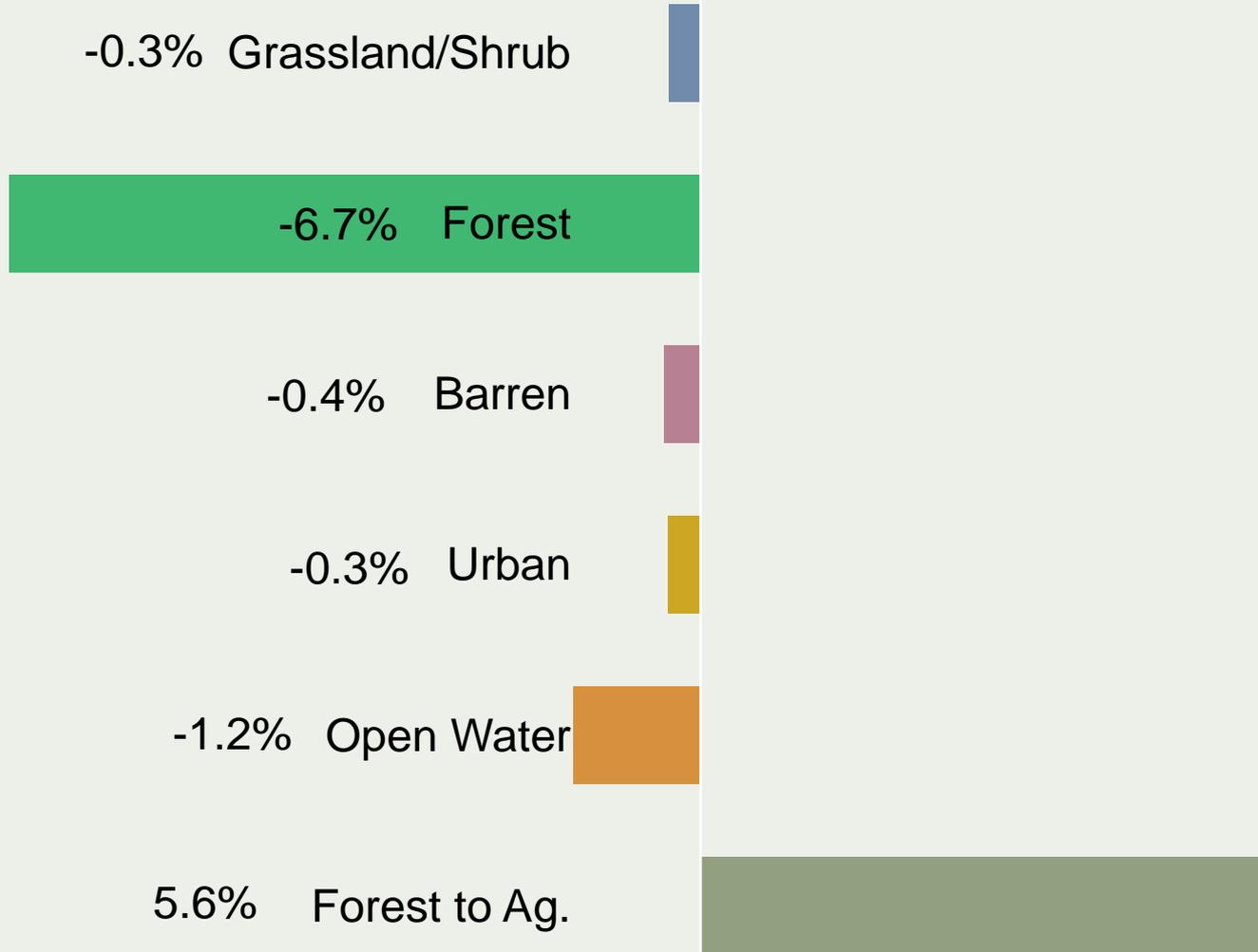
-6.7% Forest

-0.4% Barren

-0.3% Urban

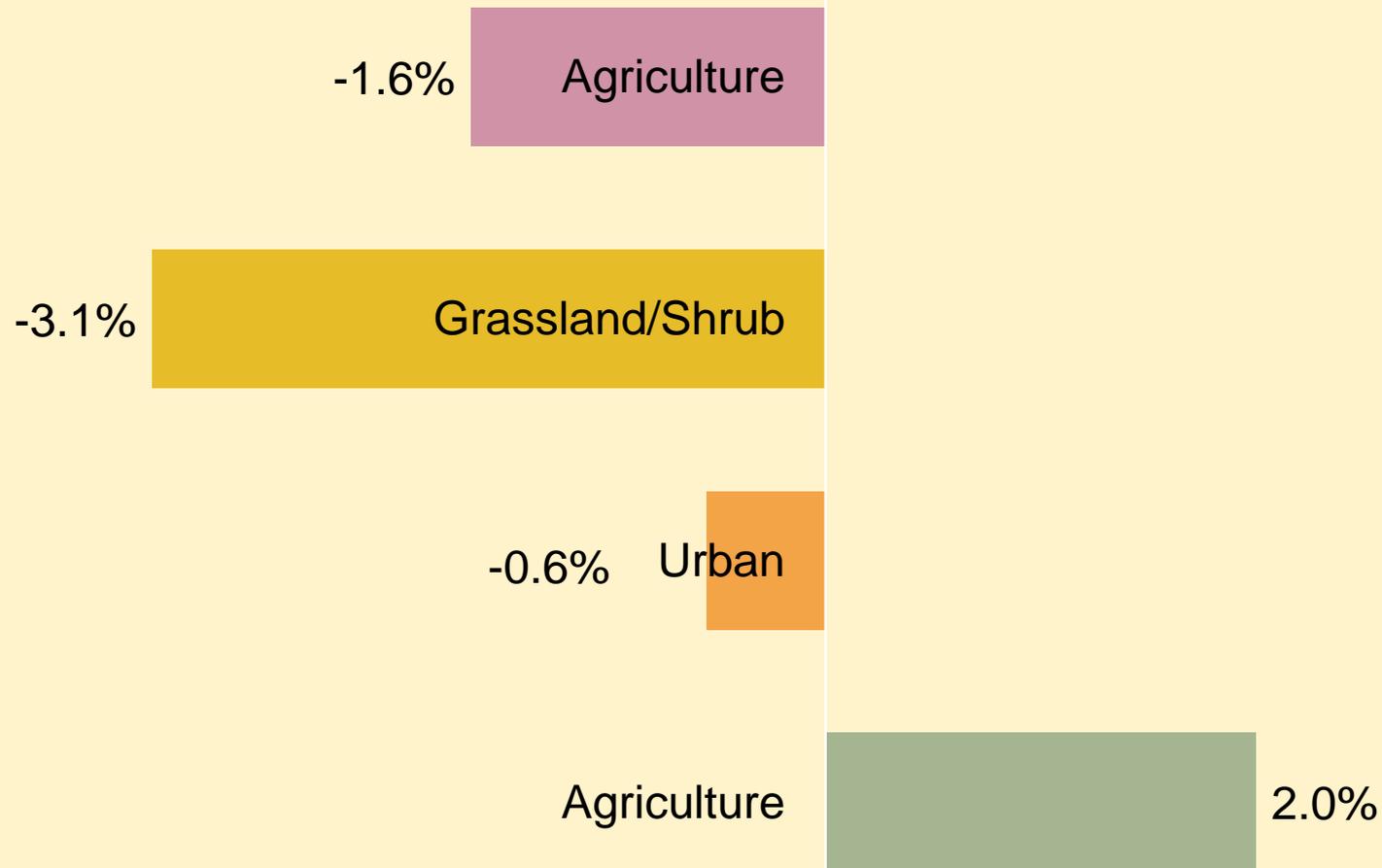
-1.2% Open Water

5.6% Forest to Ag.



# Chatham Forest Change,

1992-2001 (Net change -3.6%)



# Forest Carbon Storage for Timberlands

	Total Stored Carbon (tonnes/ha)	Hectares	US Tons CO <sub>2</sub>
Shortleaf/Loblolly	83.9	36,826	23,398,468
Oak/Pine	81.6	31,525	18,309,973
Oak/Hickory	114.2	44,961	29,093,695
Oak/Gum/Cypress	76.1	1,821	1,691,438
Total			72,493,574

# Chatham Forest Growth/Removal (1990-2001)

	Annual Growth (million cubic feet)	Annual Harvest (million cubic feet)	Net Annual Sequestration (16-20% error margin)
Chatham Co.	25.5	25.7	~0
North Carolina	1255.4	1227	~0

# What Types of Forestry Projects Sequester or Mitigate Carbon Dioxide?

- Afforestation
- Reforestation
- Preservation
- Forest Management
- Biomass energy
- Storage in wood products

# Simulated Forest Carbon Sequestration Project

## One Reforestation Project: 100 acres Cropland to Loblolly Pine

	Years 0-5	Years 5-10	Years 10-15	Years 15-20	Total over 20 years
Annual Net Offset Potential (US tons CO <sub>2</sub> eq. absorbed/year)	304	292	220	217	5170

# 20 Year total financial yield of our project

US Market \$2.50-\$29 per US ton

- \$10 a ton yields **\$51,700**

Europe Market \$13-\$38 per US ton

- \$25 per ton yields **\$129,250**

Economist- suggested price to reduce emissions

- \$30+ per ton yields **\$155,100+ (Stern, 2008)**

# Agriculture

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Carbon and Nitrogen Balance

# Agriculture Emissions and Sequestration

## Agricultural emissions estimated in Part 1

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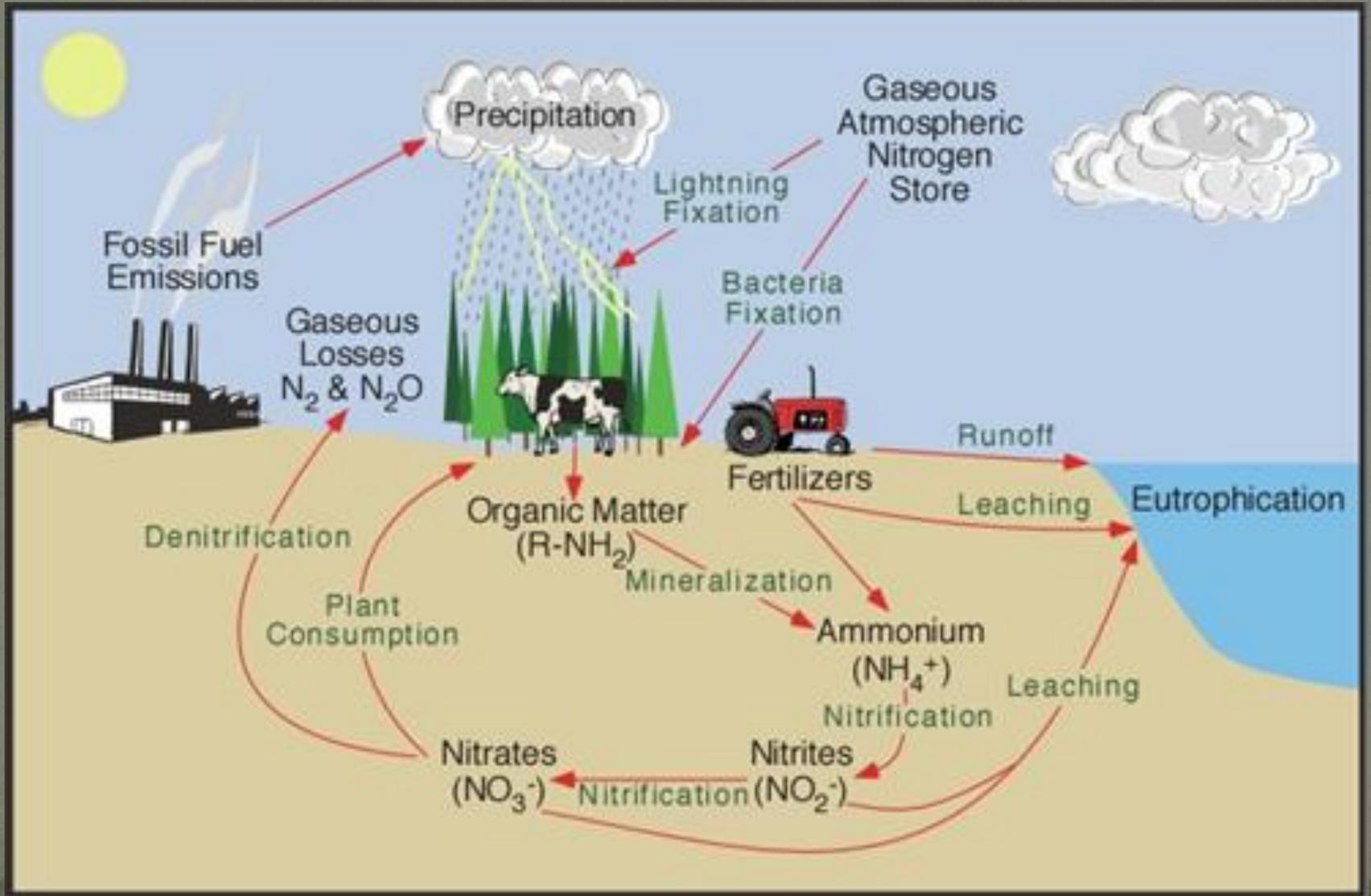
- Livestock emissions:
  1. Methane ( $\text{CH}_4$ )
  2. Nitrous Oxide ( $\text{N}_2\text{O}$ )
  3. Carbon Dioxide ( $\text{CO}_2$ )

## Agricultural Emissions considered next

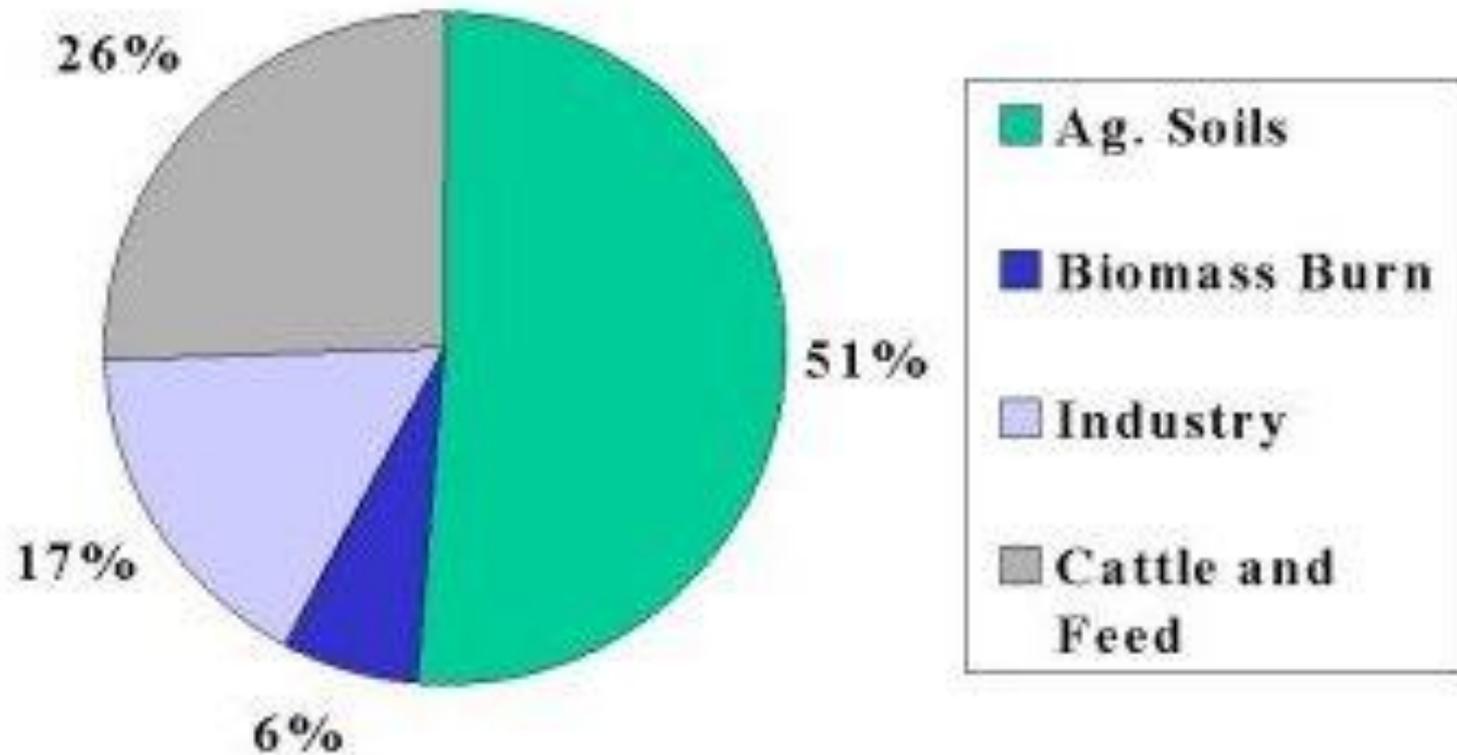
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- Agricultural soils:
  1. Nitrous Oxide ( $\text{N}_2\text{O}$ )
  2. Carbon Dioxide ( $\text{CO}_2$ )

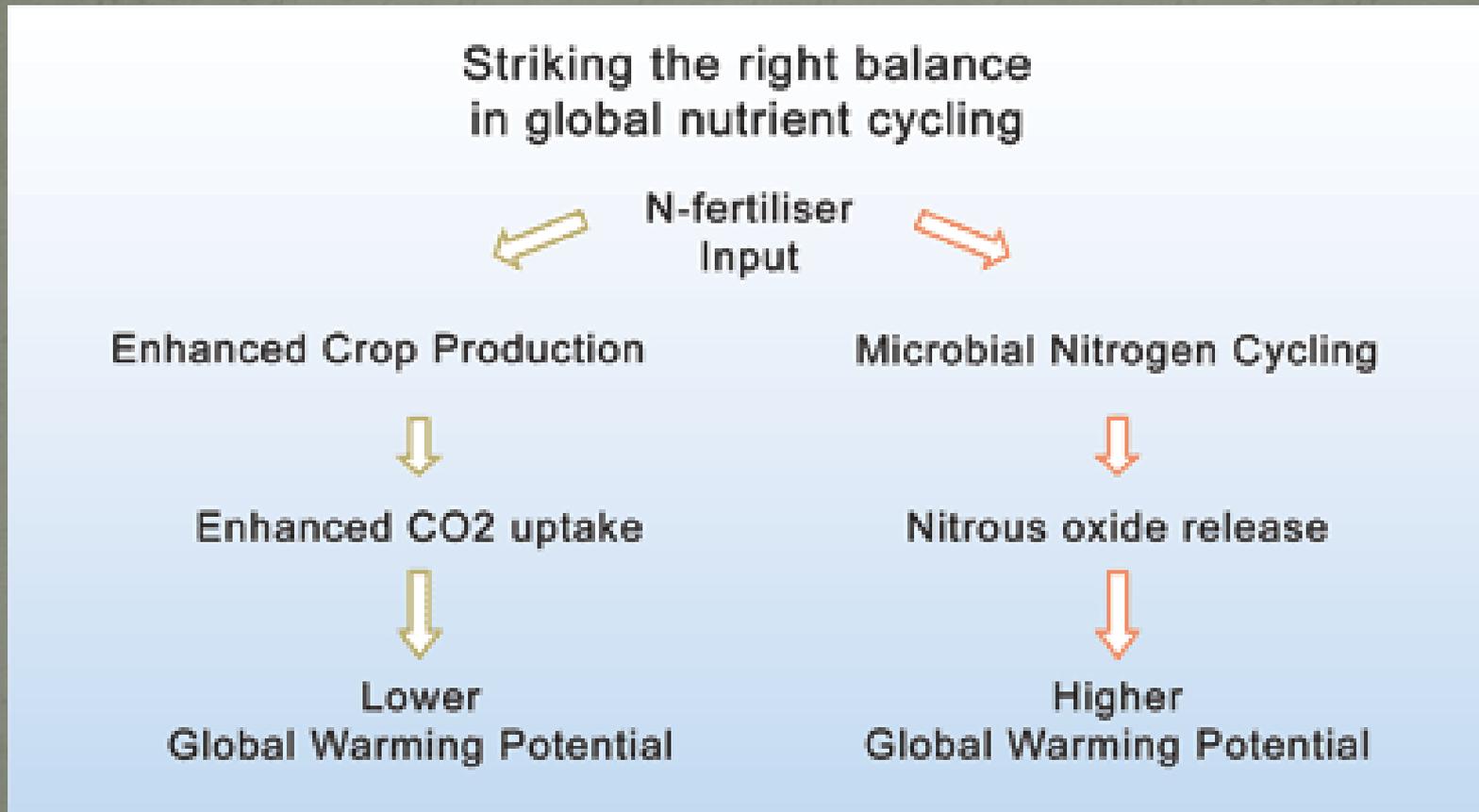
# Nitrous Oxide ( $N_2O$ ) in the Nitrogen Cycle



# Worldwide Human N<sub>2</sub>O Sources



# Nitrogen vs. Carbon



# What Agriculture Management Practices Affect Greenhouse Gas Emissions?

## Carbon

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- Conservation and Riparian buffers
- Conservation tillage
- Grazing land management
- Efficiency of farm equipment
- Transportation and storage of crops

## Nitrous Oxide

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- Reducing use of Synthetic fertilizers
- Correct amount of fertilizer
- Optimizing timing of application
- Improving irrigation practices

# Simulated Agriculture Carbon Sequestration Exercise

- For Following Conditions:
  - 100 acres
  - Clay-loam soil, non-hydric
  - **Historic:** Upland non-irrigated
  - 70s to 90s: Non-irrigated corn-cotton-soybean-tobacco; intensive tillage, no participation in conservation program
  - **Current:** Non-irrigated continuous corn; intensive tillage
  - **Future:** Irrigated corn-soybean-winter wheat; no till

# Simulated Agriculture Carbon Sequestration Exercise

- Total Tons of CO<sub>2</sub> Sequestered Per Year: 18 (Confidence Interval 4 to 42)
- Compared to Forestry Project: 259

Source: COMET-VR Century ONLINE Carbon Storage Report – 2010  
United States Department of Agriculture (USDA)  
<http://www.cometvr.colostate.edu/tool/default.asp?action=1>

# Data Needs for Carbon Sequestration Project Verification

- Agriculture
  - Tillage practices
  - Historic and current crop regimes and management practices
- Forest
  - Urban vegetation
  - End uses of wood harvest
- Future legislation and its effect on the carbon market

# Chatham's Estimated Greenhouse Gas Balance

Total Tons Carbon Dioxide Equivalents emitted in the County	2,087,803
Carbon Tons Sequestration by forests (larger than 1 acre)	0
<b>Net Emissions</b>	<b>2,087,803</b>

Carbon Stored in Forests: ~72,500,000

# Other Reasons to Value and Protect Forests

- Water purification
- Flood mitigation
- Reduced air conditioning costs in summer
- Wildlife habitat
- Recreation, hunting, fishing
- Air purification
- Higher property values

# Current County Initiatives aimed at Reducing Emissions

- Municipal energy efficiency program
- Conservation Agriculture
- Green Building Task Force
- Green Economy Task Force
- Adopted Farmland Protection Plan
- Compact Communities Ordinance
- New county buildings LEED energy efficiency requirements

# Elements to Consider in a Local Action Plan

- Expand energy conservation measures
- Expand alternative energy measures
- Energy efficient new construction
- Increase recycling
- Offset emissions:
  - Plant trees
  - Agriculture practices
  - Purchase offsets

# Suggested Criteria

- Cost-effectiveness. Implement no-cost and low-cost actions first.
- Higher cost initiatives can be compared by calculating and comparing the payback period (the time it would take for the investment to cover the cost of implementation) and amount of emissions abated.
- Decisions should balance short term versus long term goals.
- Economic cross-benefits. Actions that will serve as investments are especially important during the current economic crisis.
- Equity. Actions should aim to provide benefits to all if possible.
- Multiple benefits and cross-solutions preferred.

# Land Use Planning

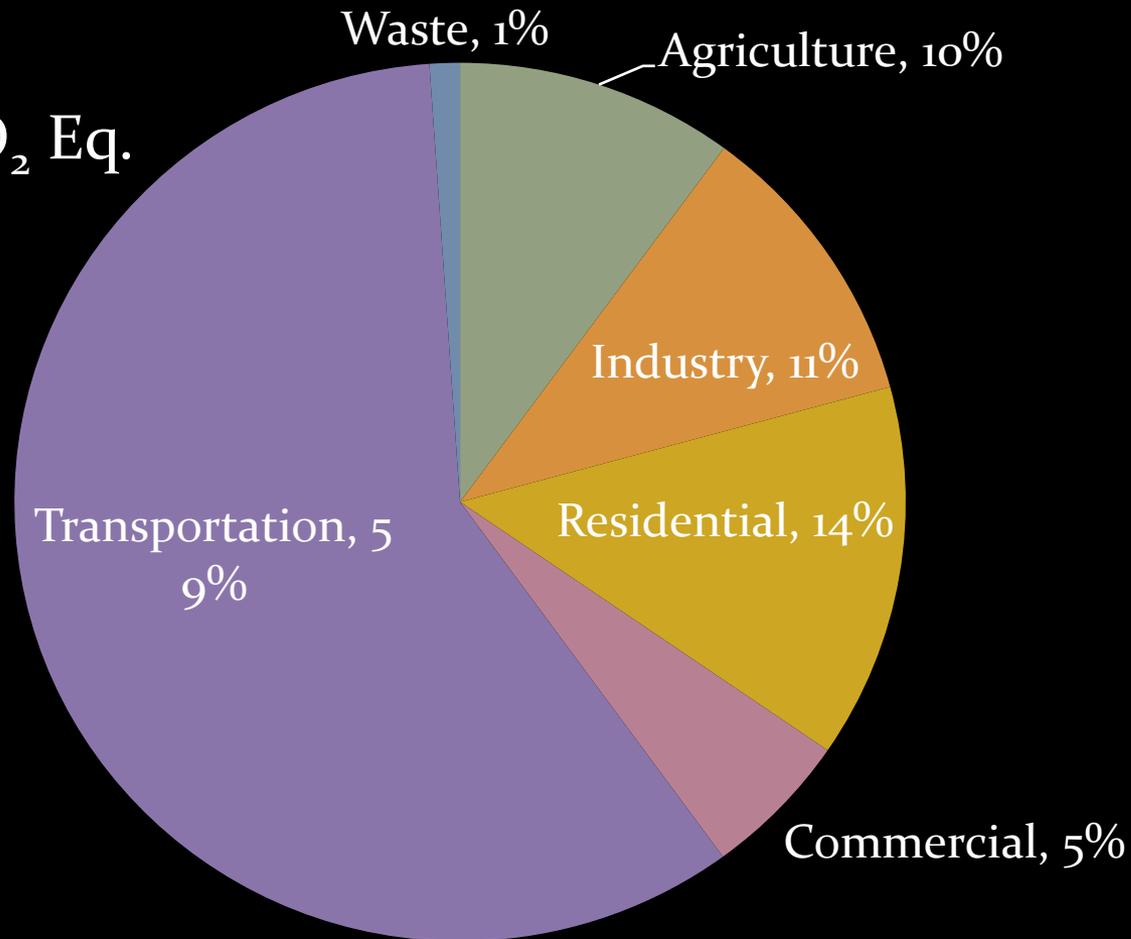
- Connect land use and transportation
  - Proximity to services and amenities
  - Locate new development near existing development and infrastructure
- Compact, mixed use development
- Provide for transportation choices, such as pedestrian and bicycle facilities
- Balance forest preservation with development

# Chatham Development Principles

1. Preserve both the form and function of rural character -- the landscape, agriculture, and home-based businesses.
2. Encourage compact communities with a mix of activities as development occurs.
3. Develop an integrated approach to protecting and promoting high-quality open space, recreation, historic and tourism locations.
4. Ensure the long-term quality and availability of groundwater and surface water resources.

# Chatham County GHG Emissions by Sector

Total GHGs:  
2,087,803 tonsCO<sub>2</sub> Eq.



# Next Steps

- Take stock of other recent strides in energy conservation
- Identify targets
- Identify priorities, i.e. low cost and cost-saving actions
- Choose actions, assign responsibility
- Implement plan
- Monitor and evaluate the plan



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# Questions?

Betsy McCorkle

Amanda

Campbell

Masters Candidate 2010

Masters Candidate

2010

Duke University

UNC-Chapel

Hill

# Appendix

## Forestland as defined by FIA:

Land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and not currently developed for a nonforest use. The minimum area for classification as forest land is 1 ac. Roadside, streamside, and shelterbelt strips of timber must be at least 120-ft wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas are classified as forest, if less than 120 ft in width or 1 ac in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied. Forest land includes three subcategories: timberland, reserved forest land, and other forest land.