United States Department
of Agriculture
Agricultural Research
Service

REAP: Renewable Energy Assessment Project

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Deputy Administrator

USDA-ARS

National Academies of Science
First Federal Sustainability Research and Development Forum
Biofuels - State of the Art Examples of Sustainable Research and Development
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- Corn stover has been identified as a significant source of biomass for bioenergy.
- However, when returned to the land, stover replenishes *Soil Organic Carbon*.
- *Soil Organic Carbon* improves soil structure, enhances water exchange, helps sustain soil microbial life.
- Removing stover can reduce grain and stover yields of subsequent crops.

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Sustainability Challenge

How to harvest corn stover without depleting *Soil Organic Carbon* and still contribute significant amounts of biomass for biofuels production

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ARS Research Infrastructure

REAP Team Locations

- Nation-wide network or coordinated research teams.
- Historic watersheds, long-term experiments, and databases.
- Interdisciplinary approach including bio-physical sciences, modeling, and economics.
- Excellent collaborations with universities, industry, and other Agencies.

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Infrastructure Applied for Outcomes

REAP Team Locations

- Documentation of management system effects.
- Algorithm-based guideline to sustainable harvest.
- Place-based decision support tools:
  - Residue harvest estimator.
  - Quantify stover economic and ecosystem service benefits.

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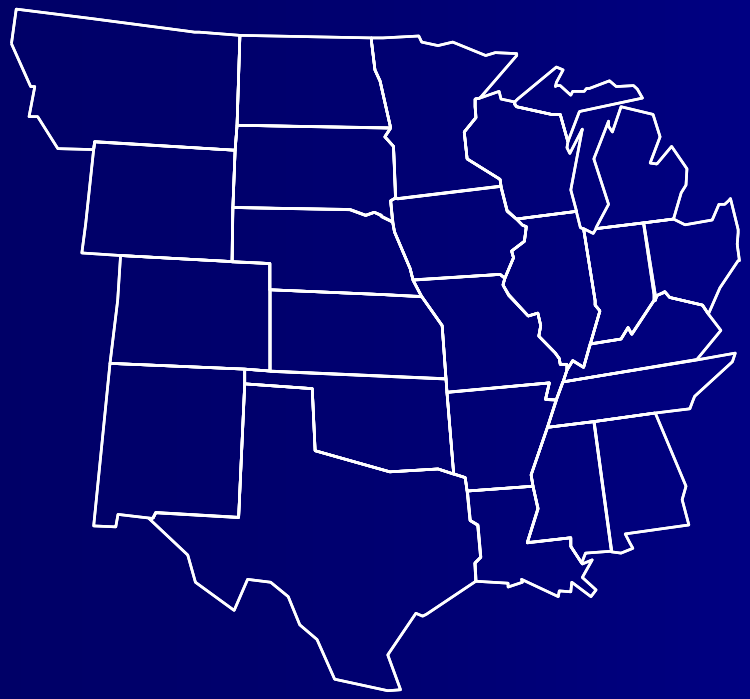
Natural environment affects *SOC* replacement requirements:



- No one replacement recommendation is possible.
- Moisture gradient.
- Temperature gradient.

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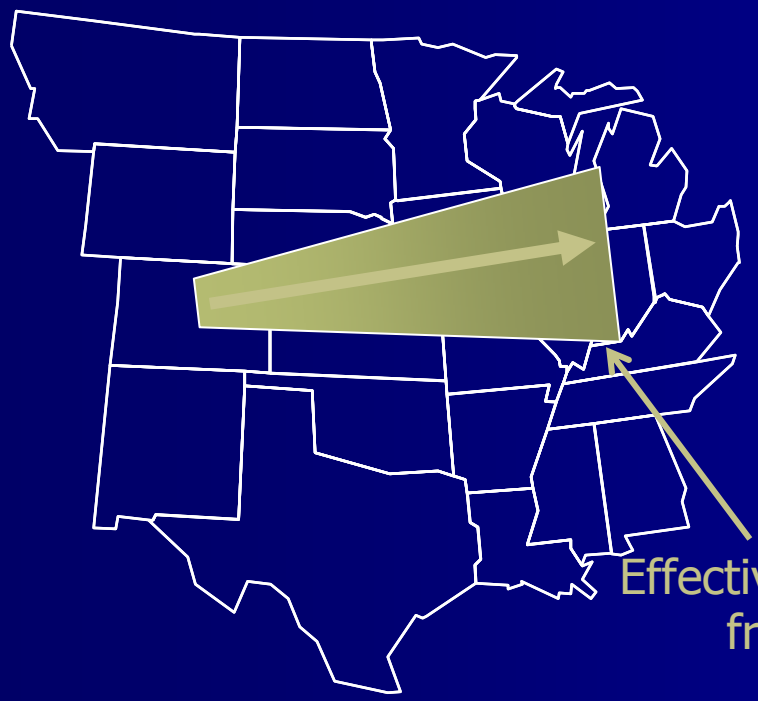

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- Temperature gradient.

Effective moisture increases from west-to-east

SOC *Increases*

(Result of Net Primary Production)

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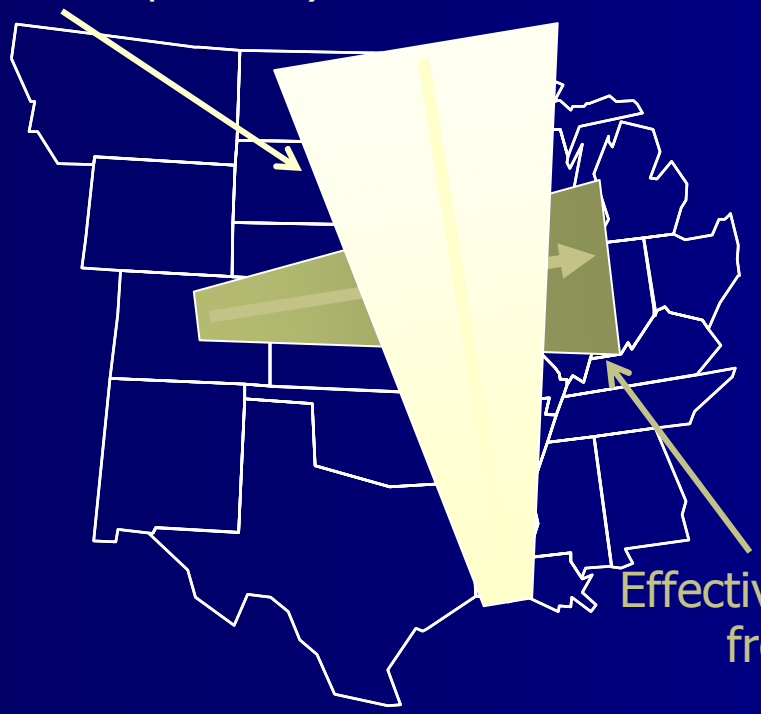
Average temperature increases from north-to-south
SOC *Decreases*
(Result of temperature)



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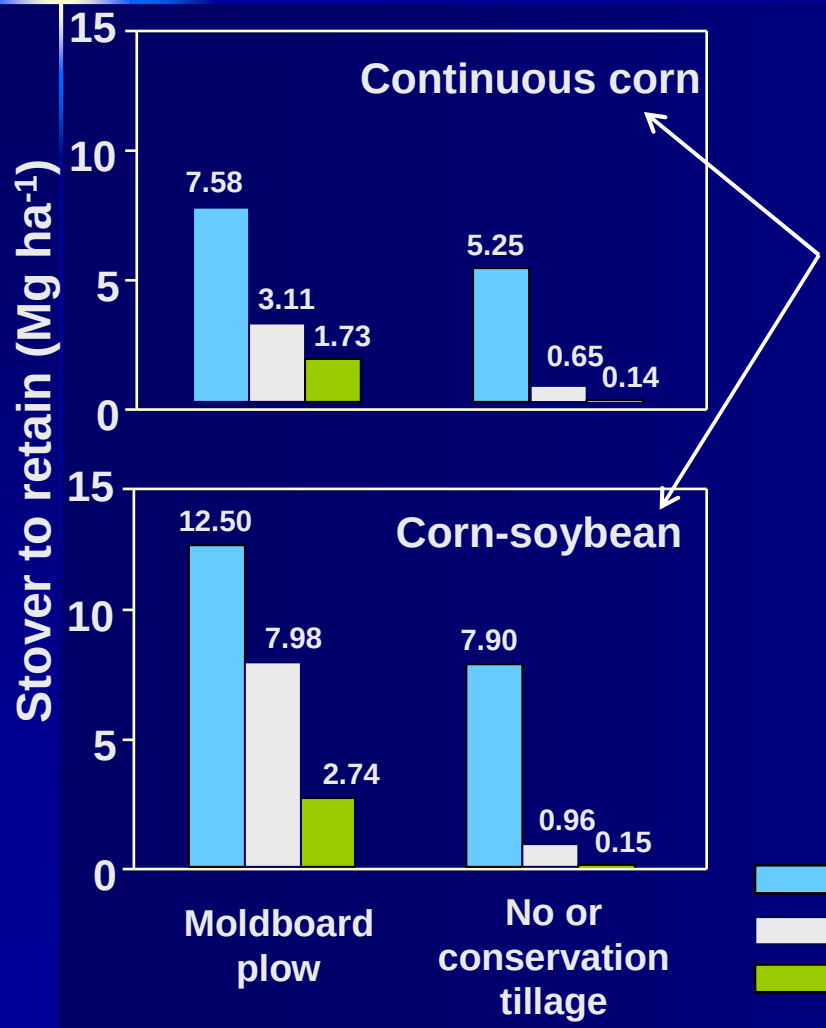

Management affects *SOC* replacement requirements:

- Crops in rotation
- Soil tillage preparation

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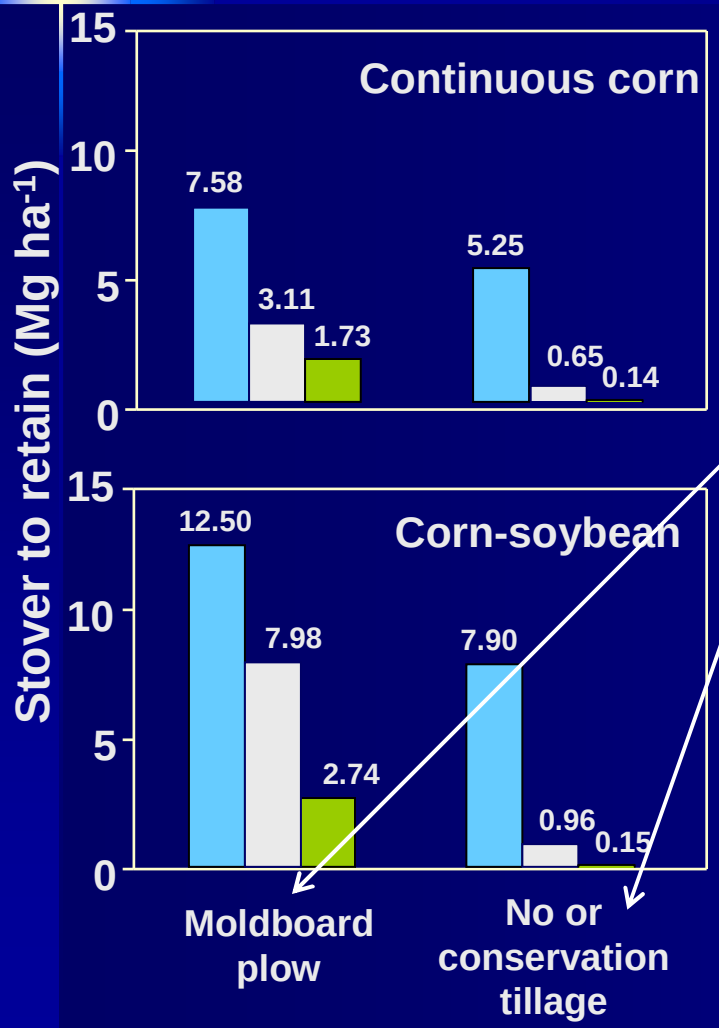

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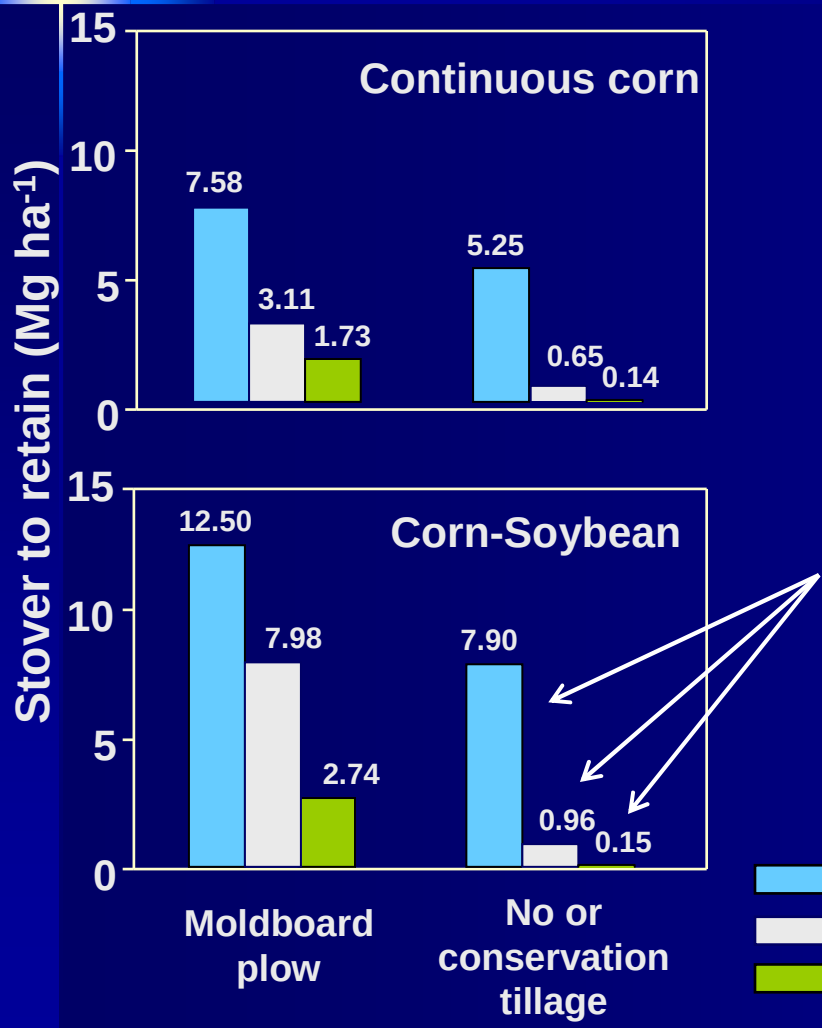

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More stover is needed to maintain *Soil Organic Carbon* than to prevent water and wind erosion.

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Corn stover removed from fields also has a nutrient replacement cost

Element	Amount in stover	Value
	Lbs/ton	$/ton
Nitrogen	16.0	8.00
Phosphorus	1.6	1.52
Potassium	13.5	2.29
Total cost		$11.81

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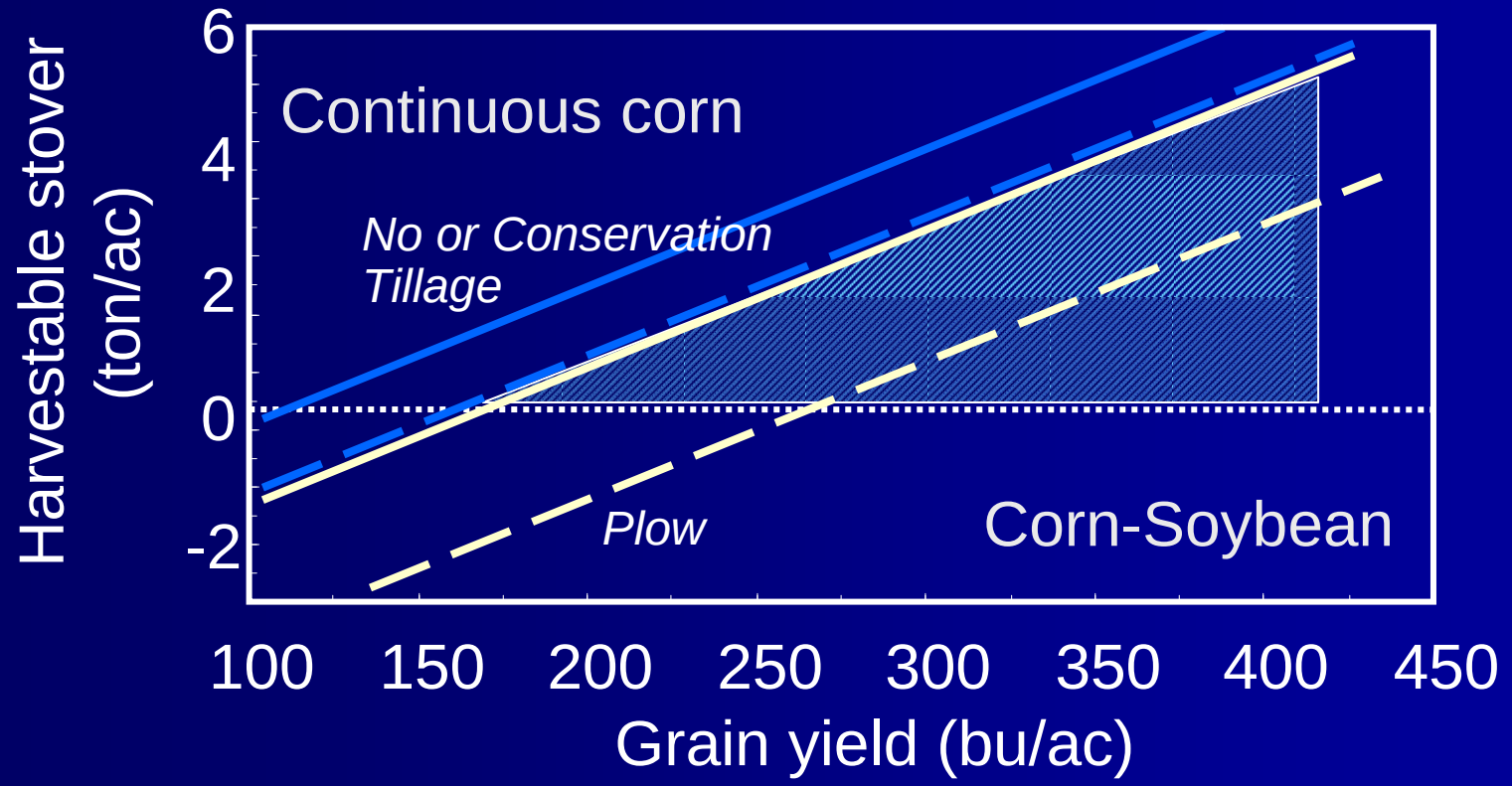
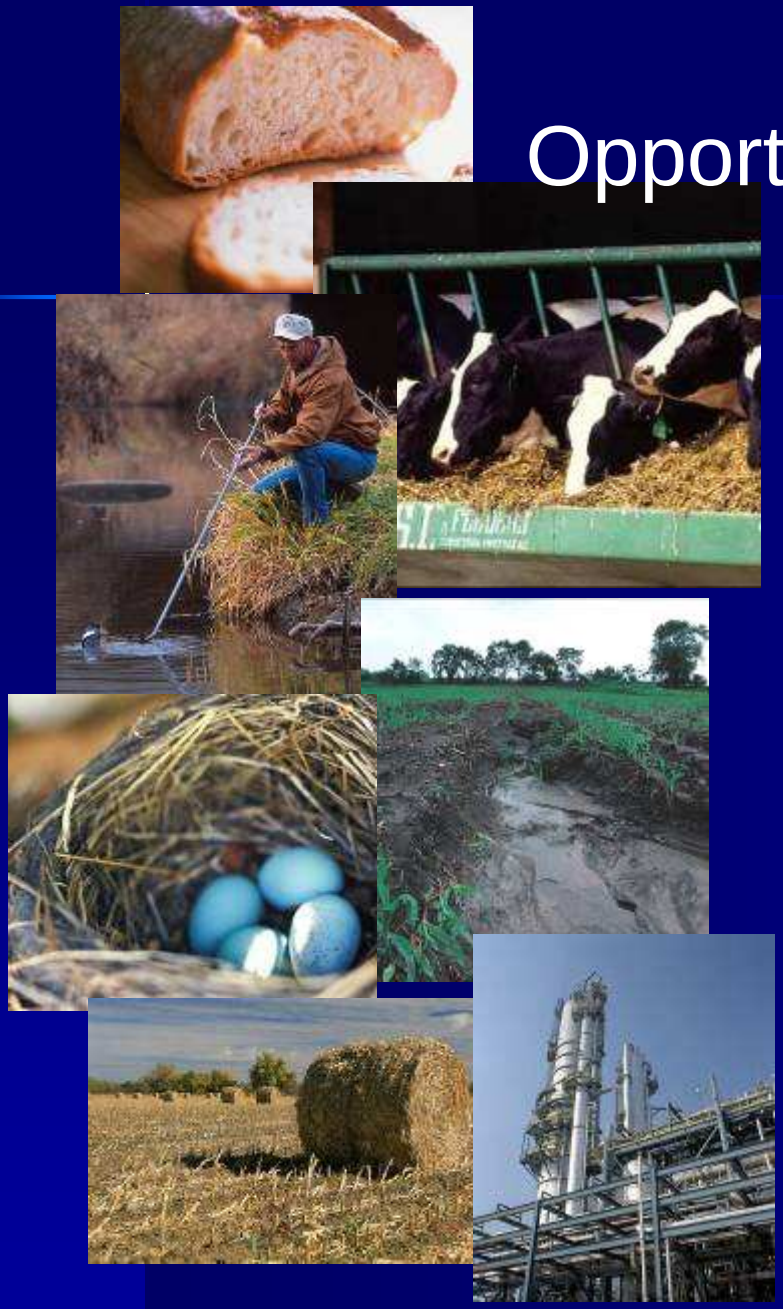
Harvestable corn stover amount by different soil management practices and grain production levels



Challenges and New Opportunities from Agriculture



- Continued traditional outputs for an increasing world population:
  - Food, feed, and fiber
- Ecosystem services:
  - Control erosion
  - Sequester carbon
  - Wildlife habitat
  - Water quality & quantity
- Replenish *SOC* & plant nutrients.
- Feedstocks for biofuels.

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