Agriculture at the Crossroads: Sustainable Feedstock Supplies

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Carbon Cycling and Carbon Sequestration.

by

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We have only One Earth!
Core research in biomass/bioenergy production focuses on:

1. Feedstock production,
2. Feedstock logistics
3. Feedstock conversion
4. Sustainability of the production system
Soil is the reservoir on which most life on earth depends, as the primary source of food, feed, forage, fiber, and pharmeceuticals.

Soil plays a vital role in sustaining human welfare and assuring future agricultural productivity and environmental stability. The study of soil as a science has provided us with a basic understanding of the physical, chemical, and biological properties and processes essential to such a complex ecosystem.

Source: Soil Science Society of America | 677 South Segoe Road | Madison, WI 53711
608-273-8080 | www.soils.org | headquarters soils.org
© Copyright 2006 | Images courtesy of the American Geological Institute and USDA
“Soil organic matter is the nation’s most precious resource.”

Daniel Albright, 1938, “Soils and Men”
Environmental Benefits

- increased water holding capacity and use efficiency
- increased cation exchange capacity
- reduced soil erosion
- improved water quality
- improved infiltration, less runoff
- decreased soil compaction
- improved soil tilth and structure
- reduced air pollution
- reduced fertilizer inputs
- increase soil buffer capacity
- increase biological activity
- increase nutrient cycling and storage
- increased diversity of microflora
- increase adsorption of pesticides
- gives soil aesthetic appeal
- increase capacity to handle manure and other wastes
- more wildlife
Conservation agriculture provides beneficial ecosystem services:

1. Food and fiber and biofuels

2. Less erosion, less pollution, clean water, fresh air, healthy soil, natural fertility, higher production, carbon credits, beautiful landscape, sustainability etc., etc.

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Soil carbon is a priceless key to the planet's health and our environmental quality.
Conservation is Linked to Bio Energy through Carbon.
Erosion - Erosion - Erosion - Erosion

Water - immediately visible

Wind - immediately visible

Aerobic - invisible

Tillage - slowly visible
Stop Erosion. Save Carbon. Park the Plow!

Credit: Ken Scott, Clear Lake, IA
Carbon is the “C” that starts “C”onservation!
The dawning of a new era in agriculture!

Agriculture has produced food, feed and fiber. Now agriculture is expected to produce food, feed, fiber and biofuel.
Biofuels can be considered "sun fuels" because they are all derived from the energy captured through photosynthesis.
The Carbon Cycle

Photosynthesis

$6 \text{CO}_2 + 6 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$

Energy Capture

Respiration

$6 \text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$

Energy Release

The devil is in the details!
Beckism #101
Nature’s Interdependent Tri-Cycles: Water, Carbon, Nitrogen,

Carbon is the “Lord of the Rings”.

H₂O  C  N

Elements: P, K, Ca, Mg, Mn, Cu, S, Cl, Zn, Bo, Mo, Fe, Na
Removal of nutrient-rich, energy-rich biomass cannot be sustained in the long term without proper management to maintain nutrient cycling. After Peter Salonius, 2007
Biomass Balancing Act

How do we maintain a sustainable balance?

Maintain our sun, soil, water and air resources!
Soil C Change with Management

Intensive Ag begins

Stover removal

Offsetting Practices (no till, cover crops, diverse rotations, etc.)

Management Changes

No Offsetting Practices

Credit: Wally Wilhelm, Dec. 2005
Soil Conservation - Bio-energy Balance

Stover Retention
- Erosion control
- Soil organic matter
- Environmental quality

Soil protection

Stover Removal
- Society’s energy needs
- Short-term economic return
- Long-term social stability

Bio-fuel production

A challenging balancing act!
Conservation Agriculture! Carbon Management! Win-Win-Win-Win Strategy!

Win #1: Growing food and fiber to feed the world.

Win #2: Growing biomass for renewable bioenergy.

Win #3: Protecting the environment and all its resources.

A lot of responsibility for farmers!
Carby Carbon