The Impact of Demands for Energy and Environmental Services on Kansas Agriculture

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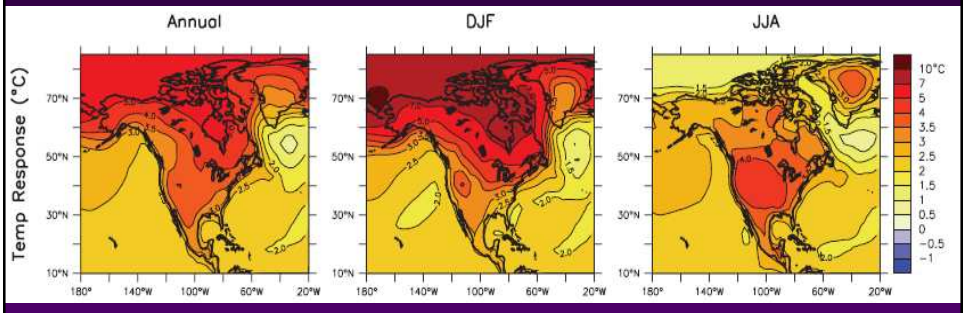
K-State Research and Extension

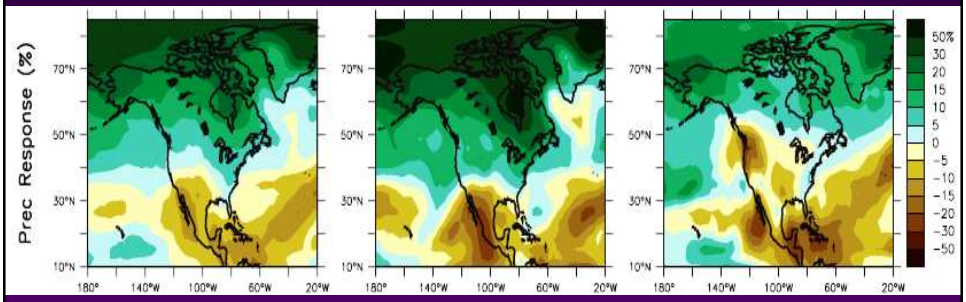
Temperature



Annual DJF JJA

IPCC, 2007

Precipitation Response

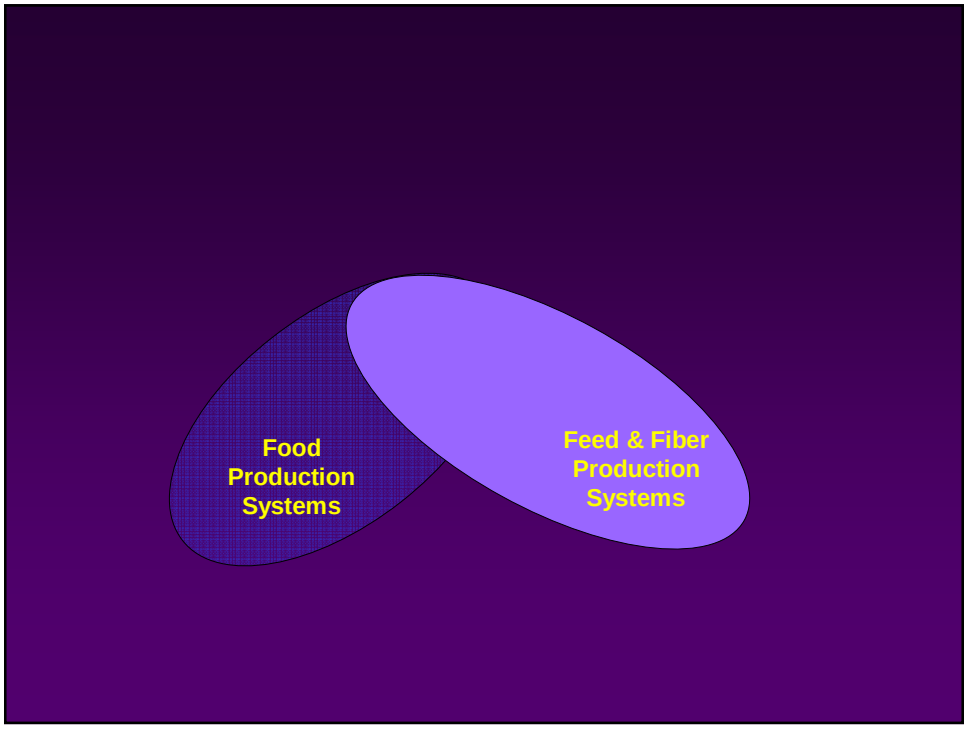


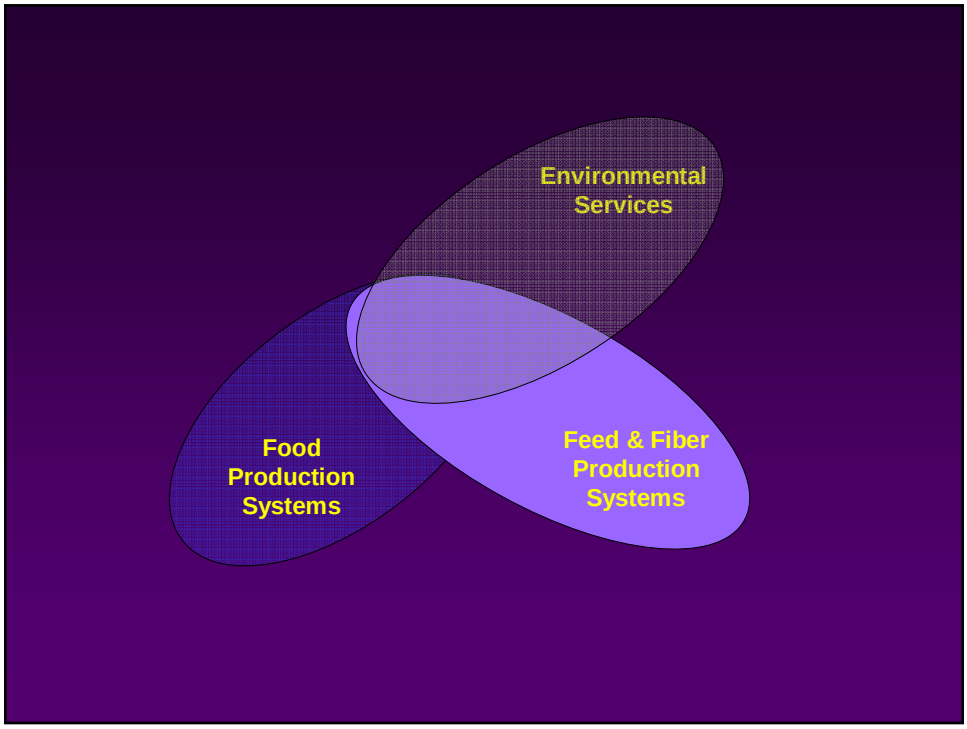
Annual DJF JJA

IPCC, 2007

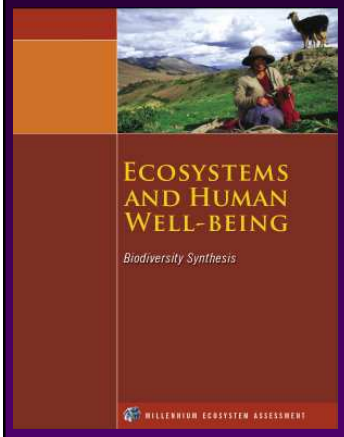
Consequences of Climate Change on Kansas Agriculture

- Increased productivity potential
  - WATER AVAILABILTY
    - Drought
    - Erosion
  - Nitrogen availability
    - Impacts forage quality
    - Grain quality
  - Hasten maturity
  - Shorten growing season
  - Increased pests

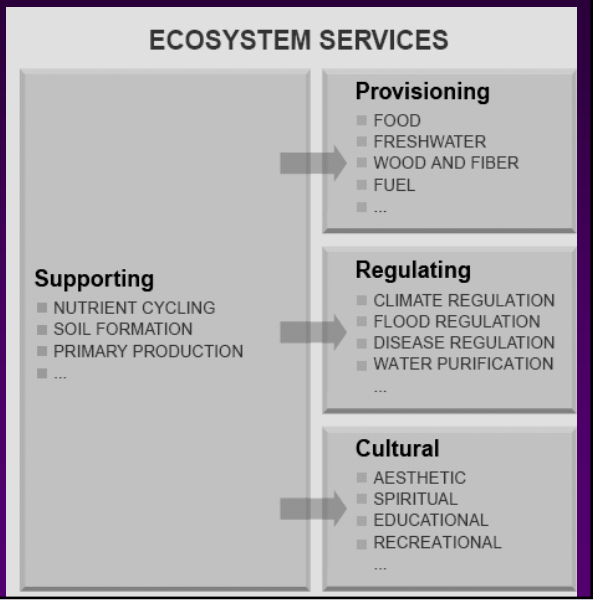

Food
Production
Systems
Feed & Fiber
Production
Systems


Environmental
Services
Food
Production
Systems
Feed & Fiber
Production
Systems

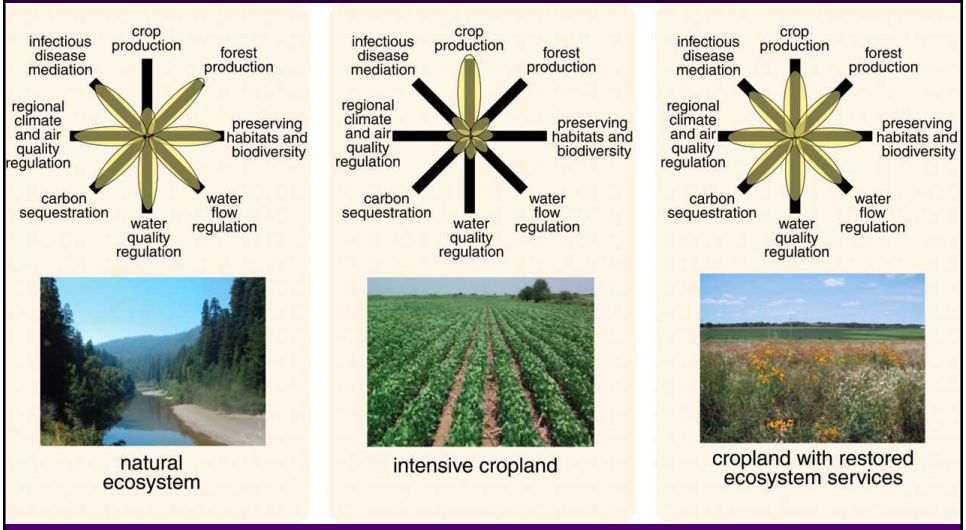
Some functions are "ecosystem services" defined as conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life



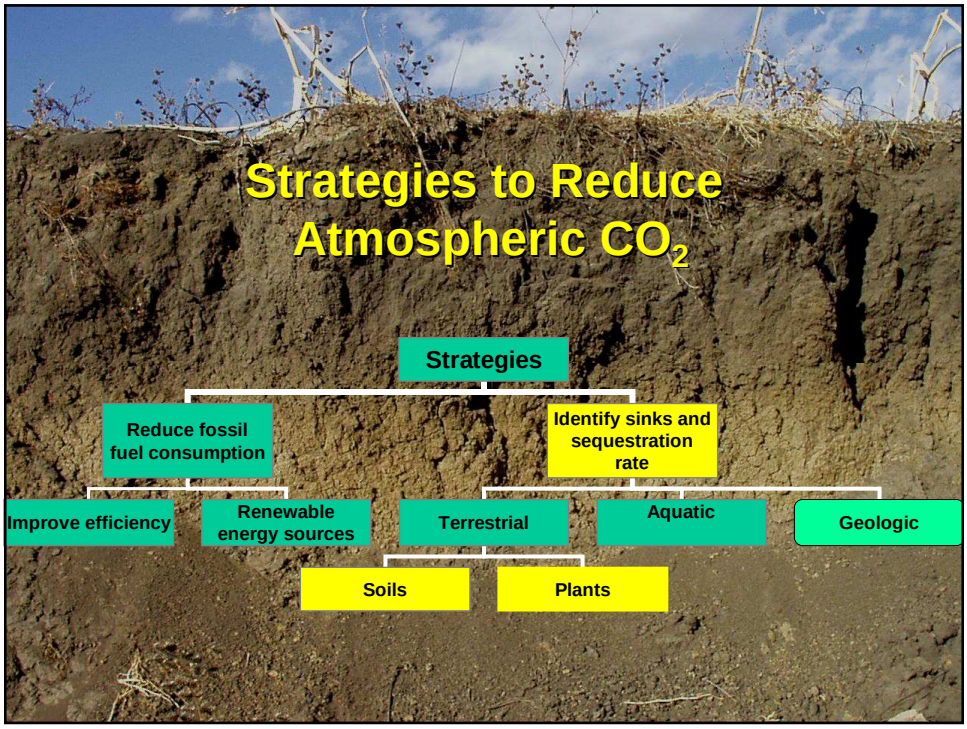
Millenium Ecosystem Assessment

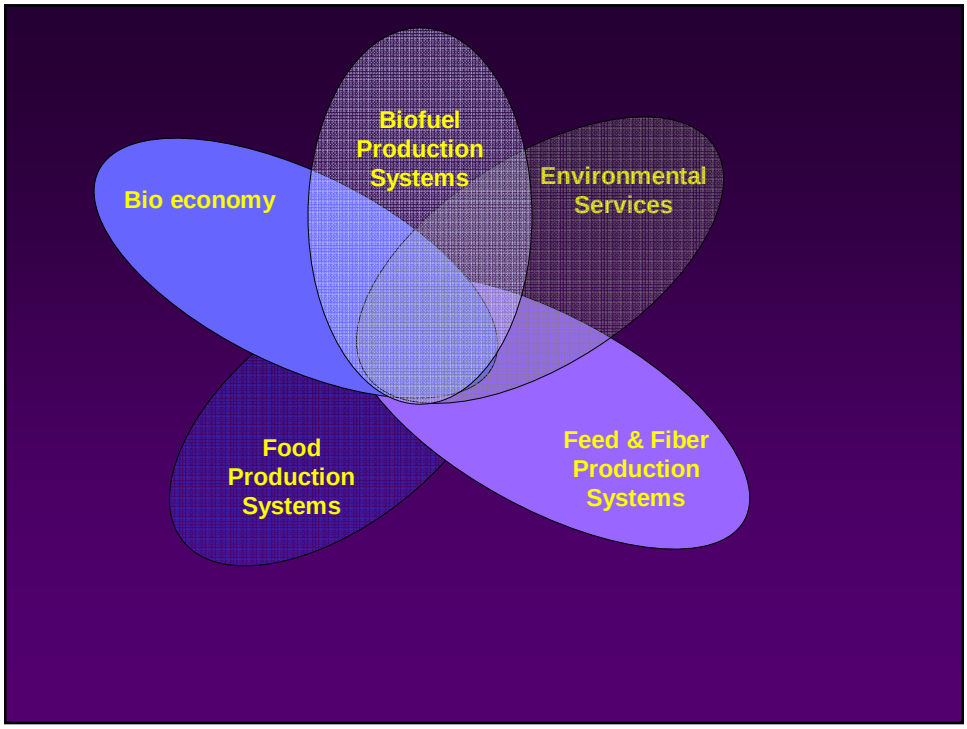


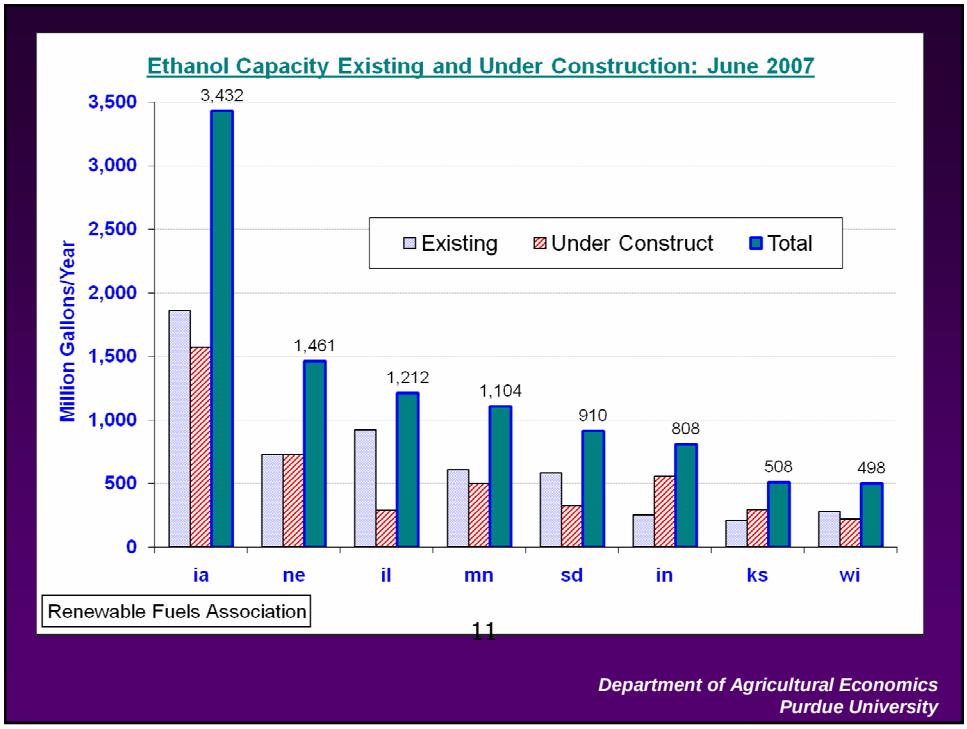
Comparing land use and trade-offs to ecosystem services



Foley et al. 2005


Strategies to Reduce Atmospheric CO_2
Strategies
Reduce fossil fuel consumption
Identify sinks and sequestration rate
Improve efficiency
Renewable energy sources
Terrestrial
Aquatic
Geologic
Soils
Plants


Biofuel Production Systems
Bio economy
Environmental Services
Food Production Systems
Feed & Fiber Production Systems


Ethanol Capacity Existing and Under Construction: June 2007
Million Gallons/Year
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Existing
Under Construct
Total
3,432
1,461
1,212
1,104
910
808
508
498
ia
ne
il
mn
sd
in
ks
wi
Renewable Fuels Association
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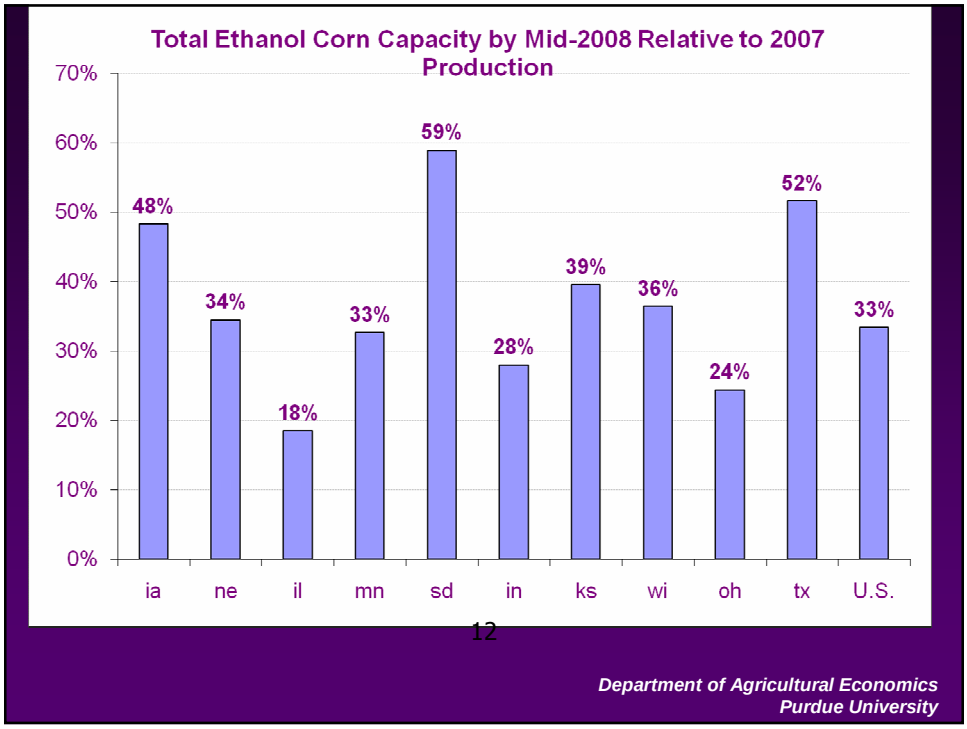
Department of Agricultural Economics
Purdue University


Total Ethanol Corn Capacity by Mid-2008 Relative to 2007 Production
70%
60%
50%
40%
30%
20%
10%
0%
48%
34%
18%
33%
59%
28%
39%
36%
24%
52%
33%
ia
ne
il
mn
sd
in
ks
wi
oh
tx
U.S.
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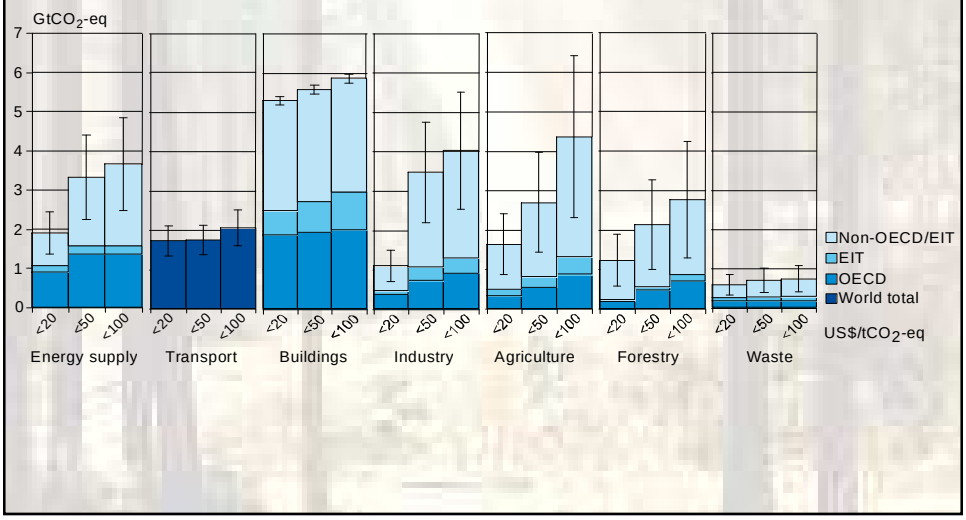
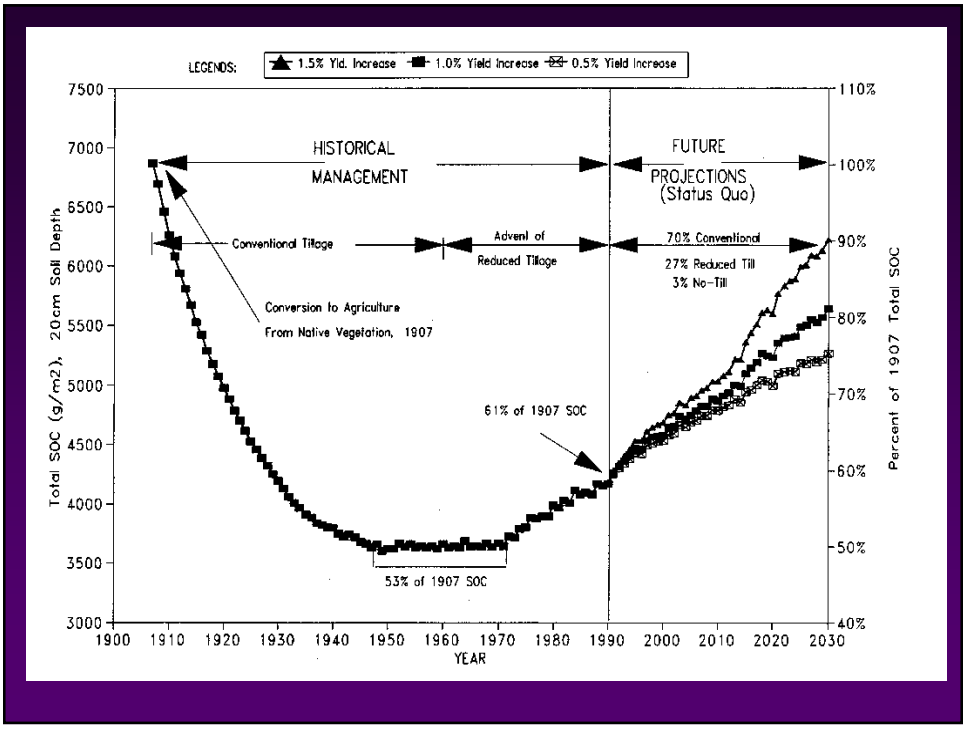
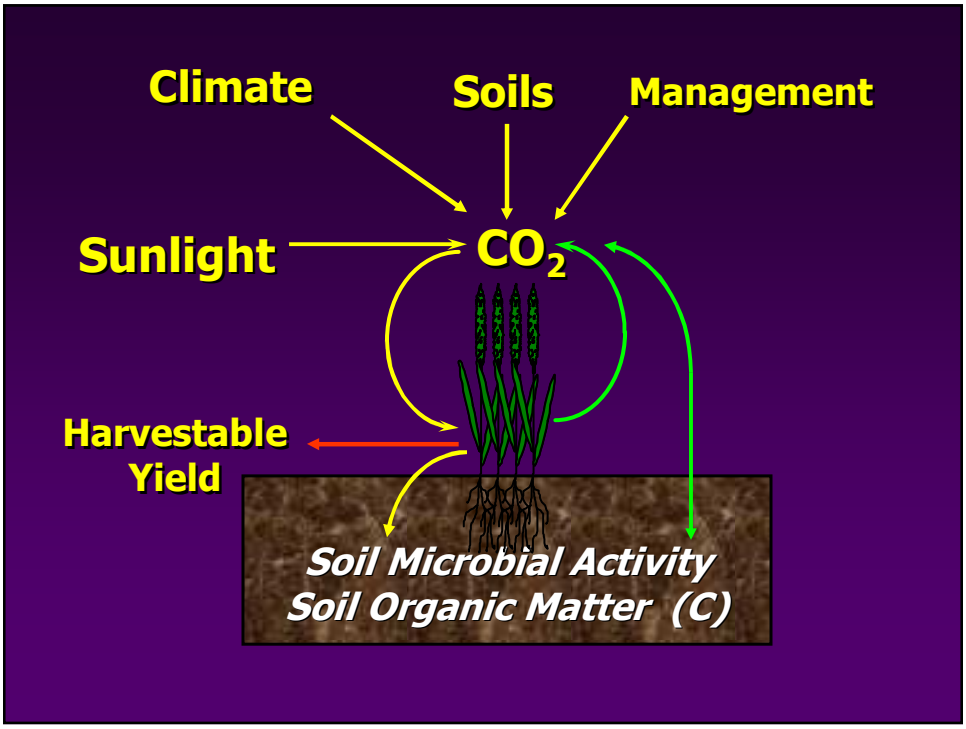
Biofuel Production Concerns

- *Changes in land use, and potential conversion of conservation lands to biomass production.*
- *Changes in water needs, availability, and water quality impacts.*
- *Competition for grains and oilseeds* and impacts on food and feed availability and prices.
- *Lifecycle analyses and GHG/C accounting* for biofuels production.
-
- *Assessing co-benefits of biofuel production*, such as soil quality, reduced erosion from marginal crop lands, and enhanced wildlife benefits.

Global economic mitigation potential for different sectors at different carbon prices



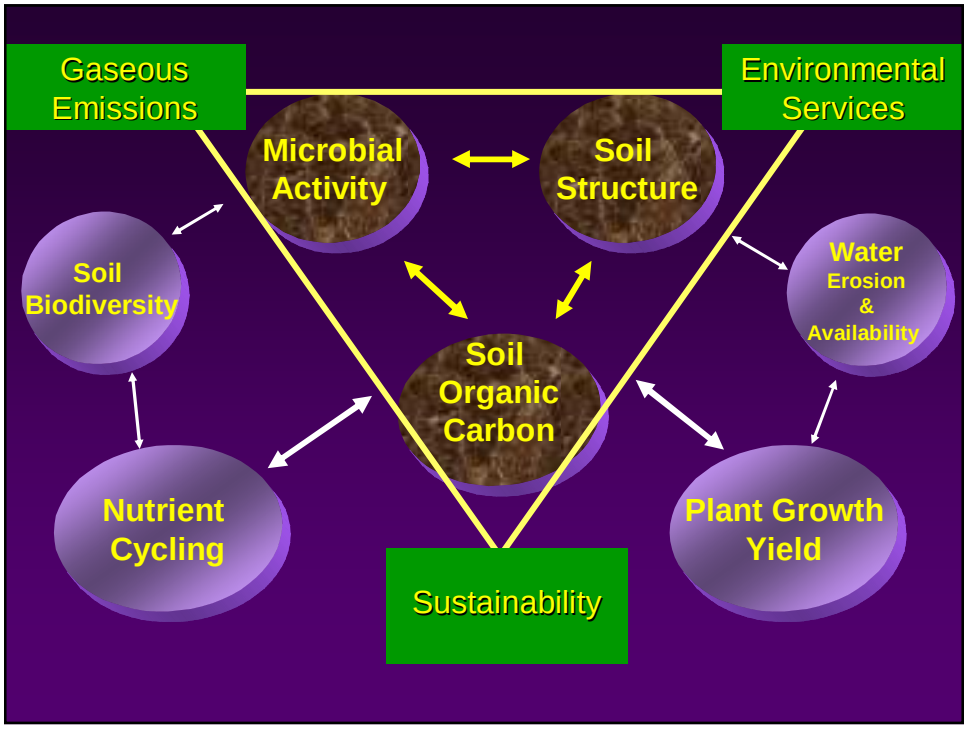

LEGENDS:
1.5% Yld. Increase
1.0% Yield Increase
0.5% Yield Increase
HISTORICAL MANAGEMENT
FUTURE PROJECTIONS (Status Quo)
Conventional Tillage
Advent of Reduced Tillage
70% Conventional
27% Reduced Till
3% No-Till
Conversion to Agriculture From Native Vegetation, 1907
61% of 1907 SOC
53% of 1907 SOC
Total SOC (g/m2), 20cm Soil Depth
Percent of 1907 Total SOC
YEAR

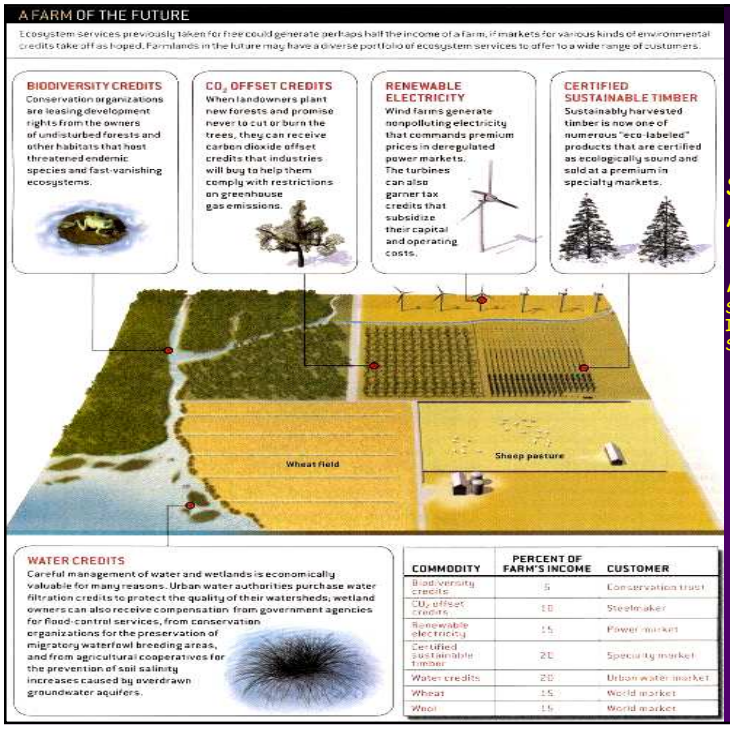

Climate
Soils
Management
Sunlight
CO_2
Harvestable Yield
Soil Microbial Activity
Soil Organic Matter (C)

No-Tillage Cropping Systems

Photo courtesy of R. Lal

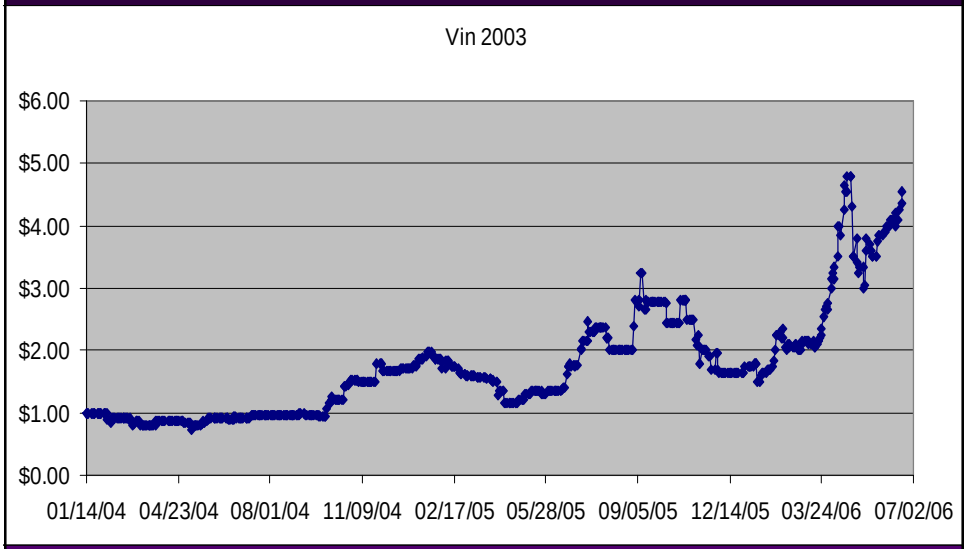
- Restores soil carbon
- Saves fuel
- Saves labor
- Reduces erosion
- Conserves moisture
- Improved soil fertility
- Controls weed
- Planting on the best date
- Lowers machinery costs
- Improves wildlife habitat





Scientific American's *Vision of the Future Farm*
Scientific American, Special Issue
September 2005

Contracts: 2 million acres
CCX Carbon Offset Prices



Summary

- Agricultural soil C sequestration
  - Keeps land in production
  - Improves soil quality
  - In many cases increases profitability for the farmer
  - Provides other environmental benefits to society
    - Water quality (less runoff, less erosion)
    - Flood control
    - Wildlife habitat
  - May help adapt to climate change as well as mitigate

Summary

- Design Agricultural Systems
  - Improved energy output per water/energy input
  - Long term sustainability life cycle based
  - Maintain soil carbon
  - Balance nutrients, pesticides
  - Lower net Carbon emissions

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  www.soilcarboncenter.k-state.edu/

  www.oznet.ksu.edu/ctec

  www.casmgs.colostate.edu/

KCCM
Kansas Coalition for Carbon Management

K-State Research and Extension