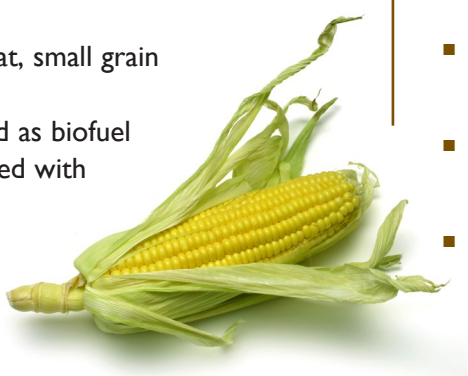
Challenges and Opportunities Surrounding a New Bioeconomy

Soils are at the interface between air, water, and biological activities. Greater demands are being placed on soils as we continue food and feedstock production and expand the use of soils for biofuel production. Failure to maintain this vital natural resource will jeopardize food and feedstock production, biomass production, grower profitability, water quality, ecological longevity, and environmental health. A major challenge will be to sustain soil quality while increasing biomass production.

30 x 30 Vision

Displace 30% liquid transportation fuels in the U.S. with biomass-derived biofuels by 2030.

- USDA-DOE Billion Ton study-1.3 billion tons of biomass by 2030. Currently 190 million dry tons available, from sustainable sources (crop residues, herbaceous and woody energy crops, and residues from processing ag and forestry)
- Assumptions:
  - ✔ Increase soybean residue-grain ratio to 2:1
  - ✔ 55 M acres idle cropland/pasture for perennial bioenergy crops
  - ✔ Increase corn, wheat, small grain yields by 50%
  - ✔ Excess manure used as biofuel
  - ✔ All cropland managed with no-till methods
  - ✔ All other available residues utilized



Ethanol from corn-based system

Challenges

- Remove 20% corn residue-technological
- Liquid fuels from corn grain and soybean seeds insufficient to meet goals
- Maintain soil organic matter and soil quality
- Provide adequate nutrients w/o increasing fertilizer applications
- Soil erosion, runoff and water pollution
- Access to adequate labor force
- Availability of sufficient feedstock storage
- Ethanol feedstock production capacity loss with loss soil productivity

Advantages

- Corn-based ethanol plants currently operating
- Familiarity with corn-based cropping systems
- Corn-based system well researched
- Commodity programs support corn and soybean production
- Infrastructure-harvesting, transport etc. in place

Ethanol from diversified cropping system

Challenges

- Infrastructure for perennial systems
- Research-use and combustion of diverse prairie polycultures for biofuel production
- Protection of marginal lands, e.g. CRP
- Education on the establishment, maintenance, and harvesting of perennials
- Incentives - perennial-based cropping systems
- Acceptance of perennial systems by farmers

Advantages

- Reduce risks to soil erosion, runoff and water quality impairment
- Perennials have fewer production failure risks
- Perennial grasses recycle nutrients reducing fertilization requirements
- Wildlife habitat enhanced
- Carbon sequestration, climate change mitigation
- Labor and storage requirements and risks spread throughout year

Opportunities to Ensure a Sustainable Bioeconomy

- Plant breeding and yield tests across broad climatic regimes
- Incorporation of molecular genetics research
- Evaluate the utility of soil management strategies for biofuel production and carbon sequestration
- On-farm research to create stewardship and partnering between farmers and energy producers
- Investigate use of diverse prairie polycultures for biofuel production and their effect on ethanol feedstock quality
- Investigate efficiency of polyculture feedstocks as a direct combustion fuel for energy generation, which could be especially useful for enhancing the sustainability of cellulosic ethanol plants

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Conclusion and Recommendations

The bioeconomy offers rural America one of the greatest opportunities that has ever occurred since the breaking of the native prairie. However, the success of a national program contributing to greater independence from foreign petroleum imports will depend greatly on the ability to sustain the quality and productivity of the soil resources. A sustainable bioeconomy, able to meet the above goals, will require information on new crops and changing agronomic practices that incorporate soil conservation and best management practices that enhance the soil resources necessary for this program. Research needs to be conducted which expands our cropping systems so the biomass can be produced in an economical and feasible (for the biorefinery) way without overstressing and degrading our soil resources.

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