Corn Stover
Cost, Availability, and
Sustainability

David Archer, Research Agricultural Scientist
USDA Agricultural Research Service
Northern Great Plains Research Laboratory
Mandan, ND
Points Favoring Harvest of Crop Residues

• Renewable
• Doesn’t require use of additional land
• Vast quantities produced
• May facilitate adoption of less-intensive tillage
2007 Corn

Midwest (13 States) Totals:
73.6 million acres
11.4 billion bushels

U.S. Totals:
86.5 million acres
13.1 billion bushels

~300-350 million tons of stover grown in U.S.

Source: USDA-NASS Cropland Data Layer
Sustainability Concerns with Harvesting Crop Residues

• Soil quality (tilth), organic matter (carbon) sustainability
• Soil structure, microbial activity
• Erosion protection
• Plant nutrients
• Evaporation
• Harvest damage (soil compaction, etc)
Biomass Gasification Demonstration and Research Facility

- University of Minnesota, Morris
  - Plant-scale project provide up to 80 percent of campus heating and cooling
  - Allow research of alternative feedstocks (e.g. wood chips, grasses, wheat straw, corn cobs, corn stover)
  - Require around 10,000 tons of biomass per year

Photo credit: University of Minnesota
Scale-up

Chippewa Valley Ethanol Company, Benson, MN: ~100,000 tons/yr (replace natural gas)

UMM plant: ~10,000 tons/yr

100 million gallon/year cellulosic plant would require ~1 million tons/yr
1st Step: Corn Cobs

Advantages

• One-pass harvest, require little change in current production practices
• Relatively high volumetric energy density
• Low nutrient content
10-mile Radius Around University of Minnesota, Morris
Analysis

• EPIC simulation model
  – calibrated to USDA-ARS field research plots at Morris, MN
  – Simulation conducted for each SSURGO soil map unit within a 10-mile radius of UMM

• Biomass farm gate cost includes:
  – Biomass harvest and in-field transportation
  – Nutrient replacement (N,P,K)
  – Short-term crop yield impacts
Average 45,558 tons available within 10-mile radius

Note: based on $20/acre cob harvest cost
Agricultural Research Service

Biomass Supply (ton)

Farmgate Biomass Price ($/ton)

$33.37

Would require harvesting corn cobs from 14,000 acres per year.
Corn Stover Harvest (chop, rake, bale)  
Chisel Plow  
Corn-Soybean Rotation

Could meet 10,000 ton demand at a price of $26.37/ton harvesting 7,100 ac/year.

Breakeven Biomass Farmgate Price ($/ton)

- 24.83 - 27.50
- 27.51 - 30.00
- 30.01 - 32.50
- 32.51 - 35.00
- 35.01 - 37.33
Production Alternatives

10,000 ton at:
- $35.22/ton ST C-S Stover
- $33.37/ton CP C-S Cob
- $26.37/ton CP C-S Stover

Farmgate Biomass Price ($/ton)

Biomass Supply (ton)
Breakeven Price Components ($/ton)

<table>
<thead>
<tr>
<th></th>
<th>Breakeven Price</th>
<th>Harvest Cost</th>
<th>Nutrient Replacement</th>
<th>Grain Production Change</th>
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<tbody>
<tr>
<td>CP C-S Cob</td>
<td>35.66</td>
<td>29.31</td>
<td>7.32</td>
<td>0.97</td>
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<td>(31.87-46.13)</td>
<td>(27.00-38.12)</td>
<td>(5.91-9.42)</td>
<td>(-0.51-7.13)</td>
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<td>CP C-S Stover</td>
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<td>7.01</td>
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<td>(24.83-37.33)</td>
<td>(22.31-27.74)</td>
<td>(5.22-8.84)</td>
<td>(-1.66-7.95)</td>
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<td>7.44</td>
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<td>(32.24-50.68)</td>
<td>(29.60-37.99)</td>
<td>(3.05-12.16)</td>
<td>(-10.77-4.80)</td>
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</table>
Value of Environmental Impacts
relative to CP C-S with no biomass harvest

Sources:
- N Benefit: replacement cost of soil N depletion ($0.47/lb).
- C Benefit: 2009 CCX carbon credit value ($6.97/ton C)
- Erosion Reduction: Hansen and Ribaudo, USDA-ERS 2008 ($5.09/ton)
Summary

• In the short-term, production of corn stover could meet UMM biomass needs at farmgate breakeven prices as low as $26/ton

• Without changes in tillage/cropping practices, corn stover harvest can have negative resource impacts which may threaten long-term sustainability

• Adoption of minimum tillage practices can mitigate many of these resource impacts, allowing sustainable corn stover harvest
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