The Conservation Decision: Economics of Conservation and Precision Agriculture

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Conservation Cropping Systems

- Cover Crop and Residue Management
- Conservation Tillage and Cash Crop Planting
- Nutrient and Pest Management
Conservation Cropping Systems

Cover Crop and Residue Management

Conservation Tillage and Cash Crop Planting

Nutrient and Pest Management

Precision Agriculture
Benefits & Costs of Conservation and Precision Agriculture

Potential Conservation/Precision Ag Benefits

**Improved Profitability**
- Higher Crop Yields/Revenues
- Lower Production Costs
- Reduces Risk
- Long-term Sustainability
- Better Management
- Less Time, Less Inputs & Equipment

**Better Environment**
- Less Soil Erosion
- Protects Water Quality
- Improved Soil Health/Productivity
- Improved Wildlife/Rural Landscape

Sources: Batte, 2000; Bergtold and Goodman, 2006; Christensen, 1985; Snapp et al., 2005
Benefits & Costs of Conservation and Precision Agriculture

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Potential Conservation/Precision Ag Costs

**Increased Direct and Indirect Costs**
- Lower Crop Yields/Revenues
- Higher Production Costs w/Technology, Cover Crop, Equipment
- Higher Human Capital Requirement (with Scarce Labor Resources)
- More Intense Crop Management
- Time Management More Crucial

**Environmental Costs**
- Precision Agriculture May Not Reduce Fertilizer/Pesticide Usage in Some Areas

Sources: Batte, 2000; Bergtold and Goodman, 2006; Christensen, 1985; Snapp et al., 2005
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1. Increase/Decrease Profit & 2. Help/Hurt Environment
Profitability of Conservation Systems Across the United States (some evidence)

Profitability for Corn-Soybean Rotations:
- Conventional Tillage = $93/ac
- Conservation Tillage = $100/ac

Profitability for Cotton Production Systems:
- Conventional Tillage = $94/ac
- Conservation Tillage = $108/ac

Source: Buman et al., 2004, 2005
### Potential Cost Savings ($/acre) of Converting to a Conservation Tillage System from a Conventional System


<table>
<thead>
<tr>
<th>Region</th>
<th>Corn Labor</th>
<th>Cotton Labor</th>
<th>Peanuts Labor</th>
<th>Corn Machinery</th>
<th>Cotton Machinery</th>
<th>Peanuts Machinery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northern Alabama</strong></td>
<td>$11.00</td>
<td>$23.00</td>
<td>N/A</td>
<td>$20.00</td>
<td>$38.00</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Central Alabama</strong></td>
<td>$6.00</td>
<td>$18.00</td>
<td>N/A</td>
<td>$15.00</td>
<td>$34.00</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Southern Alabama</strong></td>
<td>$6.00</td>
<td>$18.00</td>
<td>$13.00</td>
<td>$15.00</td>
<td>$34.00</td>
<td>$21.00</td>
</tr>
</tbody>
</table>

**Assumptions:** Use no-till in N. Alabama and strip-till in central and S. Alabama. All systems include the use of a winter cover crop. Savings based on crop budgets.

**Source:** Bergtold and Morton, "Conservation Tillage Systems Learning Tool", 2006
Potential Increases in Profit ($/acre) when Converting to a Conservation Tillage System from a Conventional System

<table>
<thead>
<tr>
<th>Location</th>
<th>Corn</th>
<th>Cotton</th>
<th>Peanuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Alabama</td>
<td>$66.00</td>
<td>$29.00</td>
<td>N/A</td>
</tr>
<tr>
<td>Central Alabama</td>
<td>$12.00</td>
<td>$57.00</td>
<td>N/A</td>
</tr>
<tr>
<td>Southern Alabama</td>
<td>$60.00</td>
<td>$41.00</td>
<td>$107.00</td>
</tr>
</tbody>
</table>

Assumptions: Use no-till in N. Alabama and strip-till in central and S. Alabama. All systems include the use of a winter cover crop. Yields are estimated using data from 30 independent studies conducted across AL and GA. Prices: $4.07/bu for corn, $0.58/lb for cotton, and $0.19/lb for peanuts. Costs are from crop budgets.

Economic Benefit of Cover Crops (Rye prior to Cotton)

Cover Crops can potentially increase profits by helping improve soil productivity, reduce erosion, and provide weed suppression.

Source: Morton et al. 2006.
Profitability of Conservation over Conventional Tillage Systems Across the Landscape for Cotton (EVS, 2003)

<table>
<thead>
<tr>
<th>Landscape</th>
<th>Conventional Tillage (CT)</th>
<th>Conservation Tillage (NT)</th>
<th>Difference of NT over CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainageway</td>
<td>$207</td>
<td>$258</td>
<td>+ 19%</td>
</tr>
<tr>
<td>Sideslope</td>
<td>$239</td>
<td>$325</td>
<td>+ 26%</td>
</tr>
<tr>
<td>Summit</td>
<td>$273</td>
<td>$367</td>
<td>+ 26%</td>
</tr>
</tbody>
</table>

Note: The conservation tillage system included a high residue cover crop mixture of black oat and rye. In addition, profit calculations include farm payments and NRCS EQIP payments.

Conservation tillage systems can increase productivity of low and high producing areas across the field.

Source: Bergtold et al., 2005; Terra et al., 2005.
In years with adverse weather (e.g. drought or hurricane), conservation tillage can help reduce losses.

Note: The conservation tillage system included a high residue cover crop mixture of black oat and rye. In addition, profit calculations include farm payments and NRCS EQIP payments.

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</tr>
</thead>
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<tr>
<td>Drainage-way</td>
<td>-$6</td>
<td>$58</td>
<td>+ $64</td>
</tr>
<tr>
<td>Sideslope</td>
<td>-$74</td>
<td>-$8</td>
<td>+ $66</td>
</tr>
<tr>
<td>Summit</td>
<td>-$47</td>
<td>$3</td>
<td>+ $50</td>
</tr>
</tbody>
</table>

Source: Bergtold et al., 2005; Terra et al., 2005.
Benefits of Variable Rate Application of Nitrogen with GPS for different crops (Texas)

**Corn**
- Yield Increase: 7.7 to 15.4%
- NPVR Increase: 13.7 to 60.5%
N applied increased by 70% to 191% across the field

**Grain Sorghum**
- Yield Increase 6.8%
- NPVR Increase: 7.9%
N applied changed by -96% to +59% across the field

**Cotton**
- Yield Increase: 0.16 to 4.0%
- NPVR Increase: 0.19 to 4.5%
N applied changed by -43% to +58% across the field

**Peanuts**
- Yield Increase: 2.3%
- NPVR Increase: 2.54%
N applied changed by -81% to +42% across the field

NPVR = Net Present Value of Returns

Source: Watson et al., 2005
Auto-guidance & GPS As Key Components in Precision Agriculture

Auto-guidance systems (automatic steering) w/GPS can provide economic benefits by controlling in-field traffic and increasing the accuracy of variable-rate input application technologies.

Adoption of GPS technologies such as yield-mapping and soil mapping fall behind other precision technologies, due to a steeper learning curve, especially for analyzing spatial data (Griffin et al., 2004).

Lambert and Lowenberg-DeBoer (2000) summarize a number of studies using GPS for yield mapping to apply variable rate inputs. These studies showed that using the yield maps reduced costs by $20 for P and $8 for K.

Controlled traffic helps to improve productivity and profitability. Bergtold et al. (2006) show that as the tillage pass in conservation tillage systems moves away from the planted row, yields drop by 24-52% and profits by 38-83%.
Making the Conservation Decision

Environment

- Soil Health
- Carbon Sequestration
- Air Quality
- Water Quality
- Quality of Life

Economics

- Risk
- Crop Yield
- Productivity
- Profit
- Input and Energy Consumption

- Making the Conservation Decision
- Input and Energy Consumption
- Profit
- Crop Yield
- Productivity
Factors affecting the adoption of practices include:

- Farm Size and Crops Grown
- Race, Gender or Age
- Educational Level and Farm Experience
- Environmental Attitudes and Beliefs
- Willingness to Learn
- Willingness to Pay for New Technologies
- Existence of Cost Share/Incentive Payments
- Conservation Program Requirements
- Farm Characteristics and Demographics, etc.

Sources: Bergtold and Molnar 2005; Hudson and Hite, 2003; Molnar et al., 2001; Uri, 1999; Wu and Babcock, 1998
Adoption of Conservation Tillage for all Crops Across the United States

Percent of Crop Land Under Conservation Tillage in the United States

Source: CTIC, 2005
Adoption of Conservation Tillage by Crop in the Southeast

Percent of Crop Land Under Conservation Tillage in the Southeast

Source: CTIC, 2005
Adoption of Conservation Tillage Practices in Alabama, 2005

Source: Bergtold and Molnar, 2005
Adoption of Precision Agriculture Practices in U.S. by Crop, 2000-2002*

* Estimates represent data from most recent year survey data was available.

Source: Griffin et al., 2004
Adoption of Precision Agriculture by Farmers in the Southeast

Adoption of Precision Agricultural Practices by Row Crop Producers in Alabama and Mississippi*

* Estimates represent data from most recent year survey data was available.

Source: Bergtold and Molnar, 2005; Hudson and Hite, 2003
Transitioning To Conservation Tillage Systems and Adopting Precision Agricultural Technologies

**Barriers to Adoption:**

- **Human Capital Investment** – Learning Technology, Know-How, Access to Information
- **Financial Investment** - dependent on farm size and potential return
- **Uncertainty and Risk** – risk averse farmers may avoid if expected returns low
- **Scarce Resources** – especially time and labor

**Potential Avenues to Overcome:**

- **Extension and Outreach** – Provide workshops, field days, and other events to educate farmers
- **Cost Share/Incentive Payments** – Promote adoption through involvement in EQIP, CSP, etc.
- **Access to Information** – Develop enough evidence to ensure farmers, and get farmers connected.
- **Educational Opportunities** – Provide incentives to get educated, especially in agricultural disciplines
Conclusions

Conservation and Precision Agriculture can:

1. Increase Crop Yields and Profits
2. Improve Long Term Sustainability
3. Help the Environment and Society