USDA Agricultural Outlook Forum 2007

# The Conservation Decision: Economics of Conservation and Precision Agriculture

Jason Bergtold
Agricultural Economist
Agricultural Research Service, USDA

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# Conservation Cropping Systems

Cover Crop and Residue Management

Conservation Tillage and Cash Crop Planting

Nutrient and Pest Management

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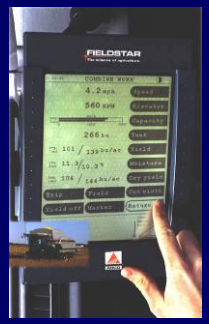
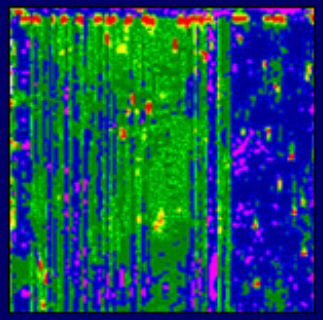
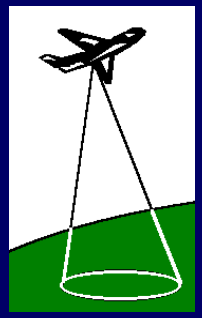
## Precision Agricluture





# Benefits & Costs of Conservation and Precision Agriculture

**Potential Conservation/Precision Ag Benefits**

***Improved Profitability***

- ***Higher Crop Yields/Revenues***
- ***Lower Producion 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

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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 Ariculture 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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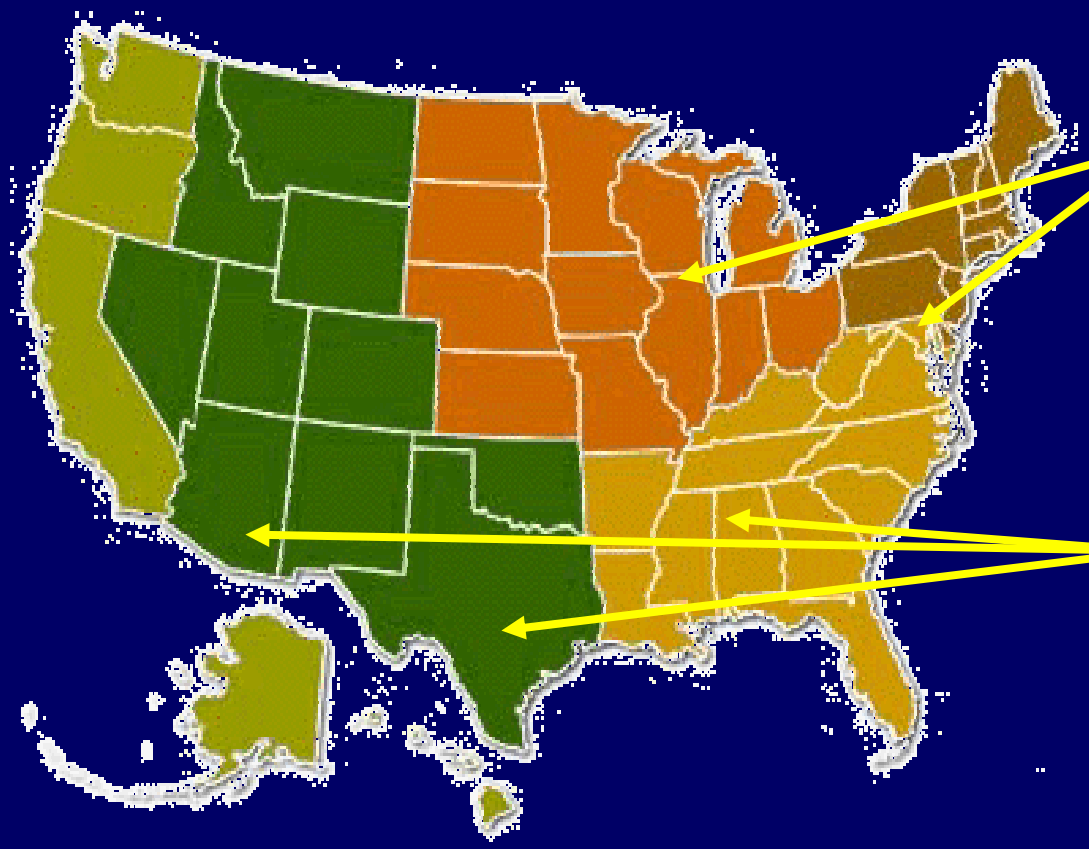
**1. Increase/Decrease Profit & 2. Help/Hurt Environment**

# Profitability of Conservation Systems Across the United States (some evidence)



**Profitability for Corn-Soybean Rotations:**

**Conventional Tillage = $93/ac**

**Conservation Tillage = $100/ac**

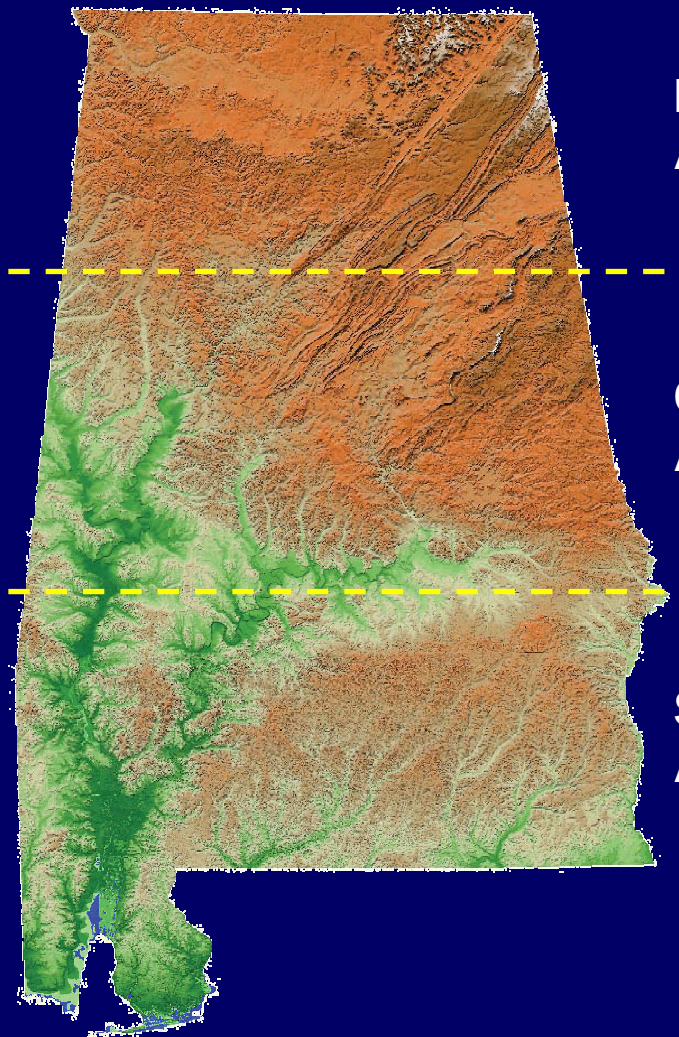
**Profitability for Cotton Production Systems:**

**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



**Northern Alabama**

| | Corn | Cotton | Peanuts |
|---|---|---|---|
| Labor | $11.00 | $23.00 | N/A |
| Machinery | $20.00 | $38.00 | N/A |

**Central Alabama**

| | Corn | Cotton | Peanuts |
|---|---|---|---|
| Labor | $6.00 | $18.00 | N/A |
| Machinery | $15.00 | $34.00 | N/A |

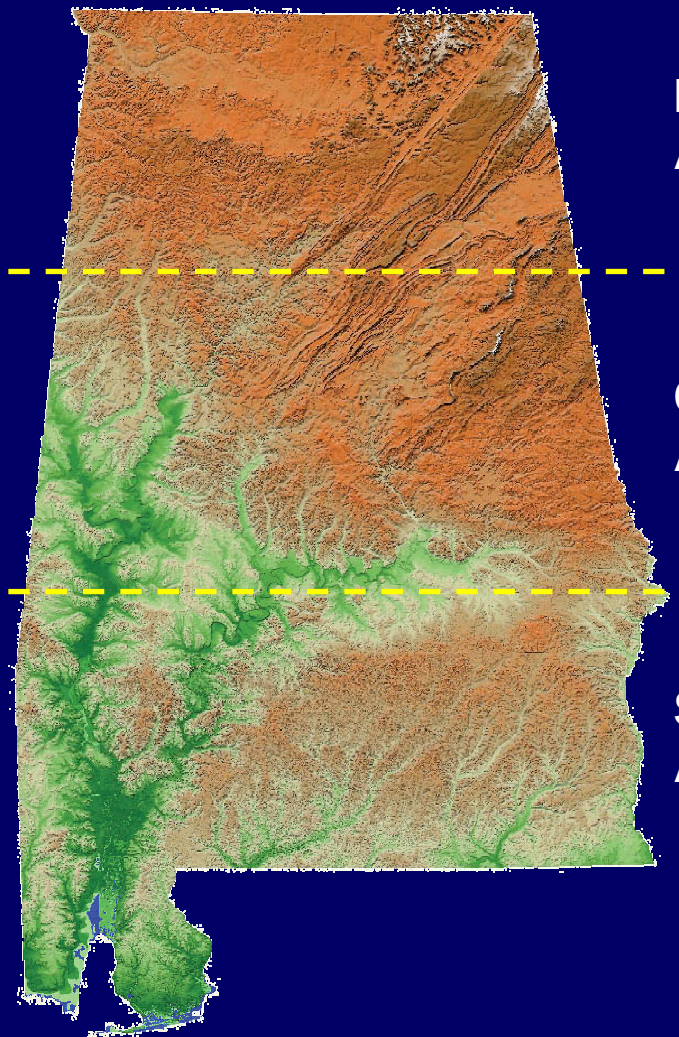
**Southern Alabama**

| | Corn | Cotton | Peanuts |
|---|---|---|---|
| Labor | $6.00 | $18.00 | $13.00 |
| Machinery | $15.00 | $34.00 | $21.00 |

*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



**Northern Alabama**

| | Corn | Cotton | Peanuts |
|---|---|---|---|
| Change in Profit | $66.00 | $29.00 | N/A |

**Central Alabama**

| | Corn | Cotton | Peanuts |
|---|---|---|---|
| Change in Profit | $12.00 | $57.00 | N/A |

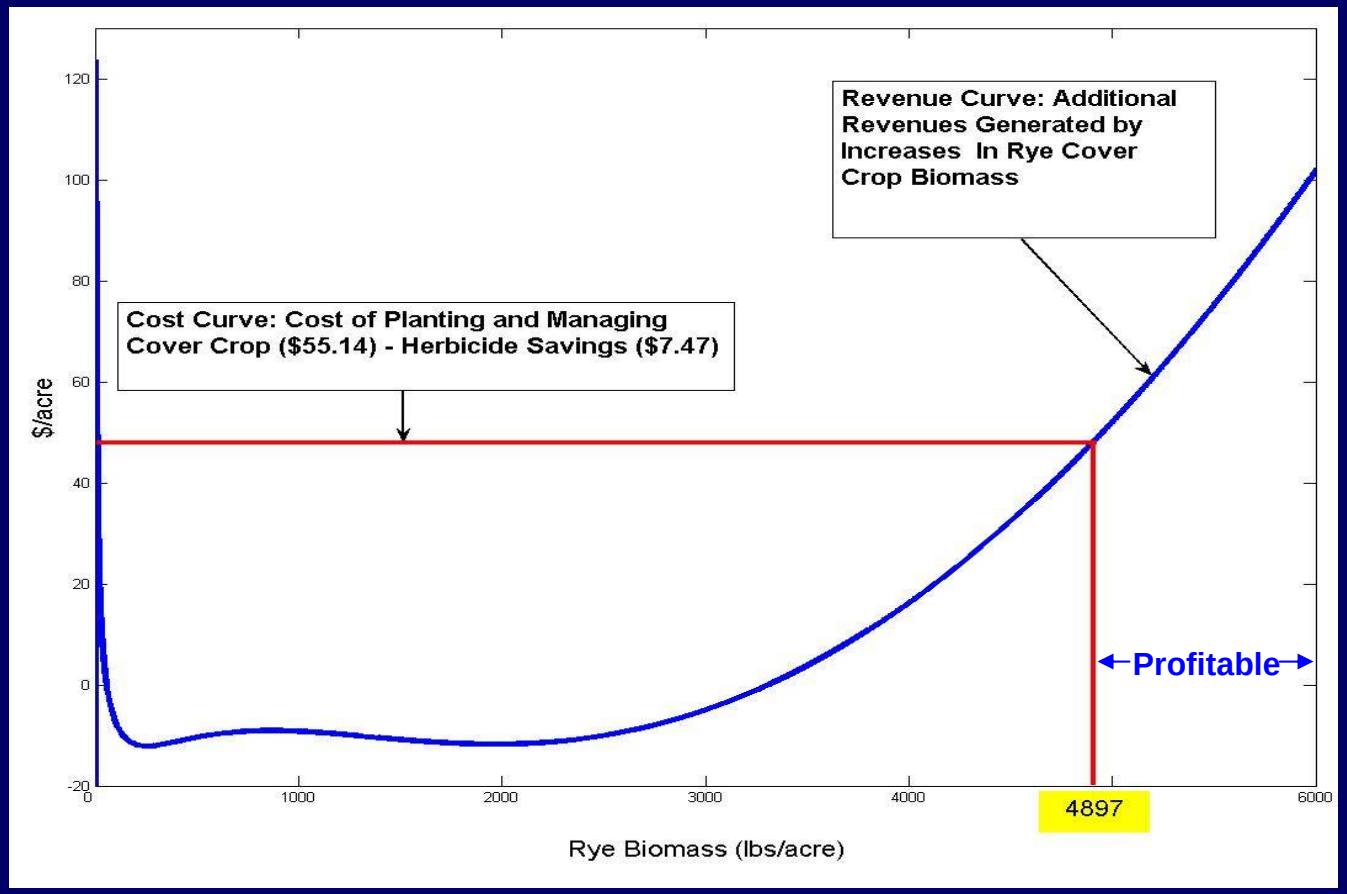
**Southern Alabama**

| | Corn | Cotton | Peanuts |
|---|---|---|---|
| Change in Profit | $60.00 | $41.00 | $107.00 |

*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.

*Source*: Bergtold and Morton, “Conservation Tillage Systems Learning Tool”, 2006

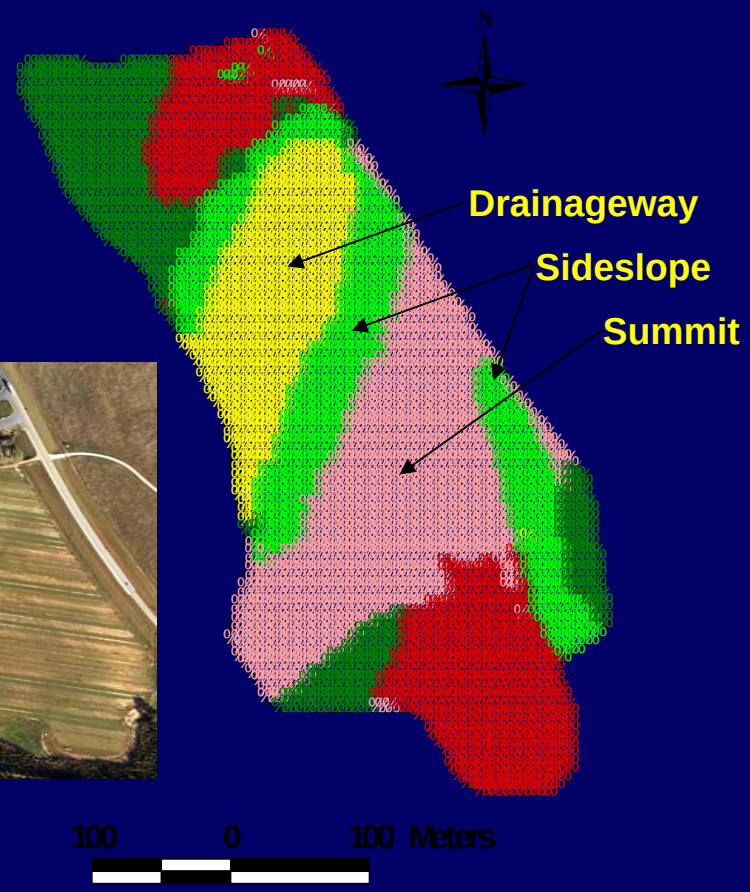
# Economic Benefit of Cover Crops (Rye prior to Cotton)




**Cover Crops can potentially increase profits by helping improve soil producitity, 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)




| Landscape | Conventional Tillage (CT) | Conservation Tillage(NT) | Difference of NT over CT |
|---|---|---|---|
| Drainage-way | **$207** | **$258** | **+ 19%** |
| Sideslope | **$239** | **$325** | **+ 26%** |
| Summit | **$273** | **$367** | **+ 26%** |

*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.

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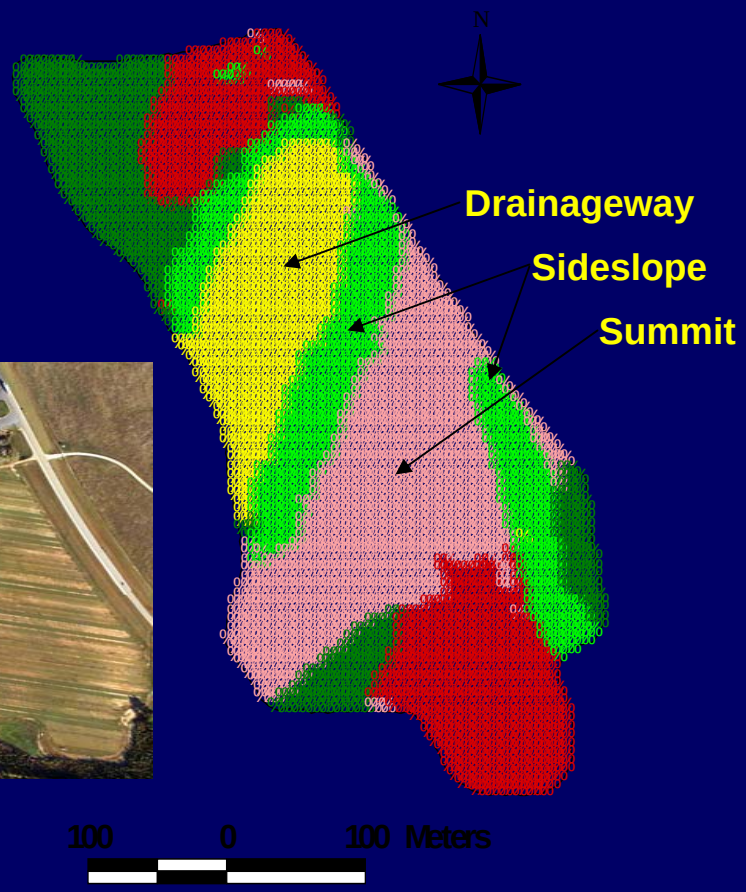



| Landscape | Conventional Tillage (CT) | Conservation Tillage(NT) | Difference of NT over CT |
|---|---|---|---|
| Drainage-way | **-$6** | **$58** | **+ $64** |
| Sideslope | **-$74** | **-$8** | **+ $66** |
| Summit | **-$47** | **$3** | **+ $50** |

*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.

**In years with adverse weather (e.g. drought or hurricane), conservation tillage can help reduce losses.**

*Source*: Bergtold *et al.*, 2005; Terra *et al*., 2005.

# Benefits of Variable Rate Application of Nitrogen with GPS for different crops (Texas)

## Corn

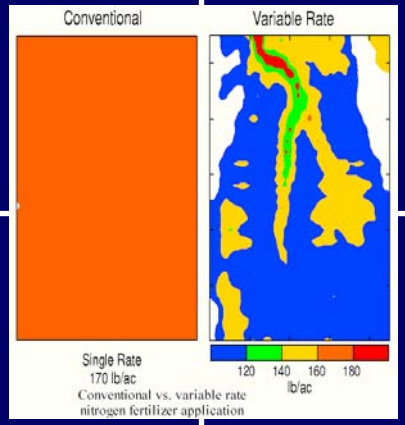
- Yield Increase: 7.7 to 15.4%
- NPVR Increase: 13.7 to 60.5%

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



Conventional vs. variable rate nitrogen fertilizer application

## 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

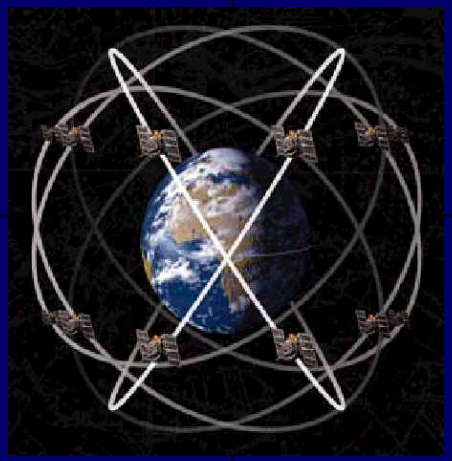
NPVR = Net Present Value of Returns

*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

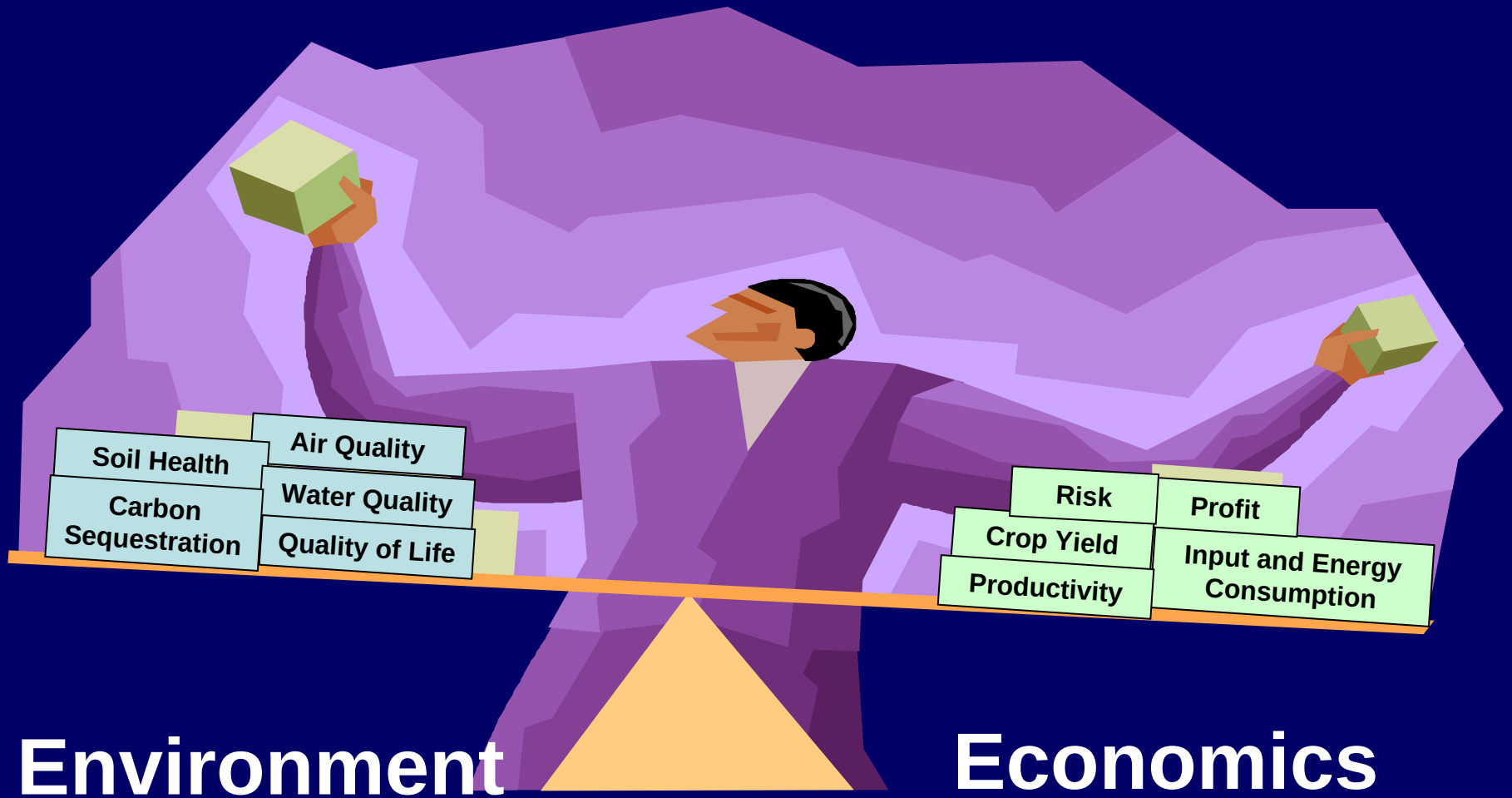
Adoption of GPS technologies such as yield-mapping and soil mapping fall behind other precision technologies, due to a steeper learning curve, especially for analyzing spatial data (Griffin *et al*., 2004)



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 producivity and profitability. Bergtold *et al*. (2006) show that as the tillage pass in conservation tillage systems moves away from theplanted row, yields drop by 24-52% and profits by 38-83%.

# Making the Conservation Decision




**Environment** **Economics**

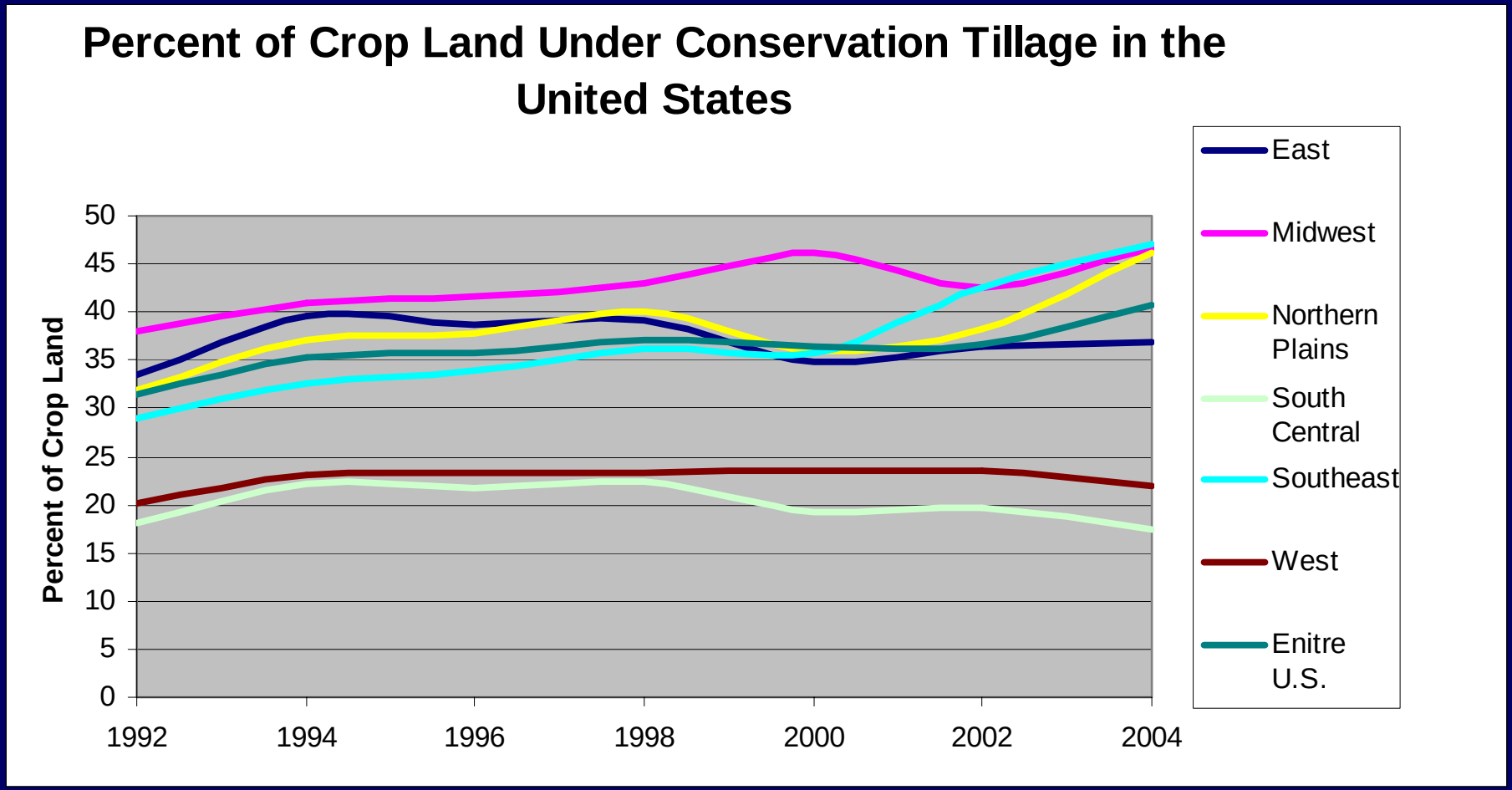
# Making the Conservation Decision


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.

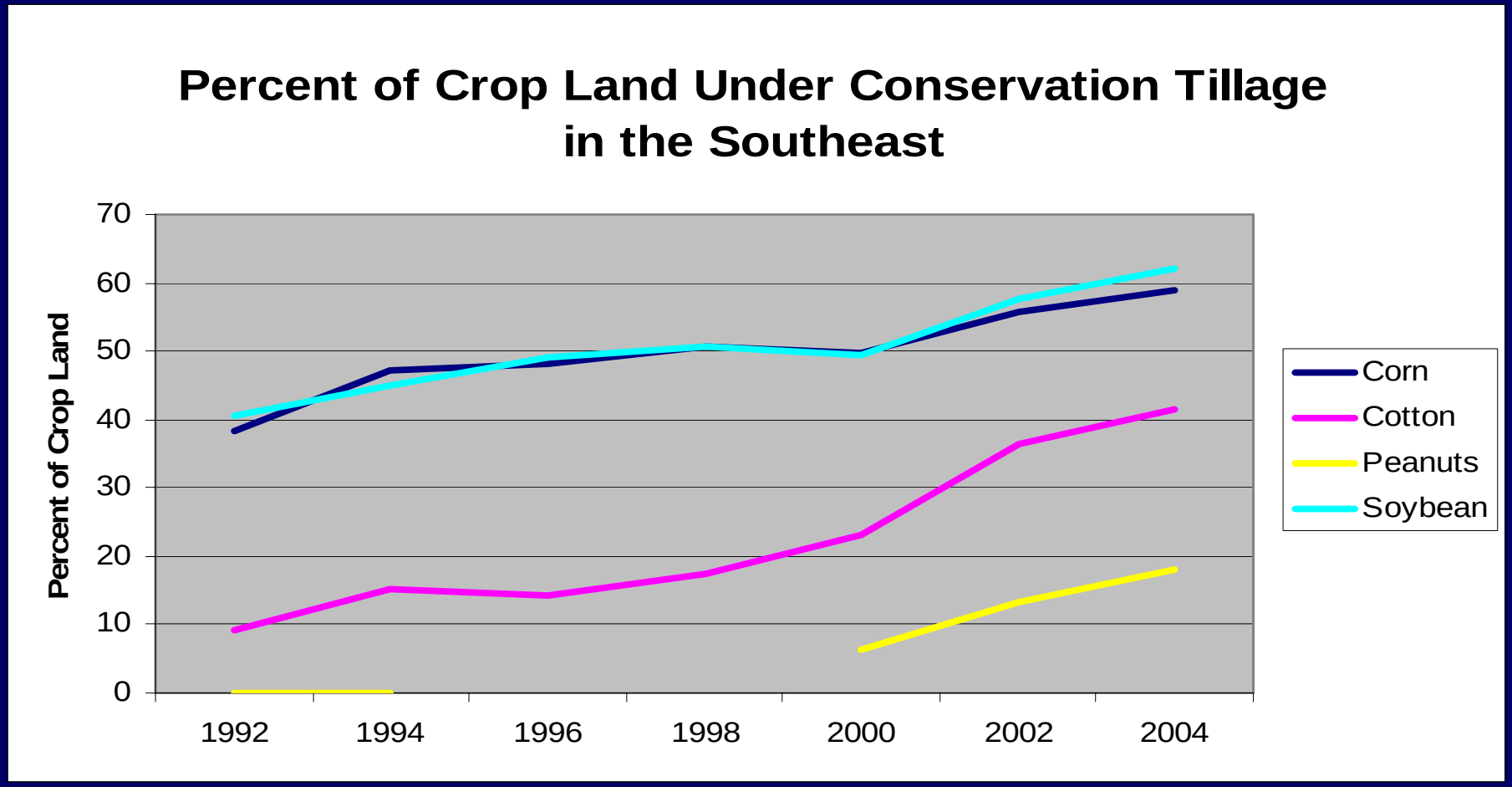
*Sources*:Bergtold and Molnar 2005; Hudson and Hite, 2003; Molnar *et al.*, 2001; Uri, 1999; Wu and Babcock, 1998

# Adoption of Conservation Tillage for all Crops Across the United States



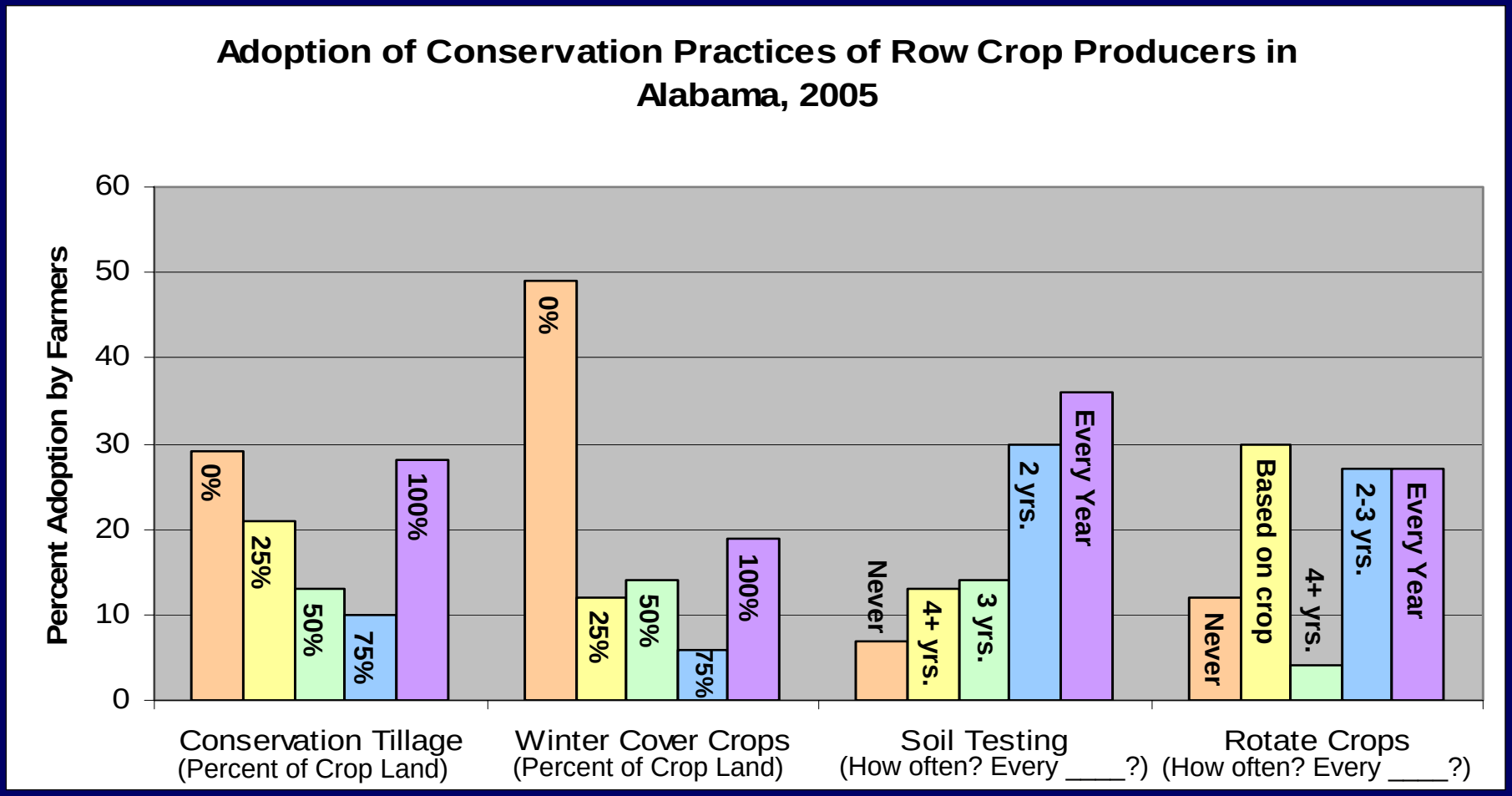

*Source*: CTIC, 2005

# Adoption of Conservation Tillage by Crop in the Southeast




*Source*: CTIC, 2005

# Adoption of Conservation Tillage Practices in Alabama




*Source*: Bergtold and Molnar, 2005

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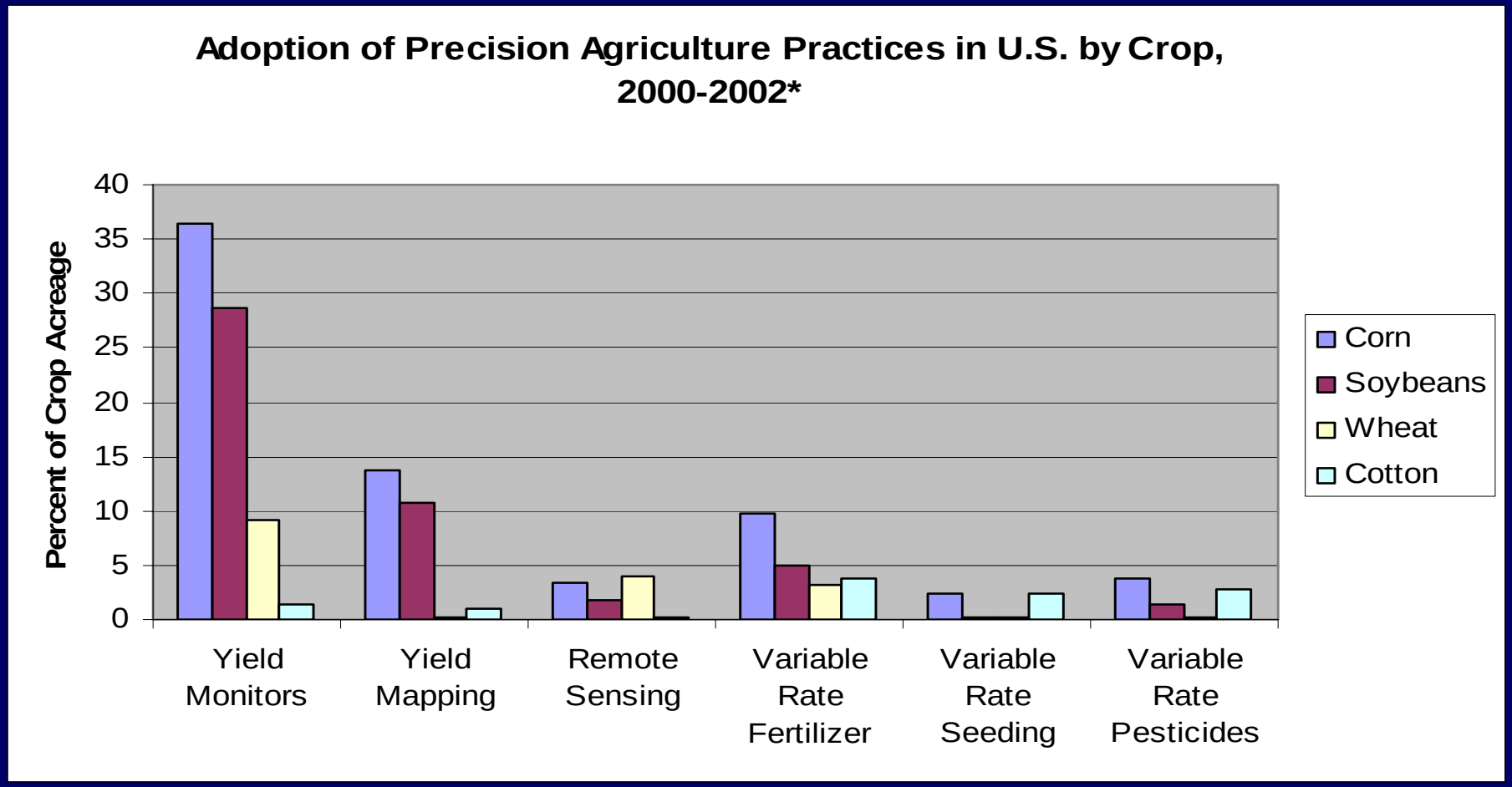
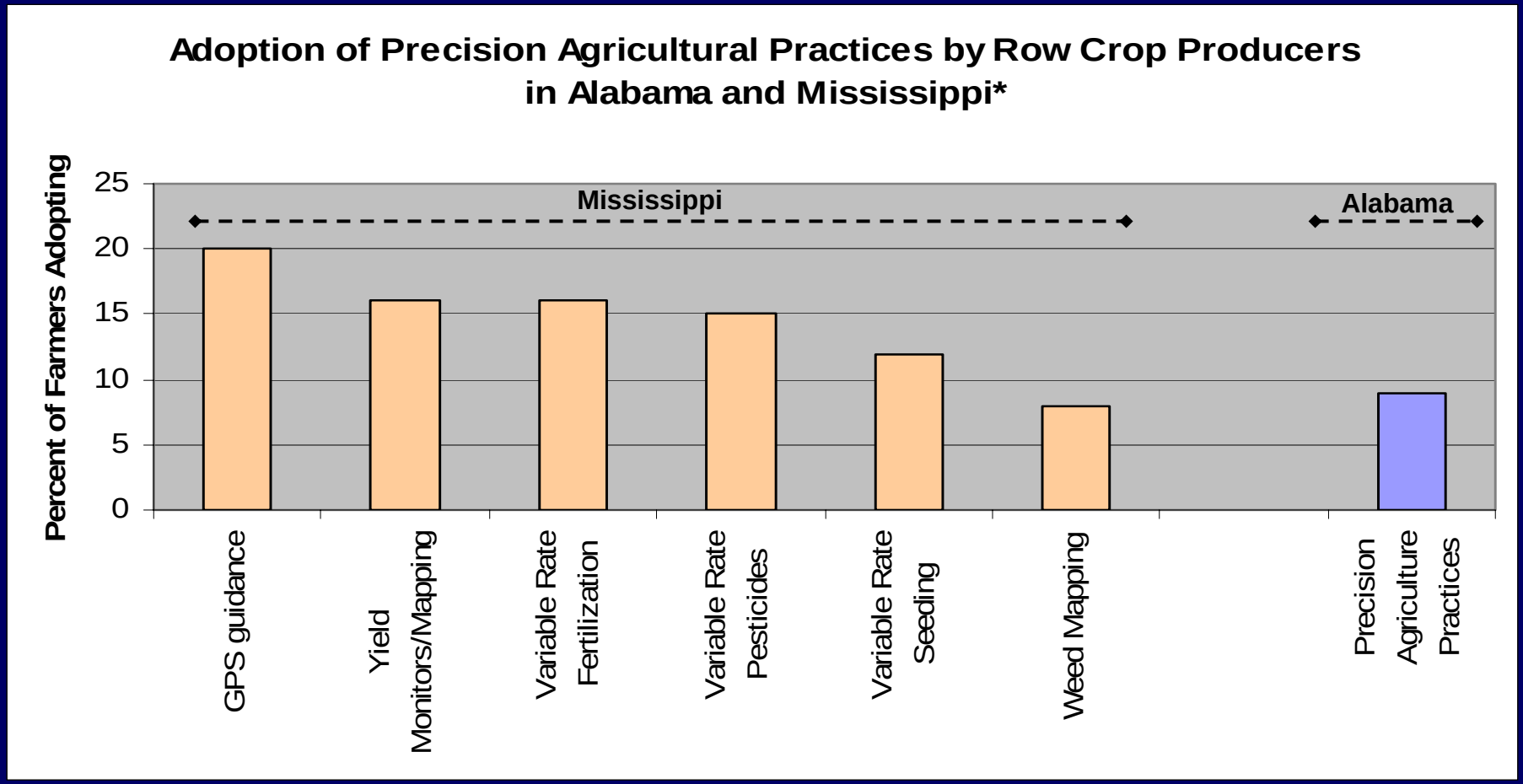



* Estimates represent data from most recent year survey data was available.

*Source*: Griffin *et al.* , 2004

# Adoption of Precision Agriculture by Farmers in the Southeast




* 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 Captial 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 througth 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 Enviroment and Society