

11. Adoption and Intensification of Conservation Practices, Risk and Policy

Jason Bergtold

<bergtold@k-state.edu>

Dr. Bergtold's research includes: the economics of adopting intensive conservation production practices and systems at the farm level; the impact of bio-energy alternatives and feedstock production on-farm; the interaction between agricultural practices, conservation policy and the environment at the farm level; and the development of applied discrete choice econometric modelling techniques. In addition, he has completed research examining the estimation of large demand systems and the international trade of peanuts. Dr. Bergtold teaches optimization techniques and methods at the graduate level.

Abstract/Summary

Conservation in cropping systems in Kansas is important for maintaining soil productivity and crop yields over time. Many farmers have already adopted conservation tillage practices, terraces, and similar conservation practices on their farm. This talk examines what it may take to get farmers to intensify their conservation efforts on farm and potential barriers to that adoption, such as risk, uncertainty, and cost. A number of conservation practices are considered, including continuous no-till, cover crops, variable rate application of inputs, and conservation crop rotations. Information about these practices and responses from an intensive farm survey conducted across the state of Kansas in 2014 will be presented.

Adoption and Intensification of Conservation Practices, Risk and Policy



Jason Bergtold, Elizabeth Canales and Jeff Williams



2014 Risk and Profit Conference
August 22, 2014
Manhattan, Kansas



Purpose of Research

- To understand farmers' decision process for adopting conservation systems and practices on-farm to help inform research, extension, outreach and policy.
- To examine the incentives and barriers to the intensification of (or doing more) conservation on-farm.

Focus

In-field conservation practices



Continuous No-Till



Conservation Crop Rotation



Cover Crops



Variable Rate Technology

Continuous No-Till

- Consists in planting crops directly into the crop residue without disturbing the soil with tillage.
 - Disturbance is limited to nutrient injection.
- No-till across all the crops planted in a field.



Conservation Crop Rotation

- Implementation of a 3 or more year rotation with three or more crops types. (This could also include a 2 year rotation with double cropping.)
- The rotation includes a combination of high residue crops, grasses and/or legumes.



Cover Crops

- Single or multiple cover crop species planted between regular cash crops to protect the soil and improve soil organic matter.
- Cover crops species :
 - Legumes: winter peas, hairy vetch, cowpeas, crimson clover, sunn hemp, etc.
 - Cereal: rye, oats, millet, etc.
 - Grass: sorghum-sudangrass hybrid, etc.
- Variable costs of planting and managing cover crops in Kansas range from \$40/acre to \$100/acre.



Variable-Rate Application of Inputs

- Varying rates of inputs (e.g. fertilizer, lime, herbicides) within a field based on field requirements (e.g. changes in soil, high/low yielding areas).
 - Map-based
 - Sensor-based



Workshops

Table 1: Workshop locations and attendees

Workshop location	Attendees
1 Salina	39
2 Great Bend	32
3 Colby	19
4 Dodge City	14
5 Wellington	21
6 Hiawatha	13
7 Topeka	25
8 Manhattan	14
9 Parsons	31
10 Pratt	10
11 Garnett	16
12 Hays	14
Total	248

- Sample was obtained from the Kansas Farm Management Association (KFMA)
- Timing: December 2013 to March 2014

Workshops

Table 1: Workshop locations and attendees

Workshop location	Attendees
1 Salina	39
2 Great Bend	32
3 Colby	19
4 Dodge City	14
5 Wellington	21
6 Hiawatha	13
7 Topeka	25
8 Manhattan	14
9 Parsons	31
10 Pratt	10
11 Garnett	16
12 Hays	14
Total	248

- Many participants are already involved with conservation on their farm.
- Recall, we are interested in the intensification of conservation on-farm. Looking at what it would take to do more conservation.

Farm Characteristics

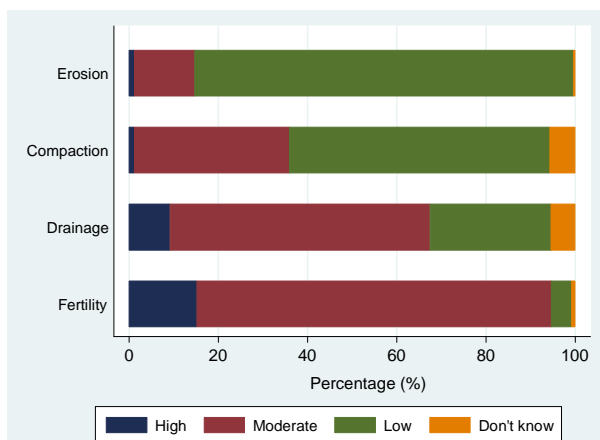
Table 2. Average farm characteristics

Variable	N	Mean	Min	Max	Census of Agriculture
Age	248	57.13	20	90	56.2 years
Average farm size	247	2,460	40	14,875	981 acres
Average sales value	242	6.2 ^b	1	9	\$ 438,020

^a Source: National Agricultural Statistics Service, USDA (2007) (> \$50K in Sales)

^b Mean sales of 6.20 corresponds to the sales category of \$400,000 to \$599,999

Soil condition

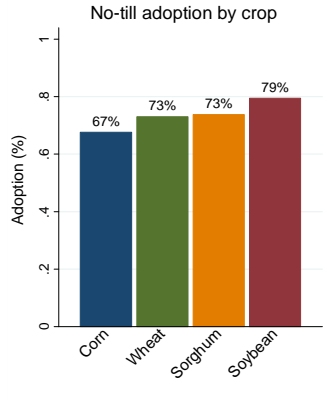


Continuous No-Till

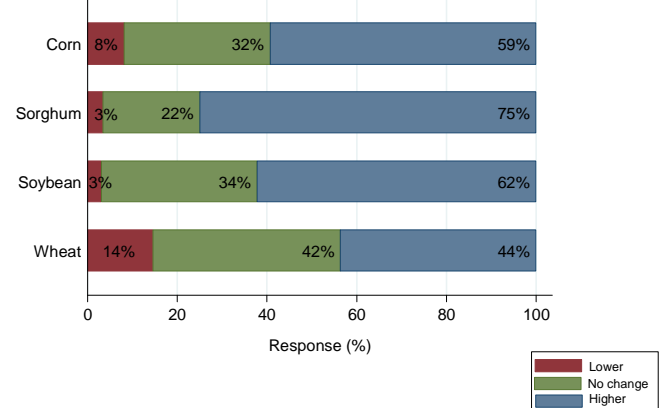
Continuous No-till

Continuous NT adoption by Region

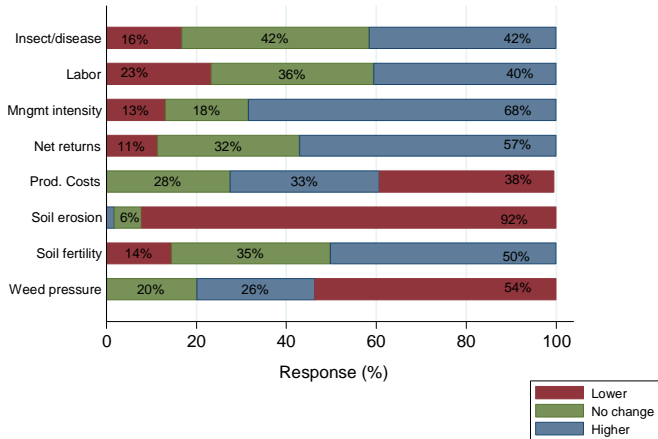
Region	Adoption level (N=248)	Percentage of land (N=151)
Western	64%	72%
Central	69%	87%
Eastern	51%	89%
Total	61%	84%



Perceived Yield effect by crop



Continuous NT-other effects

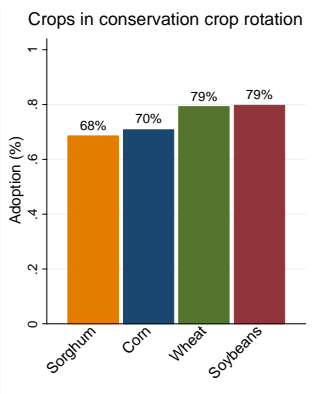


Conservation Crop Rotation

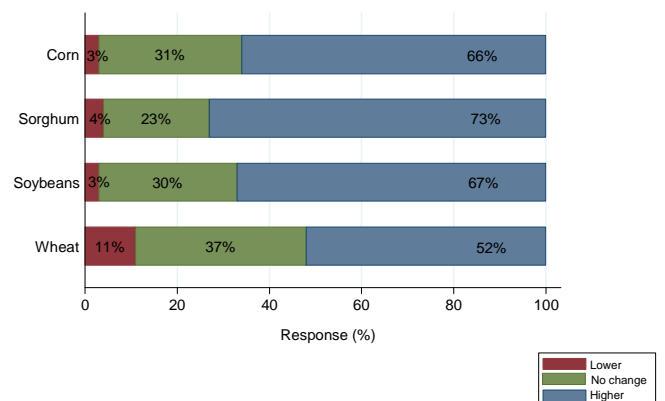
Conservation Crop Rotation

Conservation crop rotation adoption by Region

Region	Adoption level (N=248)	Percentage of land (N=156)
Western	51%	73%
Central	75%	85%
Eastern	55%	88%
Total	63%	84%



Perceived Yield effect by crop





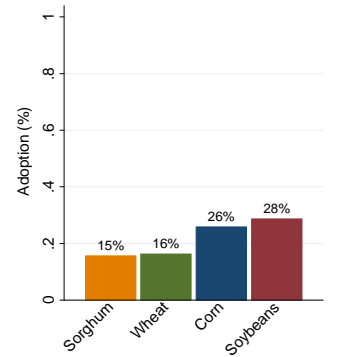
Cover Crops

Cover Crops

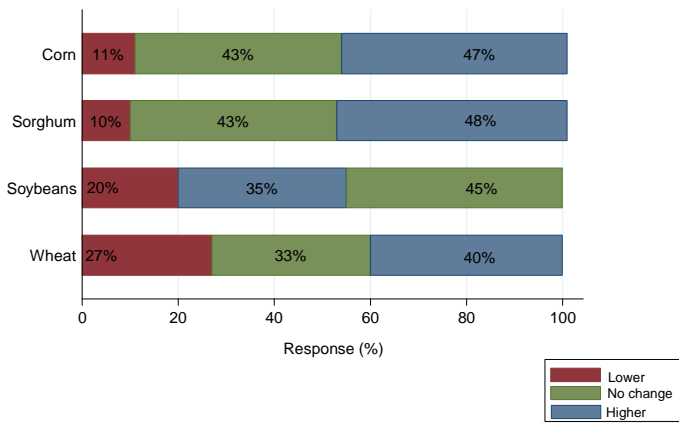
Cover crops adoption by Region

Region	Adoption level (N=248)	Percentage of land (N=84)
Western	13%	24%
Central	45%	30%
Eastern	34%	27%
Total	34%	28%

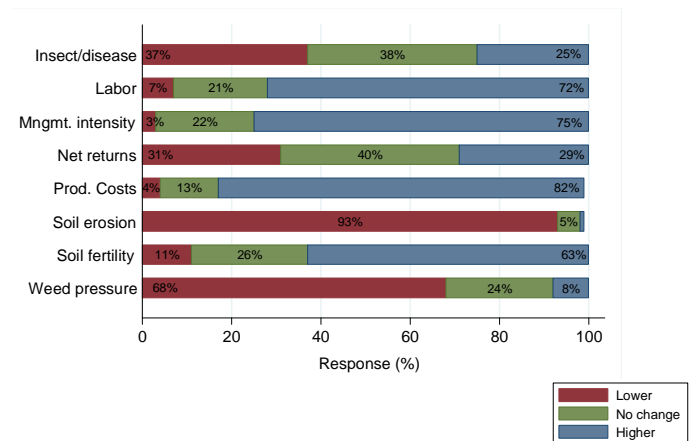
Rate of cover crop adoption - by prior crop



Perceived Yield effect by crop



Cover crop – other effects



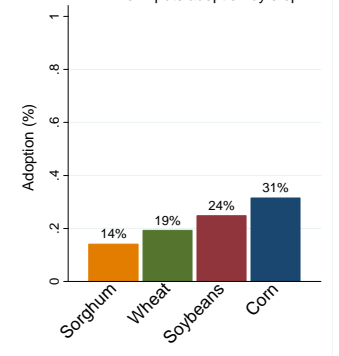
Variable Rate Technology

Variable Rate Application of Inputs

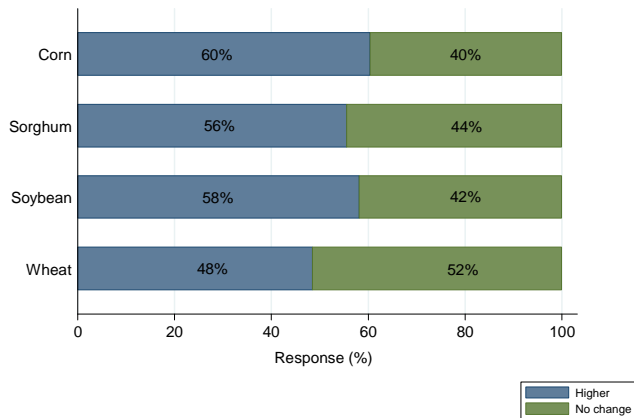
VRA of inputs adoption by Region

Region	Adoption level (N=248)	Percentage of land (N=64)
Western	6%	47%
Central	33%	56%
Eastern	31%	73%
Total	26%	63%

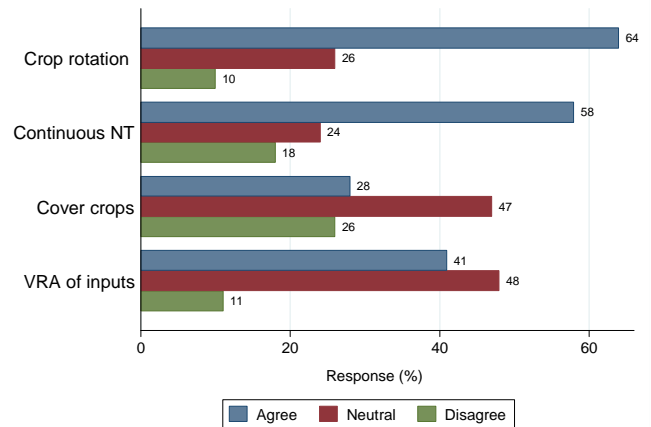
VRA of inputs adoption by crop



Perceived Yield effect by crop



Do these practices reduce risk?



Willingness to Adopt Conservation Practices

An exercise

- Willingness to adopt and intensify conservation practices on **cropland** under different contractual arrangements.
- Farmers evaluated 12 independent scenarios.
- They were asked whether they would adopt a system or stay with the status quo.
- **Contract Features:**
 1. Conservation Practices
 2. Incentive Payment
 3. Incentive Program
 4. Off-farm Environmental Benefits
 5. Riskiness: Impact on Net Farm Income



Contract Features

1. Conservation Practices:



Continuous No-Till



Conservation Crop Rotation



Cover Crops



Variable Rate Technology

Contract Features

2. Incentive Payment

- \$ /acre year (\$0, \$15, \$30, \$45, \$60, \$75)

3. Incentive Program

Federal Program



Carbon Credit Payment through a Carbon Market



Contract Features

4. Off-farm Environmental Benefits



Improvements to water quality downstream and improvements to air quality.



- Low
- Moderate
- High

5. Risk: Changes in net farm income

- Average change in net income (%)
- Probability of occurrence

Conservation Practice	Continuous no-till Cover Crops Variable rate application of inputs	
Incentive Program	Carbon Credit Payment through a Carbon Market	
Incentive Payment	\$45/acre	
Riskiness	<u>Average change in net income over 5 years</u>	<u>Probability of Occurrence</u>
	5% Loss	10% Very unlikely
	No change	80% Very likely
	5% Gain	10% Very unlikely
Off-site Environmental Impact	Moderate	

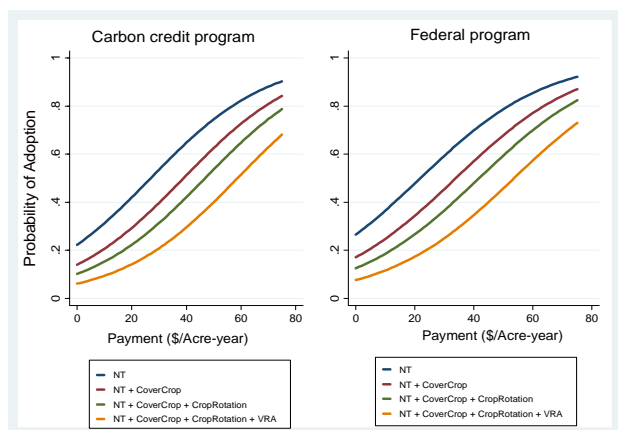
Would you adopt this system or stay with the Status Quo?

- Adopt**
 Status Quo

Results

- The level of change in net farm income is a significant factor in farmers' adoption decision.
- Farmers care about the off-farm environmental impacts associated with the practices they use on-farm
 - The results suggest that farmers are less likely to adopt contracts with lower off-farm environmental benefits.
- The result suggests a preference for federal programs over market-based programs.
 - We found a lower likelihood of adoption, for the same level of incentive payment, if the mechanism through which the incentive payment is offered is a carbon credit program.
 - Risk associated with the potential market fluctuation in carbon credit prices
 - Government intervention – carbon policy

Adoption of Conservation Practice Bundles By Program



Results

- A larger incentive is needed to induce the adoption of cover crops and variable rate application of inputs (compared to continuous NT and conservation crop rotation).
 - These practices are the least adopted across the state.
 - Services available: precision agriculture
- Main factors limiting the adoption/entering into a conservation contract:
 - Restrictiveness of programs
 - Production costs
 - 62% of the farmers would only adopt conservation practices if these result in higher net returns.



Farmers Willingness-to-Accept for Contract Attributes

Contract Attributes	WTP	St. Dev.
Continuous No-till	5.38**	(2.748)
Cover Crops	16.24***	(5.689)
Conservation Crop Rotation	10.65***	(3.862)
Variable Rate Application	16.00***	(5.493)
Low Off-farm Environmental Benefits	10.11**	(4.645)
Medium Off-farm Environmental Benefits	7.04*	(4.584)
Carbon Credit Program	6.86**	(3.364)

The amounts in the table above represent how much a farmer would have to be paid under contract to accept that contract option or adopt that particular conservation practice.

Comments?