Why do farmers adopt conservation practices?

Case Studies from the Lower Roanoke Watershed, North Carolina

by

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Date:_______________

Approved:

______________________________
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ABSTRACT

Agricultural policy is becoming increasingly influenced by environmental policy, but achieving environmental objectives through government conservation programs remains an elusive goal. Numerous studies have shown that farmers are motivated to adopt conservation practices not only by profit incentives, but also by factors such as perceptions of good stewardship and attachment to the land. In this analysis, I use innovation-adoption theory to analyze case studies of crop farmers in the Lower Roanoke watershed in North Carolina to show how they are influenced by micro-level dynamics at the farm scale. Using this theory, I explain how farmer perceptions of conservation practices can both encourage and discourage them to adopt these practices. This analysis shows that practices that provide a perceived relative advantage, through things like labor and time savings, are more readily adopted, but practices that are perceived as incompatible with farmers’ values, needs, or relationships with landowners are frequently rejected, even when economic profits might be derived from them. I also found that farmers are strongly influenced by biophysical aspects of their farm operation and have varying, but influential, interpretations of what good stewardship looks like. Based on these findings, I suggest that conservation programs could be marketed in a more effective way by appealing to farmers’ motivations and by communicating conservation benefits in ways that take farmer perceptions into account. In particular, conservation programs should be framed in a way that educates farmers about how conservation can benefit the quality of their land, crop yields, and agroecosystem.
ACKNOWLEDGEMENTS

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I. INTRODUCTION

Increasingly, federal support for agriculture is being directed toward conservation programs, and many policy analysts are predicting that environmental objectives will guide the future of agricultural policy in the United States (Napier et al. 2000; Batie and Horan 2002; Heimlich 2004; Claasen and Morehart 2006). The United States Department of Agriculture (USDA) has promoted conservation practices, largely through incentive payments, since the Dust Bowl era. However, widespread concern about agricultural impacts on water, wildlife, and soil quality persist. A number of researchers have argued that government programs targeting conservation on farmland have been inefficient and have failed to meet ecological objectives (Feather and Amacher 1994; Forster 2000; Hellin 2006). In the proceedings from a 1996 international conference on soil and water conservation (Napier et al. 2000), authors call for new policies that address the increasing social, political, and economic complexities of agriculture in the new millennium. A central component of this discussion is how to make conservation programs more effective, despite the widespread heterogeneity of farmers’ needs, attitudes, and capacities.

Understanding what motivates farmers to adopt conservation has been the subject of several decades of research. A literature review identified a wide array of findings about conservation adoption behavior from public policy, economics and sociology research. Many of these studies focus on understanding and projecting conservation adoption using quantitative analysis of sample survey data, correlating farm structural variables (such as farm size, age of farmers, etc.) with information about farmer behavior (Blase 1960; Ervin and Ervin 1982; Fuglie and Kascak 2001).

A 2006 study by the USDA’s Economic Research Service that examined trends among a national sample of farmers, showed that practices that are compatible with economic profits are adopted by all types of farmers and not limited to a certain group (Lambert et al. 2006). Feather and Cooper (1995) found that economic profits might be the most important motivator, but showed that awareness of conservation benefits and knowledge about how to use an innovation were equally important. Chouinard (2006) used a combined stewardship-profit motive benefits framework to examine farmer willingness to trade profits for stewardship and found that farmers were willing to trade. A recent study of Midwestern farmers (Ryan et al. 2003), found that variables such as farm income, farm size,
age of farmer, and other common estimators were not significant explanatory variables of farmer motivations to adopt conservation and that attachment to the land was the most significant variable.

It is clear from these contradictory findings that adoption motivation is complex and not fully understood. Napier et al. (2000) suggests that using socioeconomic, farm structure, and public policy variables to predict adoption is problematic, pointing out the contradictions in the literature and presenting new findings from a large study of Midwestern farmers where many of the standard variables, including the receipt of government incentive payments, did not correlate with adoption behavior. Napier recommends that social scientists focus on composite conservation adoption behavior (or a comprehensive analysis incorporating all aspects of farmer behavior relating to conservation on the farm), as opposed to focusing on the adoption of specific practices, in order to understand the process of adoption. He recommends more research at the farm scale to flesh out what influences farmer behavior, suggesting that the existing conservation programs may be ineffective because they are based on incorrect assumptions about why farmers decide to adopt conservation practices.

Amidst this growing body of literature there is a paucity of case studies illustrating composite conservation attitudes and behavior at the farm level. Combining qualitative insights with the depth of quantitative studies that have previously been conducted can shed light on the complexity of real-world situations on farms. My research hypothesizes that farmer attitudes and behavior interact in ways that cannot be observed in large-scale surveys and that these micro-level behaviors may be even more important than the standard variables generally used in sample surveys to determine the adoption of conservation practices.

Understanding micro-level farmer behavior is particularly important for the design of new federal “green payment” programs that are intended to provide income support, along with an incentive for conservation. The Conservation Security Program, a new provision in the Farm Bill (2002) and the country’s first green payment program, was developed to “reward the best and motivate the rest” by paying farmers for conservation related to production (such as the reduction of soil disturbance during production) and by providing payments for enhanced conservation over the years of enrollment. Farmers agree to maintain their qualifying practices for 5 to 10 years as part of the contract and can elect to undertake any of a number of enhancements voluntarily. The CSP is a more flexible conservation
program than previous Farm Bill programs because it provides incentive payments for environmental benefits, as opposed to trying to instigate specific practices. As a result, farm operators have the liberty to decide what innovations they want to adopt in order to provide water, air, soil, and wildlife benefits. Farmers’ choices about which innovations to undertake, if any, will determine how effective the program is at achieving environmental improvements. Furthermore, since the program was designed to reward those farmers who have already undertaken voluntary conservation practices, knowing what has motivated these “good actors” to undertake conservation prior to receiving incentives is important for policymakers to determine what will motivate others to adopt and to enhance the practices of already conservation-oriented farmers.

This research presents case studies of twelve farmers in one of the first watersheds selected for the Conservation Security Program, the Lower Roanoke in eastern North Carolina. These case studies describe what has influenced these farmers’ decisions to adopt conservation practices, how they perceive their impacts from conservation today, and what limits them from adopting additional conservation practices. This research provides policymakers with an example of why and how farmers undertake conservation, augmenting the existing literature showing who participates and what practices they implement.

II. Research Objectives

1. To qualitatively assess why selected farmers have adopted or not adopted conservation practices in the Lower Roanoke Watershed.
2. To understand how farmers perceive the impacts of their conservation practices.
3. To relate findings from these 12 case studies to other research.
4. To determine whether the Conservation Security Program marked an increase in farmer innovation and/or an increase in conservation awareness in the watershed.
5. To make policy recommendations about how to increase the effectiveness of conservation programs based on the findings.

III. Background

Study Area

The lower Roanoke river basin overlaps six counties in northeastern North Carolina – Bertie (70%), Martin (90%), Halifax (40%), Northampton (35%), Washington (5%), and
Beaufort (trace) counties (North Carolina Department of Environment and Natural Resources 1996). The lower Roanoke is part of a larger watershed that extends northwest into Virginia and drains southeast into the Albemarle Sound (Fig. 1). There are about 700 farms in the watershed, covering around 300,000 acres, which is 37% of the watershed’s total area. The dominant crops are corn, soybeans, tobacco, peanuts and cotton and the average farm size is 300 acres (Natural Resources Conservation Service 2007). The watershed has a higher level of poverty than the state average, and many of the state’s poorest counties are in the Lower Roanoke watershed. One of the poorest counties in the state, Bertie County, has a population that is 40% low income compared to 21% statewide (United States Census 2000).

Figure 1. Map of the Lower Roanoke Watershed. The watershed drains into the Albemarle Sound to the southeast.

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April 23rd, 2007
The watershed is an important area not only for agriculture, but also for fishing, hunting and recreation. There are six species of fish and mollusks in the basin that are listed as threatened or endangered by the State of North Carolina. Striped bass spawn in the river and other anadromous fish such as blueback herring and Atlantic sturgeon can be found in the river. The largest intact and least disturbed area of intact bottomland hardwood wetlands in the mid-Atlantic region (150,000 floodplain acres) exists along the Roanoke River (North Carolina Department of Environment and Natural Resources 1996).

Sedimentation and non-point source pollution are some of the primary environmental concerns in the watershed. Agricultural runoff has been cited as one of the largest potential sources of nutrient loading into the streams and rivers (atmospheric nitrogen is also a significant contributor), and of particular concern are phosphorous and nitrogen pollutants (McMahon and Harned 1998).

Innovation Adoption-Diffusion Theory

My case study analysis is grounded in adoption-diffusion theory. This research tradition has been used in a variety of fields beginning over fifty years ago, most commonly in agriculture, rural sociology, marketing, and communication. It is defined as “the process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among the members of a social system” (Rogers 2003). The paradigm of adoption research came out of an investigation of hybrid corn technology adoption in two Iowa communities, where a retrospective survey was used to ask respondents to recall when they adopted, where they obtained information, and what consequences arose from their adoption of the innovation (Ryan and Gross 1943; Rogers 1962; Rogers 1995; Rogers 2003).

Diffusion research has shown that the rate of adoption generally follows an s-shaped curve that varies in steepness depending on the characteristics of the adopters (Fig. 2). A few early adopters begin to use an innovation because of a perceived need, and then the innovation diffuses to others in a predictable pattern. The late adopters are often called “laggards” and a great deal of research has focused on what separates these individuals from those who adopt an innovation when it is new and untested.
Empirical research has shown that an innovation is adopted slowly by early adopters, then spreads quickly until it levels off with late adopters.

Everett Rogers, who advanced innovation diffusion theory in the late 20th century, identified five stages of innovation adoption and diffusion (Rogers 2003): knowledge, persuasion, decision, implementation, and confirmation (Fig. 3).

1. **Knowledge Stage** – This stage begins when an individual learns about an innovation, either by seeking information because of a need or because of exposure to an innovation. Rogers describes three types of knowledge: awareness knowledge, how-to knowledge, and principles knowledge. Awareness is general information, whereas how-to knowledge is understanding of the actual implementation of an innovation. Principles knowledge is information about why an innovation works, or the principles behind it (such as plant biology as the basis for fertilizer innovations). Change agents, or external promoters of innovations, play a key role in this stage.

2. **Persuasion Stage** – This is the point at which an individual forms a positive or negative attitude based his or her perceptions of the innovation. The persuasion stage is what leads to a decision to adopt or reject an innovation.
3. **Decision Stage** – This is the point at which an individual decides to move toward adoption, the full implementation of an innovation, or rejection, meaning full abandonment of an innovation.

4. **Implementation Stage** – This is the stage at which the innovator implements the innovation and adapts it according to his or her needs.

5. **Confirmation Stage** – This is the stage when an innovation becomes standard practice or when the innovator seeks out additional confirmation of an innovation’s usefulness (sometimes leading to discontinuance).

These stages are influenced by prior conditions such as an individual’s use of a related practice or felt need for a new practice, his or her innovativeness, and the norms of the social system. These stages are also influenced by communication channels among members of the social system, characteristics of the decision-making unit (in this case, the farmer), and perceived characteristics of the innovation.

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**Figure 3: Diagram of the adoption decision process (Rogers 2003).** This process is influenced by prior conditions, characteristics of the decision-making unit, and perceptions of the innovation. The communication channels that exist among innovators also influence the decision-making process.
My analysis focuses on the knowledge and persuasion stages of adoption, and, in particular, on the perceived characteristics of conservation innovations that led to the adoption or rejection of innovations during this stage. The perceived characteristics of innovations take five forms – relative advantage, compatibility, complexity, trialability, and observability (Rogers 2003) (Table 1).

Table 1. Definitions of different perceptions of innovations. These perceived characteristics of innovations are based on Everett Rogers’ adoption-diffusion theory (Rogers 2003).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Relative Advantage</td>
<td>Relative advantage is a ratio of benefits to costs of an innovation, and these benefits and costs are not only economic ones. Other benefits include an increase in social prestige, time-savings, reduction of discomfort, low initial costs, and immediacy of the rewards from the innovation (Rogers 2003).</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Rogers describes compatibility as “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (Rogers 2003). Research has shown that even if an innovation provides relative advantage, if it is incompatible with the socio-cultural values and beliefs of a community, it will often be rejected.</td>
</tr>
<tr>
<td>Complexity</td>
<td>The characteristic of complexity is described as “the degree to which an innovation is perceived as relatively difficult to understand and use” (Rogers 2003). Studies have shown that the greater the complexity of an innovation, the slower the rate of adoption.</td>
</tr>
<tr>
<td>Trialability</td>
<td>Trialability is “the degree to which an innovation may be experimented with on a limited basis (Rogers 2003).” Rates of innovation increase if there is a high level of trialability of an innovation, in other words farmers would be more willing to invest in a technology if they could easily reject it (without great economic losses) if it didn’t benefit them.</td>
</tr>
<tr>
<td>Observability</td>
<td>Observability is “the degree to which the results of an innovation are visible to others. The observability of an innovation increases the rates of adoption (Rogers 2003).</td>
</tr>
</tbody>
</table>
IV. METHODS

Methodology

I used case studies to document and analyze the innovation-adoption process. The purpose of a case study is different from a sample survey design in that it does not attempt to determine the prevalence of phenomenon; rather it attempts to investigate a phenomenon in context (Yin 2003). I used a multiple case design, the purpose of which is to replicate a phenomenon in multiple scenarios (Yin 2003). For my research, I considered each individual farmer to be a unique study to which I applied the same theoretical framework of adoption-diffusion theory. I was then able to draw cross-case conclusions.

I developed a survey instrument based on background research conducted over the summer of 2006 for Environmental Defense (Henry and Lurie 2006) and through a review of the literature. I also consulted with experts from the Natural Resources Conservation Service in North Carolina (NRCS), non-profit organizations such as Environmental Defense and the American Farmland Trust, Duke University’s Nicholas School of the Environment and Earth Sciences, and the USDA social science research team based in Greensboro, North Carolina. These expert consultations were designed to narrow my research question to what was relevant to conservation program policies. Through these expert consultations, I learned of a deficit of information pertaining to what limits farmers from undertaking conservation practices, compared to the amount of information exploring motivations to adopt conservation practices. I also learned that there is dissatisfaction about the amount of conservation that has been adopted on agricultural lands in the Lower Roanoke watershed and frustration about the ongoing impacts from agricultural on the region’s water quality.

I held a focus group with farmers from the region prior to the implementation of the survey and adapted the questions based on their feedback. The focus group session was unstructured and farmers mainly talked about the process of considering whether or not to adopt an innovation. Participants commented that farmers in the region were losing money by not using certain conservation practices and suggested that the reason for this might be a resistance to change.
Subject Selection

I obtained the names of interview subjects from a variety of sources, including the NRCS district conservationists, USDA extension service, farmers, and farming advocacy groups. All farmers agreed to be interviewed in accordance with a Duke University-approved verbal consent agreement.

I grouped respondents into two categories: recipients and non-recipients of Conservation Security Program funding. I interviewed six individuals from each category. In each category, for comparative purposes, I categorized farmers based on USDA farm characteristics (Table 2).

Table 2. Farmer typologies (Hoppe et al. 2000, as adapted in Lambert et al. 2006).

<table>
<thead>
<tr>
<th>Typology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retired/Residential</td>
<td>Small farms with sales under $250,000 whose operator is retired or whose main occupation is something other than farming.</td>
</tr>
<tr>
<td>Low-Sales</td>
<td>Farms with sales less than $100,000 whose operator’s main occupation is farming.</td>
</tr>
<tr>
<td>High-Sales</td>
<td>Farms with sales between $100,000 and $250,000 whose operator’s main occupation is farming.</td>
</tr>
<tr>
<td>Commercial</td>
<td>Farms with sales greater than $250,000 whose operator’s main occupation is farming.</td>
</tr>
</tbody>
</table>

I conducted semi-structured interviews with each farmer, using a set of research questions based in adoption-diffusion theory. Interviews lasted anywhere from forty-five minutes to four hours, depending on the farmer’s interest in speaking more about the research questions. However, the same protocol was followed regardless, with extra time used for probing further into some of the farmer’s answers to the general set of research questions and to touring the farm. Questions were open-ended, allowing farmers to come up with responses unprompted (as opposed to pre-defining terms such as “conservation”). Probing was used to get farmers to explain their answers and to fully explore their opinions.

I recorded interviews (with each farmer’s permission) on an iPod for later transcription. I was the only one to conduct interviews, allowing me to minimize response bias by using the same approach to questioning with each interview subject. Response bias may have resulted from my association with an environmental management program, however I made clear in my introduction that responses would be kept strictly confidential, that there were no right answers to any of my questions, and that I wanted their honest
opinions about these topics, since their input would provide valuable insight about what farmers really care about when it comes to conservation. Considering that all contacted farmers who were available during the two weeks during which I scheduled interviews agreed to participate, it seems clear that farmers did not feel threatened by the topic or by my association with the environmental management program at Duke.

Research Questions/ Hypotheses

The theoretical framework of adoption-diffusion theory informed my research questions. These questions focused on four general areas: the farmer’s conservation adoption history, his motivations to adopt each conservation practice currently implemented on the farm, his perceived limitations to undertake more conservation, and a self-assessment of conservation successes and needs (Table 3). Prior to asking these questions, I obtained background information from each farmer pertaining to his farming operation, what crops he was growing, how many acres he was operating, his total sales, and what conservation practices he used (both through participation in government conservation programs and without these incentives).

Data Analysis

My data consisted of transcripts from recorded interviews and field notes from background interviews conducted during the summer of 2006 (Henry and Lurie 2006). Case studies were compiled from the interview transcripts to represent each individual farmer’s conservation history, adoption motivations, perceptions of limitations to conservation adoption, and self-assessment of conservation accomplishments and needs.

A first level of coding was done on the case studies to categorize conservation practices into general categories (Table 4). Dependent variables from adoption-diffusion literature were then used to code the case studies for the purpose of pattern-matching across cases. Motivations and limitations of adoption were coded based on the farmers’ perceptions of relative advantage, compatibility, complexity, trialability, and observability (Table 1). Cross-case comparisons were then done for each perception variable to show similarities and differences between the case studies.
Table 3. Description of interview questions posed to Lower Roanoke farmers and rationale for asking them.

<table>
<thead>
<tr>
<th>Conservation Adoption History</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Would you consider yourself a conservationist? If so, when did you begin to consider yourself a conservationist?</strong></td>
</tr>
<tr>
<td>This question was intended to illuminate whether there was a moment of recognition for the farmer or if he considered stewardship to be an inherent trait.</td>
</tr>
<tr>
<td><strong>Why did you choose to start these conservation practices? Talk about the process of making that decision.</strong></td>
</tr>
<tr>
<td>Conservation Adoption Motivations</td>
</tr>
<tr>
<td>This question was left open-ended for the farmer to define on his own terms what conservation practices to speak about and how to define them. This allowed me to compare what farmers were more interested in as well as to highlight those practices for which a clear decision was made. I then probed for information about motivations to undertake practices discussed in the background section.</td>
</tr>
<tr>
<td><strong>Why do you think some farmers undertake more conservation than others? What do you think is preventing farmers from doing more conservation?</strong></td>
</tr>
<tr>
<td>Limits to Conservation Adoption</td>
</tr>
<tr>
<td>It is a standard survey research strategy to ask respondents about the behavior of peers, in order to gain insight without making them feel under scrutiny. This was especially important for this question, since farmers may not want to seem hypocritical by directly commenting on their own shortfalls after claiming to be conservationists.</td>
</tr>
<tr>
<td><strong>Show me, on this satellite map of your farm, where you think your conservation practices have had the biggest impacts. Show me where you would do more conservation if you were able to. What would help you to do that?</strong></td>
</tr>
<tr>
<td>Conservation Self-Assessment</td>
</tr>
<tr>
<td>This question allowed for discussion to focus on real examples, rather than hypothetical examples. It was also a good way to identify how farmers defined “success” in terms of their conservation. Furthermore, it provided data for geospatial analysis comparing farmer perceptions of successful conservation with watershed vulnerabilities.</td>
</tr>
</tbody>
</table>
Since the sample was small, statistical analysis was not conducted using farmer typologies as independent variables. However, the farmer typologies served as descriptive context for each case. My analysis focuses on illustrating the range of variables influencing farmer decision-making, rather than trying to narrow the focus to a set of predictor variables.

Table 4. General descriptions of the most common conservation innovations discussed during farmer interviews (adapted from Parker 2003).

<table>
<thead>
<tr>
<th>Conservation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillage</td>
<td>Any tillage system that reduces the soil disturbance during planting and leaves residue on the surface of the soil for reduced erosion. This includes strip-till, reduced-till, minimum-till, and no-till.</td>
</tr>
<tr>
<td>Cover Crop</td>
<td>Crop planted to reduce erosion and chemical runoff during the off-season, to increase organic matter, and to improve the structure of the soil. Also provides some wildlife habitat.</td>
</tr>
<tr>
<td>Grassed Waterways</td>
<td>Waterways that are graded to slow the flow of water, thereby reducing erosion and planted with vegetation to reduce erosion, flooding, and chemical runoff.</td>
</tr>
<tr>
<td>Field Borders/Hedgerows</td>
<td>A border on the edge or middle of a field that provides food and habitat for wildlife, reduces wind erosion of crops, and attracts beneficial insects to the field.</td>
</tr>
<tr>
<td>Filter Strips</td>
<td>An area of flood occurrence or runoff that is planted with vegetation to remove sediment and chemical runoff by filtration.</td>
</tr>
<tr>
<td>Crop Contours</td>
<td>Row crops planted on the landscape in an orientation that reduces erosion and improves water retention and drainage.</td>
</tr>
<tr>
<td>Nutrient Management</td>
<td>Management of nutrient applications for optimum yields with minimum loss to the environment.</td>
</tr>
<tr>
<td>Integrated Pest</td>
<td>Pest management that includes biological and human controls such as crop scouting to limit chemical controls of pests.</td>
</tr>
<tr>
<td>Wildlife Habitat</td>
<td>Restoration of habitat in a way that is consistent with local ecosystems and occurs on land that is retired from agricultural production for the long-term.</td>
</tr>
</tbody>
</table>

**Geospatial Analysis**

Farmers drew polygons of conservation impacts and conservation needs on a satellite map of their farm (Fig. 4). As previously mentioned, this allowed farmers to talk about actual examples of conservation that they had undertaken and to express limitations that were
preventing them from undertaking new practices. Satellite pictures from 2005 were purchased (TerraServer 2007), printed as 2 by 2 foot images and laminated. Farmers were presented with a copy to retain separate from the researcher’s on which responses were drawn. All comments that farmers made while drawing on the maps were incorporated into the qualitative analysis as additional evidence of motivations and limitations.

The polygons showing successes and limitations were then digitized in a geographic information system (GIS). A vulnerability map of the watershed was created using soil data obtained from the Soil Survey Geographic Database (SSURGO), available online from the NRCS (Natural Resources Conservation Service 2007), a 30-meter digital elevation grid obtained from the United States Geological Survey (2007) Seamless Server, and a 2002 cropland data layer obtained from the USDA National Agriculture Statistics Service (United States Department of Agriculture 2002). Only polygons showing impacts and needs related to soil conservation were used for the analysis in order to have a basis for comparison and since this was the concern that farmers most often discussed.

Figure 4. Example of a farmer self-assessment using satellite imagery to indicate locations of conservation impacts. This farmer circled a section of his farm that was uphill from the river and on sandier land, where he said no-till had reduced the amount of erosion that he was experiencing.
I used the Universal Soil Loss Equation (USLE) as a way to capture vulnerability. This equation uses six variables to gauge soil loss, incorporating soil type and structure, rainfall, slope and slope length, crop type, and conservation practices (Table 5). I then compared the mean values of the USLE (measured in tons per acre per year of soil loss) on the entire farm compared to the portion where the farmer indicated having improved soil structure from conservation practices. Finally, I quantified the amount of soil erosion reduced by the use of no-till, the practice that farmers indicated as having the most erosion-reduction impacts, to illustrate how much soil erosion would likely be reduced from this type of conservation practice across the watershed.

Table 5. The Universal Soil Loss Equation in GIS (Jianguo 2007), computed as $A = RKLSCP$ (Wischmer 1954).

| A | The computed soil loss (tons/acre/year) |
| R | The rainfall-runoff erosivity factor (300 for entire watershed, see Jianguo 2007) |
| K | The soil erodibility factor (obtained as a table with SSURGO data) |
| LS | The slope length factor * the slope steepness factor. Computed with GIS using the equation (Jianguo 2007):

\[
LS = (\text{FlowAccumulation} \times \text{CellSize} / 22.13)^{0.4} (\text{Sin.Slope} / 0.0896)^{1.3}
\]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop</td>
<td>C-factor (baseline)</td>
<td>C-Factor (no-till)</td>
</tr>
<tr>
<td>Winter wheat</td>
<td>0.35</td>
<td>0.26</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Other Crops</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Soybeans</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Peanuts</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Other small grains and hay</td>
<td>0.35</td>
<td>0.26</td>
</tr>
<tr>
<td>Other crops</td>
<td>0.5</td>
<td>0.38</td>
</tr>
<tr>
<td>Corn</td>
<td>0.4</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| P | The supporting practices factor: Baseline value = 1 (Jianguo 2007) |
V. RESULTS

Characteristics of Farmers

I interviewed twelve agricultural operators. They were all men, six were older than fifty, six were younger than fifty (four were in their thirties). Two were African American, and ten were Caucasian. One farm was categorized as low sales, three were high sales, and eight were commercial (Table 2). They were all crop farms, varying from 500 - 10,000 acres. All of the farmers interviewed qualified as agricultural producers; they are directly involved in agricultural production and receive 50% or more of their gross income from agricultural production. They are also categorized as agricultural operators, since they make the financial and management decisions on their farms.

Prior Conditions Leading to Conservation

Adoption-diffusion theory suggests that there are prior conditions and characteristics of individuals that lead them to adopt an innovation (Rogers 2003). In this analysis, a farmer’s stewardship ethic was often identified as their motivation to adopt conservation. One important insight obtained in the background information section of each interview was that every single farmer considered himself a conservationist, regardless of whether or not he obtained conservation program payments.

Stewardship motivations were varied. A common one had to do with preserving water quality, possibly due to this region’s cultural ties to the water-related activities such as boating and fishing. One farmer commented on the changes in water quality he’s seen over time: “It’s preserving the water quality that we have. You don’t have a red Roanoke River flowing down here like it used to. I’ve been going on the river a long time and it’s a lot cleaner than it used to be. You used to have 3-4 inches of rain in that river and it would be red, red. It was eroding soil that came down.” Another said: “We just knew we needed to stop farming all the way to the edge of that swamp, to where the edge of that hill was. Once we put those filter strips in, those field borders, the [water] test levels went down unbelievable. The chemicals stay up on the hill, instead of going down into the swampland. I know that was good, because whatever goes out, comes out here [in the Albemarle Sound].”
Another common stewardship motivation was wildlife. Many farmers recalled the disappearance of quail on their farms and were nostalgic for the “quail call in the morning.” This wasn’t necessarily tied to hunting, as expressed by one farmer: “We were just doing things to preserve the wildlife too. I don’t hunt, but I love to look at them. We noticed a tremendous increase in the quail population when we started strip-tilling.” Another commented that incentive payments wouldn’t be necessary to motivate him to conserve: “If I really see the quail come back, then I’ll do it on every farm whether I get paid or not.” Another farmer also liked to look at them: “We hunt ‘em some, but mainly [do conservation] to draw ducks to the farm, so you can see ‘em. I love the visual aspect of it. I love to look at it.”

A general perspective of seeing oneself as a steward of the land or a conservationist was also evident in many of the farmers: “The reason that I went to strip-tilling was certainly economics. But in the same breath, I consider myself a conservationist.” Another said: “If I could pick what’s on my tombstone, that’s what it would be, that I was a good steward of the land. I feel like I’m just as much an environmentalist as anybody, I always have been.” Some farmers saw conservation as an inherited trait: “I never really thought about it. Ever since I started farming, I felt like part of my job was to protect the soil.” Another said: “I’ve always been a conservationist at heart as far as that’s concerned. Because obviously you’ve gotta look after your land, you know.”

Concern for future generations is another prior condition that motivates some farmers to undertake conservation practices: “We want this land to be here and to be productive, and not just for us but for our children, our grandchildren, their grandchildren and right on if they gonna use it. It’s not here today and gone tomorrow. You gotta look ahead.” Another commented that: “We were doing [conservation] to preserve the land. I’m the fourth generation here, my son’ll be the fifth generation and hopefully there’ll be some more. And if we don’t take care to preserve it, it won’t be here. Conservation’s very important from the standpoint of being able to pass on what we have in better condition than how we received it ourselves.”

Another prior condition influencing knowledge and opinions about conservation practices came from individuals outside of the community or external forces such as government regulations. For instance, the Highly Erodible Lands (HEL) legislation that was
enacted in 1985 required farmers to address soil erosion on identified areas (Food Security Act, 1985). Another major factor was the influence of the Natural Resources Conservation Service district conservationist (DC). Nearly every farmer interviewed in one DC’s district mentioned that he was a direct factor influencing their decision to adopt conservation. It was clear that the DC played a significant role in motivating adoption in one district far more than others. This was evident from one farmer’s comment that: “I farm here in Halifax County, I also farm in Northampton; and Halifax is a more progressive conservation tillage and no-till county. So when I jumped over in Northampton County that first year and did it as well and everybody saw it, and a lot of those guys hadn’t seen it as much. I bet 5 neighbors did it the year after I did it. And I had one of the best cotton yields that year. That helped too, that you were doing something completely different and you happened to hit it pretty good as well.” This also illustrates how farmers bring knowledge and information to each other in the diffusion process.

One farmer attributed his conservation ethic to his wife: “I’ve always been somebody that tries to look after the land, but [my wife’s] an environmentalist. It’s just little things, I’ve become more aware that everybody does a little bit to help. So, I’m gonna have to give her some of the credit for that.”

Since most farmers do not own most of the land that they farm, but instead rent it, landowners were another external influence. More commonly, landowners arose as a limitation to conservation, but when it came to the aesthetics of the farm, conservation practices that had aesthetic appeal were done to appease the landowners: “To be honest with you, I know some landowners that ride by and say ‘well this guy’s farm looks good compared to this guy. He just disked his farm and there’s water standing everywhere. Landowners tend to like farmers that look after their stuff more. Especially ones that live on the farm and have to look out their back door at it every day.” Another made a similar comment: “[Conservation], that’s been one of the things that we’ve been able to do, in renting land, the landlords we have like what we do because we tend their farm the same as we tend our land. That’s helped us a lot.”

One additional prior condition that led to adoption was a growing concern about the future of the Farm Bill programs. Several farmers commented on their expectation that conservation programs might replace income support. This was a motivation for several of
them to increase their capacity to undertake conservation practices: “It may be that the farm program may shift more toward conservation payments than commodity payments. So, in the same process, I’m training myself, trying to get familiar with and being ready to make that move if it shifts that way.”

Was there a moment when the farmer first considered himself a conservation innovator?

The answers to this research question were strikingly similar. As previously mentioned, every interviewed farmer considered himself to be a conservationist, regardless of whether or not he was a recipient of conservation program funding. Furthermore, most of the farmers recalled the adoption of conservation tillage as the point at which they saw themselves as conservationists (this was also the most frequently discussed conservation innovation). Another striking element of this recollection was that this occurred for farmers anywhere from thirty years ago to only three years ago.

One of the farmers recalled his first conservation innovation as follows: “Way back before people knew what no-tilling was about, this was about 30 years ago, we used to plant a lot of wheat down in our lowlands. We probably planted more wheat than anyone in the county. We were trying to plant beans behind it. We had some planters that you could call no-till back then, which is nothing like no-till now. We tried to use those. We planted in wheat stubble… and we’d have to burn it, it was terrible. We got away from it finally, but that was our first encounter with no-till. When I really got into no-till it was some time in the 80s. When all these rulings came out about how we’re ruining the land, we had some [highly erodible land] and I thought ‘this is gonna be awful, we’re gonna have to do contouring all over’ but I thought I’d tried the no-till. I tried it on about 20-30 acres the first year and it did work really well. The next year I jumped it to about half my acres and then the next I did all of it. I’ve been doing it ever since.”

A younger farmer described a similar experience: “I think it was ‘97 when we started strip-till. We did half conventional and half strip-till. That was a dry summer and we saw the benefit immediately, the first year. So, we basically haven’t conventionally tilled any land since then.” Another said that he first thought of himself as a conservationist “about 3 years ago, when I bought my no-till planters.”
What aspects and perceptions of conservation practices motivate farmers to adopt them? What aspects and perceptions limit them from adopting?

As previously mentioned, relative advantage, compatibility, complexity, trialability, and observability of innovations are all characteristics that influence the process of adoption. Farmers’ perceptions of innovations can have both a positive and a negative influence on the decision to adopt.

1) **Relative advantage** was defined previously as the ratio of benefits to costs of an innovation, which can include things like time-savings, reduction of discomfort, social prestige, and actual economic benefits. Relative disadvantage can include things like delayed rewards from an innovation or reduction of social prestige.

a) **Benefits from Relative Advantage**

**Soil Conservation**

Soil conservation was one of the primary issues that farmers commented on when discussing their motivations to adopt conservation practices. This motivation was relevant to a variety of conservation practices, such as field borders, grassed waterways, and conservation tillage.

One comment that illustrates how central soil conservation is to farmers’ perceptions is: “we’ve had field borders and turn rows forever. I was brought up that we didn’t let the land erode and wash away and… that you can’t farm right up to the ditch. So you left turn rows to preserve your land. It’s been a way of life for me.”

Soil conservation motivations are based not only on lessons from fathers and grandfathers, but also on a view toward the future: “For Pete’s sake, we’re not in it for two days or two years. Most farmers are in it for the long haul. If you lose your topsoil, your organic matter and humus, you’re in bad trouble.”

The visual experience of seeing soil erosion reduced was also an important element of the soil conservation motivation. Several farmers commented on how disturbing it is to see their soil washing off their land. This stems from the loss of their most precious commodity, the soil, rather than concern for water quality. One farmer explained his motivation for
grassed waterways as: “I’m working the same topsoil as I worked last year, it’s not all down in the swamp.” Another made a similar comment about no-till farming: “I could tell a big difference by what’s in the ditches and what’s in the riverway.” Another said: “After it rains, the sedimentation settles out in that grass and you can hardly drive around it. That shows how much it’s preventing the stuff from running off the field.”

Several of the farmers expressed a willingness to trade economic profits for soil conservation. One commented that: “You’re taking up more space, but you’re slowing that water speed down to stop erosion. You lose some ground, but you save topsoil and nutrients.” Another shared a similar sentiment: “I lose a little cropland, but I gain by not washing the ends off.”

Soil Quality

Soil quality is another biophysical motivation for conservation practices. Farmer comments about soil quality had to do with building up the soil, rather than preventing its loss. Most of the soil quality motivations were realized through conservation tillage practices as well as cover cropping.

Several farmers described the land becoming more “mellow” from reduced tillage practices. One explained the benefit as: “As the soil gets more mellow, it can hold more fertilizer. More moisture. Less runoff. Less erosion.” Farmers also discussed building organic matter and “opening up” the soil as the motivation: “It’s a real slow process to build back this organic matter. But it works and it’s got the land opened up and full of capillaries and things. It’s good and it holds things together.”

Many also referred to soil quality in a broader sense: “As far as organic matter, your pH is up good, everything’s probably in better shape than it’s ever been as far as the land itself.” Another said: “I reckon conservation is more for the land, isn’t it.”

Reduction of Cultivation of Unproductive Land

Areas where the soil quality was not good on the farm were also targeted for conservation practices. Both in background research and interviews, farmers continually commented that areas where they were doing conservation were on previously unproductive land. This was a motivation for a variety of conservation practices. One farmer mentioned
that he put field borders in because the area shaded by the trees on the edge of his farm was not productive: “Around the ends, if you’ve got a lot of large trees, there’s gonna be a shady area where you’re not gonna get a lot of production anyhow. And so, I feel like it’s a break-even thing. If anything, it’s an asset rather than losing money on it.”

Wetlands, pine tree plantations, and Conservation Reserve Program (1985) easements (15-30 year contracts to allow hardwood trees to grow up on the land) were also common conservation practices on unproductive land. One farmer had an economic perspective on this: “The rent on that farm was about 80 bucks an acre. The government’s paying you 50 bucks not to work it. But it really wasn’t all that productive anyway. These spots, I said ‘hey, I will put these in the bird program if you’ll approve them.’ Like this is a real wet area, maybe one out of three years you might pick that crop anyway.”

*Increased Crop Yields*

Increased crop yields were also important. This was the deal breaker for one farmer who was skeptical about no-till before trying it: “I’ll tell you what, I think we’ve got less problem with insects and diseases, both. It was contradictory to what we thought was a good thing for years and years.”

One farmer suggested that all of the conservation practices were improving yields: “The conservation stuff helps you to work in a way that you could produce more crop off the land. You’re getting rid of the low spots, you’re keeping your crop from drowning.”

Another commented on the tradeoff between the costs and benefits of using a cover crop with no-till, saying: “The root mass and what it does for the soil, as far as loosen up the soil, helps our yields with cotton. So that’s why we make that investment.”

*Time and Labor Savings*

Conservation tillage provides a relative advantage in terms of time-savings and reduction of discomfort in terms of labor. Reduced tillage means fewer passes over the field, since it involves planting seeds directly into the stubble left from a cover crop or last year’s crop. The reduced trips over the field not only save the farmer a great deal of time, but also save tremendous amounts of fuel: “In ’06 is the first year that I went 100 percent strip-till
in cotton. I guess that’s certainly a conservation measure. But, economics, mostly, dictated that. Instead of 7 trips over the field, you make 2, you know.”

Another motivation for conservation tillage, as many of the farmers talked about, was being able to get out on the field after a rain: “When you have no-tilled for a few years, it starts having a tremendous effect on the absorption properties and absorption giving properties. You can go out and get on a field, usually if it’s rained an inch or so, you can get on the field in a day. If you’re in conventional tillage, it’s more like 3 days. I got stuck once this year, all the people I know have been stuck every which way.”

A few farmers talked about how the cost savings from no-till were so significant that if they had to revert back to conventional practices they would go out of business. One commented that: “No-till is cutting costs better than anything.” Another said: “It saves a whole lot of time. We work give or take 1800 acres and it’s just me and one full-time employee. When I was a small boy, my father was working about 600 acres with 4 people. So, we’ve tripled our acreage and cut our workforce in half. It doesn’t take long to do the math on that.”

Economic Profits

Some farmers had purely economic objectives for doing conservation: “If you don’t use conservation practices, I don’t care whether they’re dictated to you or not, if you don’t use conservation practices you’re gonna hurt from it sooner or later.” Another commented that: “[Conservation and economics] almost go hand-in-hand. It seems like everybody wins. I win by saving fuel. The consumer wins by the water quality and everything being better. So, I guess it’s one of those win-win situations.” Another commented that: “Everything we do that’s a conservation practice, more or less, we can see an economic value from it too. Where it’s not hard to look and see that no-till land with a good cover crop on it does better than no-till land without cover crop. That’s why we make that big investment every year. We actually have an airplane fly our cover crop on every year before we even pick soybeans or defoliate our cotton.”

As already alluded to, reduced tillage in particular, provided significant economic benefit to farmers: “The strip-till saves you time and saves you fuel. I have always seen it as
improving my bottom line. Because the strip-tillage has cut my fuel use in half. At one time we were using approximately 10,000 gallons of diesel fuel. Now we’re using 5,000, roughly. That helps in more ways than you realize.”

Cost-savings were also the motivation for one farmer to reduce chemical applications to his field: “We do anything we can to cut production costs. The way that we do it, there again on the environmental things, we spray the least amount that we have to.” Others expressed frustration at the stereotype of farmers spraying excess chemicals on their fields, commenting that these inputs are far too expensive to waste: “What commercial fertilizer costs, you sit down and watch it all blow down into the swamp and I can’t stand it.” Another commented on the economic balance of chemical inputs to yield outputs: “We don’t farm with the Cadillac approach. I guess I use the Ford / Chevrolet approach, whatever. In other words, I don’t use the ultimate approach. Take peanuts, for example, some people use all kind of fumigants and such, they have to because of the soils. We don’t. Our inputs are low, our output is not as high, but when you draw the bottom line we’re probably just about as good as everyone else.”

Monetary incentives provided another economic benefit. Certain programs were noted as creating an incentive to undertake conservation that would otherwise not have been adopted. This seemed especially relevant to programs for wildlife: “So much of this conservation, people think is free money, but it gives you added cost. The wildlife bundle on CSP, we’re putting in a cover crop, is expensive. We’re getting an airplane to come in and fly it on. You’ve spent $12-15 per acre to put out that cover crop.” Another said about the state quail habitat program: “CP-33’s a good program. Nobody would leave out that amount of land without an incentive payment. The CP-33, was purely the money they pay you to plant those strips. We’ve always planted some stuff for the deer, but not on that kinda schedule.”

One farmer, who worked 10,000 acres, noted that the monetary incentives can be maximized with crop subsidy payments so that once a farmer reaches his maximum on subsidy payments, he can take out the rest of the land and get conservation payments on it: “Say I’m working 500 acres that I’m not getting a payment on, because the first 9,000 I’ve received all the government will let me have. The other 500 I’m working for the fun of it. So, let’s put the bird sanctuary here, and let’s put this program here, and get some type of
payment off of it.” This farmer only sought payments for conservation after he had reached the limit of subsidy payments that he could receive for growing crops. Since conservation payments are less per acre than crop subsidy payments, this farmer was prioritizing the subsidy payments over conservation.

b) Limits to Relative Advantage

Time

Even though time savings was a relative advantage from many of the working lands practices like no-till, time expense was a limit to some farmers for other practices, particularly for things like grassed waterways and field borders.

Delayed Returns and Doubt about the Future

Another limit to relative advantage was doubt about the future of farming. One relative advantage that has been highlighted in past research is the immediacy of rewards. This can also be explained as a limit to conservation if the rewards are delayed. Conservation practices are inherently long-term and farmers pointed this out as a limitation: “I think one of the limiting factors for some of the people is that they’re just in it for the short term. You have people out here that are farming solely on a dollar/cents basis.” Another said: “When you say future generations in farming, hoo-wee. They’re an endangered species if there’s ever been one.”

A related factor is the risk inherent in farming: “Farming has changed so much. Everything’s so high tech. There’s not as big of a return in farming as it was when I came back from school. As when I came back to farming. Your profit margin is very slim, your investment is magnum high, my equipment is 10 times more than it was when I came back. It’s a good life, but it’s so weather related now, things are changing so fast. It’s just not what the profit margin used to be. It’s a risky business.”

Lack of social prestige

Lack of social prestige may also be a limitation. One farmer commented that: “We’re a throwaway society. If we can throw it away, we will. Including farmland.” Another stated
more directly: “It’s sad to say, but a lot of people don’t feel like they need us.” If farmers perceive themselves as playing an unimportant role in society, they are less likely to adopt technologies that benefit society such as conservation practices due to a lack of social prestige.

*Land Ownership*

Land ownership was one of the dominant reasons cited for not undertaking conservation: “It gets back to renting land. People’ll come in here and pay top dollar for a piece of land, pay more than it’s worth, and they can’t do the extras. If you’re renting from a landlord that cares about his farm, he would rather take a few dollars less in rent and do the things that need to be done. That’s why you see a lot of it, folks not caring to get into the conservation practices. Some landlords’ll only rent for a year or two years. You can’t do much to land if you don’t know you’re gonna have it again.” Another shared a similar sentiment: “It might sound greedy of me, but if I don’t own the land I don’t like to do but so much to it. Because, it seems like a lot of my landlords are just money hungry, to be quite honest. Any work that I do, at the end of the three year lease if they don’t want to renew, I’ve done something for somebody else, so to speak, I guess.”

One farmer gave an example of experiencing this disincentive: “I’ve had farms that I’ve gone in, put my bulldozers in, built roads in, at my expense, cleared up hog lots in, put in drain tile, at my expense, to make the farm better, and then, when you get it done, somebody come along and say you’re paying $50 an acre of rent, and somebody come along and says ‘I’m gonna pay you $60 an acre of rent’. And then, they say, ‘well golly-dad, they’re gonna offer me $60 dollars’. And they don’t think about the $4,000 that you spent on getting their land looking good. Not everybody’s like that. But, a lot of people are. You’ve done the things that make it a better farm. You’ve done the things you were supposed to, because you’re a steward of the land. Then they rent it out to somebody else, and most of the time it’s the guy that’s not gonna do that, because he’s gonna pay more money.”

Land ownership is also a tremendous obstacle to obtaining incentive payments for conservation. Since many of the conservation programs require landowners to sign contracts, which necessitate long-term leases, the farmer is often unable to negotiate the longer lease and therefore unable to obtain the contract. One farmer commented: “I hate to say that, but
the leasing issue is a big issue. If you can’t control the land that long, for long-term conservation practices, you can’t sign up for them.” Another farmer commented that: “Look if you sign a 7-year agreement that you’re gonna strip-till, you don’t know that you’re gonna work that farm 7 years. And to go explain it to the landowner, that ‘hey, I need you to sign up for this 7-year…’ most of our landowners are little old ladies that, they don’t comprehend it.” Another farmer shared a related sentiment: “For the most part, to be honest with you, it’s just a matter of rocking the boat. I know my landlords and I know that right now is not a good time, unless it was going to be completely no cost to them at all, I don’t think it’s a time to approach them. They’re so frustrated with the income off the farm anyhow. We all are.”

Another concern is that the landowner will try to take the incentive payments for himself: “Last time I talked to fellow farmers about CSP one of the main things they was worrying about is the landlord wanting the payment, when the farmer was doing the work. And that’s a big issue here.”

**Reduced yields**

Several farmers thought that either perceived or actual reduced yields limited some farmers from adopting conservation tillage practices on their farms: “You’ve got to make the same yields that you are in conventional till. And then have the labor savings and the equipment cost savings and the number of trips across the field. There are several people out there doing no-till that aren’t making the yields to stay in it.”

One farmer acknowledged that he might eventually get increased yields, but couldn’t afford the lag time: “Everything I’ve read about no-till, the first year or two you’re gonna have reduced yields. I can’t farm with reduced yields, it’ll put me out of business.”

**Cost**

In contrast to the comments related to cost-savings from many conservation practices, there were also comments about increased costs. In particular, this was related to start-up costs of purchasing equipment. One farmer said: “Purchasing the equipment that it takes to no-till or strip-till, that’s probably the biggest set-back. The ones that I talk to, they really want to go no-till or strip-till, but they don’t have the equipment to do it.”
Another farmer commented that: “Unless it would be cost-effective for me, and when I say that, I mean that it would not cost me a lot of money or would pay me back in a lot of time, I wouldn’t even do it on my own land. The marginal profit right now is too close.” Another shared a similar sentiment: “I’m speaking about land that I rent, it’s certainly not worth it to me to rent land and put it into a program that pays me nothing. Land that I own, may be a different story. But it’s all about the money really.”

Another farmer didn’t see conservation as inherently advantageous: “Everything’s an economic decision. [Conservation] has gotta make sense economically, ‘cause it doesn’t do us any good if it puts us outta business. We wanna do as much conservation as we can, but at the same time we’ve gotta stay in business.”

**Market forces**

Certain market forces also limit conservation practices. One farmer said that peanut shelling factories are no longer accepting no-till peanuts because the peanuts are “full of trash” (or contain more roots and debris than conventional peanuts). Another farmer commented that his conservation was dependent on commodity prices: “If cotton was $1/pound, I wouldn’t sign up for none of this. I’d be planting cotton everywhere I can. With commodity prices low, and the government’s got this conservation program incentive, then it’s more attractive than it would be with commodity prices high.”

2) **Compatibility** was previously described as the degree to which an innovation fits with the needs, existing practices, and values of the farmer.

a) **Benefits to compatibility**

Several farmers commented that they do the same practices on non-CSP land as they do on CSP land, saying: “Once you set up your operation to go one way, you’re pretty much gonna do it everywhere.” Another echoed this: “I work every field the same. Even the land I don’t own is getting worked no-till or strip-till.” This seemed to relate more to working lands conservation practices such as no-till, compared to structural conservation practices such as vegetated waterways and field borders that farmers limited to the land that they own.
b) Limits to compatibility

Resistance to Change/Traditional Values

Resistance to change and traditional values were two frequently mentioned reasons to not adopt: “I think the main factor is: ‘Hey, I’ve done it this way all my life. My daddy did it this way. A lot of them are stuck on a format that they’ve done for all their life. It’s hard to change. And it is hard to change, if something’s been working for you.’” One farmer thought that the older farmers were more stuck in their ways and commented: “They’re like 65 and it’s just the way they’ve always done it. This one guy in particular that I’m thinking of, he’d rather be on that tractor, disk ing and doing this stuff, than anything else in the world. And it’s not gonna make him any more money. It’s costing him money. He’s spending more money per acre than I am.”

Several farmers commented about this trait in themselves: “I just do what I want to do. I don’t go out and make drastic changes.” Another said: “It’s human nature, people don’t like change, especially with farmers. Me, I can speak about myself, daddy did it this way, he always did it this way and it worked.” Another commented on this about conservation tillage equipment: “Some didn’t want to get the new equipment. Some of us fear doing something new.”

Others attributed resistance to other cultural traits, for instance one farmer thought that women landlords were a barrier: “The girls are more interested in developing the land. They’re just not interested in taking care of the land, it’s just not one of their priorities.” Another thought that a culture of fishing and hunting was an important part of the stewardship ethic of farmers: “Some of your farmers, they didn’t hunt. They weren’t hunters and fishermen. My dad taught me to hunt and fish, I taught my son. That’s our goal, to work that end, whereas their goal is to maximize profit on every acre that they can maximize on.”

Resistance to Incentives

One farmer expressed some disdain for other farmers who accepted conservation payments (he did not participate in any of them) and said: “[Government money] is not my motivation. I don’t participate in that. It is [the motivation] for some, anyway.” Another said: “The farmers would be doing the same thing if, well most farmers really don’t want [the
payments]. They’d rather see it where they could do all these things to their farm that they wanted to: fences, pay for their own waterways, put in new shelters and things of that nature. They’d rather be spending their own money.”

Another concern was about the stability of support from the conservation programs: “Well, like anything with the government, the money’s not always there. It may be there the first year, but not the rest of the years when you need it to be.”

Concern about External Influence

Farmers had various concerns about enrolling in conservation programs. One was a concern that they would be overly regulated, such as this farmer’s concern over being able to fix ruts on his land if needed: “They were saying that if you disked your land you’d have to pay the money back that you’d received. That was a hoopla for a bunch of people. That may keep people out.” One commented that: “Let’s face it. Farmers are independent, that’s the reason we farm. I think that’s a good thing, in some respects, because if we don’t look after ourselves, nobody else will. I think anybody that farms for themselves or works for themselves, would be very reluctant to have somebody come in and say ‘you’ve got to do this, or you’ve got to do that.’ Particularly on a timely basis. I don’t mind suggestions, but I don’t want to be told what I got to do. My father always said ‘you can lead me a long way, but don’t try to drive me.’ That’s pretty much the way I feel.”

Others attributed this sentiment to older generations: “I think the older generation of farmers would give up on it faster. They’ll just say ‘Ah, the hell with it. I ain’t havin a bunch of people coming out to my land telling me what I can and can’t do.’”

Another farmer was going to drop out of the CSP program because of the bureaucracy. He commented that it was too complicated and he hadn’t been fully informed about the requirements before signing up and would be “glad to get out of it.” Others complained about the instability of program payments. Another said that he hadn’t enrolled because: “It’s back to that thing, that I was saying about a lot of paperwork and things like that. It’s just that, you know, we’re already implementing it on our own enough. I feel like I’d rather do the job that we’re doing, we’re following the guidelines that we think is good for our land, instead of somebody coming in and telling us, ‘well you need to do this’ and we
know what’s gonna work on our land. We’ve experimented enough to know what works on our land. We’re satisfied with what we’re doing on our land.”

*Less Need*

Another barrier to compatibility is the amount the farmer needs the conservation innovation. Farmland varies and a farmer with lowlands or highly erodible soil has a greater need for conservation practices than a farmer on high, fertile, flat land. This was reflected in some of the comments: “In some areas where they just don’t really need [reduced tillage] quite as bad, maybe where it’s flat, maybe it’s not as important as on hilly land or land with an incline where you get more runoff.” Another said: “It might be that they’re in an area where their land dries real quick. They can go back and get on it tomorrow when it rains. That is the reason that I would think.” Another farmer commented on this about himself: “We don’t strip till, because our type land is a quick sandy base and we’ve got to irrigate it at least a little bit.”

There are also crops that are less conducive to certain conservation practices: “It’s hard for a tobacco farmer or a vegetable farmer that relies on tillage. There have been folks that have tried no-till tobacco and it has failed.” Other physical variables also limit conservation, as illustrated by this farmer: “We never did cover crop. We have a problem down here getting the wheat in. The field was so wet, you couldn’t get out there to put it in.”

*Farm Size*

The size of the farm impacts the adoption of conservation practices. The farmer with the largest amount of acreage of those interviewed (10,000 acres) noted that: “When I make a mistake, it’s a big mistake. It’s a $100,000 mistake. Whereas if I’m kind of following and it’s proven that it works, then I say ‘I know it works’ and I can slowly shift to that kind of operation. I have to be real careful about jumping on.”

Some farmers perceived this as a limit to others: “You take a farmer that’s farming 1,000 acres, he can look after it. A man that’s looking after 10,000 acres, he can’t put the time and I don’t think he can have the management.” Another said: “People that’s tend a lot of land are stretched out.”
Farm Structure

The structure of the farm also influences adoption. One farmer commented about his own farm that: “In most cases, it’s bigger, open land that’s easier to work with than what we’ve got here. In most cases they own their own land or have a longer-term lease on it. It makes it easier to work with, so they can invest a little money of their own.”

Another commented that the conservation itself can detrimentally impact the farm structure: “Probably, I would say, when you’ve got a big field and you have to divide it back up. It’ll make it into smaller fields. It’s not as economical to farm, it’s more time consuming. More maintenance. You’ve got to devote your time and your money to the things that, in other words, I think I’m better off doing it along the edges than I am in the middle of my field, because it’s easier to maintain around the edges than through the middle of the field.”

3) Complexity is the degree of knowledge and technical understanding required for implementing an innovation. Understandably, this serves as more of an obstacle than a benefit. In fact, none of the farmers mentioned lack of complexity as a factor motivating them to adopt conservation practices, but there were some limitations related to complexity.

a) Limits Related to Complexity

One of the limits related to complexity mentioned by farmers was integrating new equipment in order to undertake certain conservation practices. This was particularly relevant to reduced tillage, since farmers had to make tremendous changes to their equipment and to their planting and harvesting practices to undertake reduced tillage. Several commented on this limitation: “With no-till you have to [adjust equipment] more. This is one reason why a lot of farmers don’t ever want to get into no-till. Some people think it’s a big equipment decision.” Another commented that: “Strip-tilling, some of the draw-backs is changing your equipment. You going from a disk and bedder, you’ve got to trade all that in and buy these new strip-till rigs.”

Another provided a good illustration of the difference in complexity between a conventional tillage system and a conservation tillage system: “See, when I’m plantin’ I
might have a man run the planter, but I’m there behind him all day making sure that when conditions change, I change the unit, and I change the planters. With a conventional system, all you gotta do is go out there, and no matter what the field conditions are, you just go plant it. When it comes to planting, [conventional] is easier.”

Some farmers said that certain concepts don’t make sense to farmers. One commented about cover crop that: “Some people have a hard time with spending $13/acre in the fall on grass on the land that you’re gonna kill. That concept doesn’t make sense to them.” Another commented similarly the fear that biodiesel will add complexity to their operation: “I think people were afraid at the beginning that you were gonna have to change so much stuff and that the tractors were gonna be different, but it’s the same thing. They pump it in the tank and you wouldn’t know the difference.”

4) **Trialability** describes the degree to which an innovation can be experimented with on a limited basis. This serves as a benefit when it exists, but as a limitation when an innovation must be fully adopted at the start.

a) **Benefits from Trialability**

As previously discussed, the conservation tillage movement has been influential on farmer awareness of conservation, but it also provides an example of how conservation tillage caught on because of its trialability. Farmers repeatedly mentioned how they tried the reduced tillage on smaller number of acres, then ramped it up to the rest of the farm after seeing it succeed.

5) **Observability** is the degree to which an innovation and its benefits are visible. However, observability can also impair perceptions of an innovation.

a) **Benefits from Observability**

Visual aspects of conservation practices often arose as important characteristics of conservation. One farmer said that what finally convinced him to adopt reduced tillage practices was observing them in other people’s fields: “I saw it working for other farmers, the strip-tilling. It was almost like I had to do it to survive. Really, seeing other farmers do it,
yeah. But that too is the same thing as these programs staring you in the face. You ride by and you see your buddy out there strip-tilling, then you get to these meetings and these roundtable discussions, and they talk about how great it is when they do this and that. The more it’s talked about, the more it’s practiced, the more it catches on to the slow ones like me.”

Another commented on a shift in perspective leading him to adopt conservation tillage: “I used to think it was just wonderful to see a freshly plowed field a long time ago. It looked like a picture out there. When I first started no-tilling, and other people looked at it too… I mean, that’s terrible looking stuff out there. Man, it looks pretty to me now. And the other, I think, people are crazy to do that. You know, they’re gonna lose all the soil and everything else. So, what used to look good to me, does not look good to me anymore and vice versa. And it’s because of knowin’ what the end result is gonna be.”

Visual aspects of other types of conservation were also a motivation, such as planting trees: “Those pine trees over there are ready to be harvested, but we’re not harvesting them because we like the way they look.” One farmer did a lot of motor oil recycling and trash recycling: “I just don’t like to ride around and see paper and trash all over the farm.”

b) Limits from Observability

Perceptions related to the observability of an innovation can also be a barrier. This is especially evident with no-till. Farmers often commented on how it looked “trashy” or “messy.” For instance, one farmer commented: “I like [conventional tillage]; it looks pretty. And that doesn’t look pretty over there, it’s full of trash. But it’s not trash, it’s what’s gonna be organic matter and it’s stoppin’ all kinds of things from happenin’.”

One of the younger farmers commented that this perspective is especially predominant among the older crowd: “As far as no-till, there are a few hard-core farmers that do not like the way no-till looks. I caught a lot of flak when I went to Northampton County and started doing that kind of stuff. And a lot of people talked trash. They thought it was lazy farming and just kinda tacky looking. So, you had those conventional ideas of the way it should look. That’s a barrier for some people, especially the older crowd.” Another echoed this idea: “People would sit around in the store saying ‘yea, that looks horrible, I
wouldn’t have that mess on my farm.’ The guys that did it was braggin’ about it, the guys that didn’t want to do it was fussin’ about it.”

Another talked about the change in perspective that comes from understanding the benefits of no-till: “It was a hard transition to go from a cultivated crop to a non-cultivated crop. It was a night and day difference. But now, we don’t see that anymore. It’s real strange for us to go somewhere now and see disk ing and breaking. Before, when you rode down the road, and sure you knew the wind was blowing and the soil was moving, but it didn’t make the impact that it makes on us today. We know what we’re losing now. I think that if they could ever see and understand that it will work. I think so many of them are like I was. It takes acceptance, but it works.” Another made a similar comment: “A lot of people can’t get past that first stage of planting no-till. If they can get their mind past that first stage, they probably would love it.”

Another farmer expressed his dislike for field borders that function as wildlife habitat: “We’ve got some people in the neighborhood, they basically do nothing. They don’t even mow the hedgerows on some of the farms. Which I realize now, for the wildlife, recommend leaving one side of the ditch one year, then letting it grow up, then mowing it down, for the quail and what have you. That’s not really feasible for us. I reckon it comes down to pride, pride in your farm.”

**Summary of Perceptions**

Table 6 summarizes the positive and negative influences that each of the five perceptions of innovations had on farmers’ decisions to adopt conservation practices in these case studies. The negative influences from perceptions were more numerous than the positive influences, however this does not suggest that these were more dominant. Some aspects were mentioned in only one or two case studies. The practices that were most prevalent, those underlined in the matrix, could be categorized into three areas: biophysical aspects, social aspects, and economic aspects of the farming operation. The biophysical aspects were dominant. Things like soil quality, soil erosion and visual aspects of the farm landscape had strong influences on farmers’ perceptions. Social elements, such as land ownership relationships and traditional values were also important influences. Economic
aspects were related more to labor and time-savings, and the immediacy of benefits that were obtained from using conservation practices, rather than direct economic profits.

Table 6. Matrix of positive and negative influences of Rogers’ five perceptions of innovations on farmers decisions to adopt conservation innovations. Those perceptions that farmers discussed the most are underlined.

<table>
<thead>
<tr>
<th>Relative Advantage</th>
<th>Positive (+)</th>
<th>Negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Soil quality</td>
<td>- Time</td>
<td></td>
</tr>
<tr>
<td>+ Soil conservation</td>
<td>- Cost</td>
<td></td>
</tr>
<tr>
<td>+ Unproductive Land</td>
<td>- Reduced yields</td>
<td></td>
</tr>
<tr>
<td>+ Increased crop yields</td>
<td>- Land ownership</td>
<td></td>
</tr>
<tr>
<td>+ Time and labor savings</td>
<td>- Market forces</td>
<td></td>
</tr>
<tr>
<td>+ Economic profits</td>
<td>- Delayed returns</td>
<td></td>
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<tr>
<td></td>
<td>- Doubt about future</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Lack of social prestige</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Resistance to change/traditional values</td>
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<tr>
<td></td>
<td>- Resistance to incentive payments</td>
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<tr>
<td></td>
<td>- Distrust of outsiders</td>
<td></td>
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<tr>
<td></td>
<td>- Crop type = less need</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Soil quality = less need</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Farm size</td>
<td></td>
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<tr>
<td></td>
<td>- Farm structure</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Compatibility</th>
<th>Positive (+)</th>
<th>Negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Easier to work all fields the same</td>
<td>- Learning new equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Increased farmer involvement/labor</td>
<td></td>
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<tr>
<td></td>
<td>- Learning a new system</td>
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<table>
<thead>
<tr>
<th>Complexity</th>
<th>Positive (+)</th>
<th>Negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>There were no perceived positive aspects related to complexity of an innovation associated with adoption.</td>
<td>- Learning new equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Increased farmer involvement/labor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Learning a new system</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trialability</th>
<th>Positive (+)</th>
<th>Negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Being able to try no-till on part of the farm before using it everywhere</td>
<td>There were no perceived negative aspects related to a lack of trialability.</td>
<td></td>
</tr>
<tr>
<td>+ Not seeing soil erode off the land</td>
<td>- Perception of “trashy” or “messy” landscape</td>
<td></td>
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<table>
<thead>
<tr>
<th>Observability</th>
<th>Positive (+)</th>
<th>Negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Visual sight of wildlife</td>
<td>- Perception of looking lazy</td>
<td></td>
</tr>
<tr>
<td>+ Seeing other farmers use conservation</td>
<td></td>
<td></td>
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</tbody>
</table>
The category of relative advantage had the largest number of variables in both the positive and negative categories; the range of comments shows how much influence this type of perception has on farmers’ decision-making process. Compatibility perceptions included a diversity of negative influences, but had only one positive element, suggesting that it is perceived more when it is a problem, but possibly taken for granted when it isn’t. Trialability was not mentioned with regard to negative influences and was only mentioned briefly related to a positive element. Complexity was only mentioned as a limitation. Similar to compatibility, complexity may be perceived only when it is a problem. Observability had both positive and negative influences on adoption and, like relative advantage, dominated discussions.

**HOW DO FARMERS ASSESS THEIR CONSERVATION SUCCESSES AND OPPORTUNITIES?**

After reclassifying extreme values of over 250 tons per acre per year to 250 (these extreme values may have resulted from ditches on the landscape, but they only occur on a small number of cells and have very little impact on the watershed average), the mean erosion rate under baseline (conventional tillage) conditions was 4.18 tons per acre per year of soil loss. This is considered to be a relatively low rate of soil loss (Ontario Ministry of Agriculture 2000). Under a reduced tillage system, estimated as having a 25 percent reduction in the C-factor of the USLE (Wang and Cui 2005), the soil loss rate was 3.35 tons per acre per year. This is an average reduction of 0.83 tons per acre per year, which amounts to a reduction of 249,000 tons of soil per year when extrapolated to the 300,000 acres of cropland in the watershed. This provides a general idea of how much an innovation like no-till can benefit environmental quality, in particular water quality, since sediment transports pollutants into waterways and causes turbidity that impairs aquatic habitat.
When comparing mean erosion rates on fields that farmers had targeted for conservation practices, to whole farm means, some of the fields that farmers chose had higher mean erosion rates than the whole farm mean, but some were the same or even lower (Fig. 5). On some farms, one of the fields targeted for conservation might have a higher than average mean, while another field targeted for conservation on the same farm might have lower than average mean, suggesting that variation in farmers’ skill at identifying erosion “hot spots” does not explain this pattern (Fig. 6). Perhaps farmers are not targeting the most erodible fields for conservation, or perhaps they are, but using cues that are not captured by the factors in the USLE equation.

Figure 5. Soil loss (tons / acre / year) as estimated by the USLE for the whole farm ( ■ ) and for fields targeted for conservation ( ▲ and ◆ ). USLE values over 15 are categorized as “severe” (Ontario Ministry of Agriculture 2000) and are therefore truncated for graphical representation ( ▲ ). These are descriptive statistics only and do not imply a test of significant difference.
Figure 6. Example of a case study using the Universal Soil Loss Equation to compare the mean rate of erosion (in tons/acre/year) on fields that farmers identified for conservation (outlined in gray) compared to the entire farm (outlined in white). The northernmost farm has a low erosion rate and one of the two conservation “hot spots” is higher than average, the other is lower than average. On the other farm, the two “hot spots” are slightly higher than the whole farm mean.

Do green payments increase conservation adoption?

All six of the interviewed CSP recipients explained that they had changed very little about their farm operation, or nothing at all, to qualify for the CSP. The program mission, as previously mentioned, is to “reward the best and motivate the rest.” From the comments gathered, it seems to be accomplishing this objective. The following comments illustrate the changes made by CSP recipients in order to qualify for the program:
Farmer A

“The only thing I hadn’t done was the cattle on my own. I had cattle on the farm. In order to keep the cattle and go to tier 3, I had to put the pasture into quarters to rotate them. Well, I started to do that and then at the last hour I decided not to do that. The more I thought about it, the less I thought of doing the job of fencing everything and all that kind of thing. I just got about enough of that. I don’t want to fool with it. They’re off the farm, so I’m out of the cattle business. Some of the field borders before I got in the program were not as wide as what I have now. But I have a lot more than what’s required. Cover crops I do anyway. [Nutrient management and soil sampling] you do anyway, whether you’re in the program or not. I’ve been doing that forever.”

Farmer B

“It’s done what it meant to do. It’s changed our operation. We started [GPS tracking for more precision planting and reduced soil disturbance] after the fact. The wildlife bundles, we weren’t doing it to that extent. We were doing cover crop, but weren’t doing it everywhere. We were doing some scouting for insects, but not as much as now. Nutrient management we weren’t doing that before. I’m not putting cover crop on non-CSP land with the airplane every year. We put cover crop on the other land as we get to it. If we get to it, great, if not we don’t.”

Farmer C

“All the practices that were practiced on the farm that is in the program are practiced on the farms that are not in the program. These farm practices, other than the widths of some of the buffers, we were doing before the program started. As far as nutrient management, scouting, and doing everything on thresholds. We do everything on an economic threshold level. We were doing all of that before we enrolled in the program. We have been strip-till for about 6 years and have been putting cover on for at least that long.”

He says he would continue with all of his conservation even without program payments. “Basically, we were doing everything. We’ve got a 50-foot buffer here. Before the program went in, we probably had a 20-foot buffer. Where I’ve got full grassland waterways that I’m working with, I wouldn’t take ‘em out because I can’t farm without ‘em, I might cut them back. Where I’ve got 20 feet now, 10 feet would serve me just as well. It’s little things like that, for the program. When I say we had a lot of the practices in, but we probably widened ‘em out and made ‘em better.”

“One of the main thing with CSP that we’ve started doing is not mowing between April 15th and September 15th. And, that also was one of the hardest things to sell the landlord on. By September 15th, it really looks bad from not being mowed. And a lot of the landlords we have, really like things to look nice. But I sold them on the idea that it was better for them and us and that if we were gonna be in these programs down the road and all that we had to start doing it. A lot of the land around here now is in the programs or trying to get where we can be in them. It’s not like you’re the only one doing it.”
“If an animal wanted to move from this side of the farm to this side of the farm, he could do it in cover. When we went into the program, it was just that way. It was one of our objectives with the wildlife for the set-aside areas, was to have it so something could move through this area. We had to complete it once we got into [CSP] and to not mow it between April and September and when we do mow it, we mow it higher than we used to.”

Farmer D

“I do have to prepare the fields every now and then for peanuts. Every year I have to disturb about 400 acres of land [for peanuts]. But, they’re bedded back up and then I use that old bed for a long time. Now that I’m in the CSP, I can’t do that. There’s nothing wrong with no-tilling peanuts, it makes mighty good yields doing it, but it’s just harder to do. It tears the peanuts up more and your equipment takes a lot of abuse.”

“I’m changing [deer habitat] over to CSP, into a field border. You have to burn it [for quail].”

Farmer E

“The only difference, well two differences. With CSP, you have to base your nitrogen applications on a realistic yield expectation. Basically, it’s a paper trail. The other one is a biodiversity bundle for quail habitat. You have to have cover crop and a 30-foot buffer on 50% of the field. And you can’t mow that during the breeding season of quail. We plant the buffer [on the non-CSP land]. We use all the same tillage and fertilizer practices across the board.

He’s also thinking about doing a Global Positioning System enhancement: “That’s one thing they harp on in the [CSP] and one enhancement is using GPS to reduce soil compaction on the traffic patterns in your fields. There’s a lot more [enhancements] in CSP, but we’ve done all the ones that seem practical to us.”

Farmer F

This farmer had adopted strip-till a few years before the CSP. He said he didn’t change any practices, but expects to: “I haven’t gotten into [biodiesel] yet, but I’m going into that this year.”

Motivating the Rest?

The CSP program was clearly motivating others to adopt conservation practices. This was evident from one farmer’s comment about a nearby watershed preparing for eligibility: “Don’t get me wrong, there are a lot of growers in the area that are having to make a lot of equipment changes. It makes it tough. The folks in the Tar Pam, that contract is supposed to
come out in Spring 2009, they’re doing a mad scramble getting ready for it. Everybody’s gonna try. Well, most of them.”

Another farmer commented on the change in perspective brought about by the CSP: “I think [the CSP] has changed people’s attitudes a whole lot in this area. Used to be, it would be a little three-year program, a little five-year program, a little this, a little that, it never really would get my attention. And all of a sudden, there was a lot of advertisement about this program, CSP, and everybody wanted to jump in. And ‘if you don’t get in now, it’ll be 7 years before you can get in again.’ So, that’s part of the reason why I jumped in and got a few acres in it anyway. I think a lot of guys went down there and signed up, ‘just give me a little bit of it’ you know, so they can work their way up.”

VI. DISCUSSION

Nearly every single farmer expressed a land stewardship motivation, regardless of his level of conservation. Clearfield (1986) and Lovejoy and Napier (1986) make the distinction between attitudes and actual behavior, suggesting that even though farmers may perceive conservation needs, express stewardship motivations, and have the knowledge to address conservation problems, they may not do so. These case studies support this hypothesis, since even those farmers doing very limited conservation considered themselves stewards of the land despite their acknowledged low level of conservation.

The conservation tillage movement has had a big impact on farmers’ awareness of themselves as conservationists. It was also the most frequently discussed conservation innovation—farmers were excited to talk about it. They saw the benefits as both economic (often expressed in terms of reduced labor and time savings) and biophysical (most often expressed as improvements in soil quality). Conservation tillage was an example of how conservation and economics can go hand-in-hand, as mentioned by several of the case study subjects. The stark contrast that they perceived between the way their fathers and grandfathers used the land and how they care for the land today shows how one innovation can change conservation attitudes. In these case studies, conservation tillage often marked the beginning of a more conservation-oriented farming operation, but more research should be done to determine whether this is a prevalent phenomenon.
Farmers are clearly motivated and limited by complex factors that interact at the farm level. Motivations to adopt conservation in these case studies were expressed largely in terms of relative advantage and observability, while limitations ranged from the compatibility of a conservation innovation with a farmer’s values or needs, perceptions tied to observability, and relative advantage of an innovation. It is significant that farmers didn’t bring up issues related to complexity or trialability as limitations. While these may function as limitations in reality, the fact that they didn’t arise in discussions shows that they are less at the forefront of farmers’ minds than other limitations. Again, there is little research on limitations to relate to this finding.

Research has shown that relative advantage is the dominant category influencing innovation adoption (Rogers 2003). In these case studies, relative advantage was the most frequently discussed conservation motivation and limitation. However, there are clear distinctions between these two elements. Positive perceptions largely focused on biophysical aspects of the farm operation, such as soil quality and increased crop yields. In contrast, the limitations were frequently related to social and economic forces limiting the farmer from benefiting from the innovation. While there are few studies about these limitations, Hellin (2006) found that soil quality and productivity are strong motivators. He found that farmers are more interested in conservation from a soil quality benefits perspective, rather than simply from a motivation to reduce soil loss. Improved soil quality enhances production and this can be a strong motivator for farmers to use conservation tillage. Environmental benefits were perceived as ancillary to soil quality benefits.

There are numerous studies supporting the time/labor savings and economic profits motivations (Feather and Cooper 1995; Fuglie and Kascak 2001; Chouinard et al. 2006) and this is the central premise for incentive programs. However, the phenomenon of farmers being motivated to trade economic profit for stewardship has also been documented in research (Chouinard et al. 2006). These case studies showed a similar phenomenon. Farmers were willing to trade profits for stewardship in the case of field borders and chemical reduction in several cases even when other benefits, such as time and labor savings, were not achieved.

Compatibility was also a dominant limitation to conservation adoption. While farmers were motivated to implement some practices on all of their fields (especially working lands
conservation practices), regardless of whether or not they received incentive payments, they were limited by a variety of factors. Several of these factors were attitudinal. Farmers’ resistance to change and traditional values, along with their distrust of the government and outsiders, limited conservation adoption. These limitations are not widely documented in previous research. Feather and Cooper (1995) found that incentive programs are not always sufficient to encourage adoption. In the case of soil moisture testing, Feather and Cooper showed that a $40 per acre incentive (exorbitantly high compared to other incentive programs) would not even achieve a 50% adoption rate. In this case, they argued that farmer resistance to change was a strong limitation.

The influence of compatibility issues, including less need, incompatible crop type, and varying farm size and structural limitations, have all been widely documented in the literature (Feather and Amacher 1994; Feather and Cooper 1995; Forster 2000; Napier et al. 2000; Hellin 2006). Lambert et al. (2006) found that practices tied to production are more likely to be adopted by larger farms, but this was contradicted in one of my case studies where a farmer harvesting 10,000 acres said that it was riskier for him to integrate conservation into his practice, since he had more to lose. Few studies have documented the impact of the actual farm layout to determine what limitations arise from different landscape arrangements, but this was an issue that several farmers discussed. For instance, field borders can be obstructions on some farms, but on others they can fit well with how the farmer is working his field. More research should be done about how landscape setting impacts the use of conservation practices.

None of the case studies revealed complexity (in this case, the ease of understanding and implementing an innovation) to be a positive influence on conservation adoption. However, complexity was a limitation. This is consistent with the findings of Feather and Cooper (1995) suggesting that familiarity and know-how are important motivators. Complexity was one of the less frequently discussed aspects of conservation practices. Trialability was also one of the least talked about, but it did arise in conjunction with farmers recalling their first use of a reduced tillage system.

The influence of observability was frequently mentioned as a limitation as well as a positive influence. This has been shown in the literature and was a dominant theme in these case studies as well. However, as illustrated by Nassauer (1992), many conservation
practices are either not evident to farmers or are perceived as aesthetically displeasing. The comments about conservation tillage in the case studies provide a perfect example of how an innovation can go from visually unattractive to visually attractive and how important this change in perception is to convincing farmers to adopt and to changing perceptions of good stewardship. These case studies also support the importance of visibility. For instance, not a single farmer discussed benefits to air quality from the reduced use of fuel in conservation tillage, despite this serving as one of the environmental benefits farmers can provide for CSP payments. This may stem from the fact that these benefits are not visually observed.

Farmers are motivated to reduce erosion on their farm, as shown in research such as that of Clearfield and Osgood (1986), who note that both perceived and actual soil erosion conditions influence adoption. However, the erosion benefits may be perceived differently at the farm level than what would be important at the watershed scale. The USLE assessment shows that farmers may be seeing things not seen at watershed scale, which could be important to understanding motivations. If farmers are motivated by biophysical aspects of their farm operation, are their perceptions accurate? My analysis doesn’t answer this question conclusively, since the USLE is only one measure of soil concerns on the farm. Regardless, more research should be done about whether farmers are seeing vulnerabilities that match watershed-wide vulnerabilities in order to better target environmental objectives. This is particularly important for meeting watershed-wide environmental objectives through programs like the CSP, if farmers are making the decisions about which conservation practices to undertake on their farm.

**VII. Conclusions and Policy Implications**

The fact that relative advantage and observability are the two dominant categories influencing adoption would suggest that policymakers should focus on increasing awareness of relative advantages of innovations and changing visual perceptions of what good stewardship looks like. Programs should use visual aids to influence farmer perceptions of good land stewardship. Nassauer (1992) suggests the use of signs to identify conservation projects and to create a new image of what “good stewardship” looks like. Another strategy is to provide information about conservation practices along with visual images of what these practices can do for the farmer. If policymakers are to increase relative advantage, they need
to understand how biophysical aspects of the farm operation are the mechanism through which farmers perceive benefits. If soil quality and soil conservation are two primary motivators, policymakers should also understand that farmers experiencing less erosion would have less incentive for adopting conservation practices that provide these advantages; they should be encouraged to take part in programs that are more appropriate to their landscapes. In short, conservation programs should be framed in a way that shows what benefits farmers gain from undertaking conservation, mostly in the biophysical realm but also in cost and labor savings, rather than in terms of environmental improvements only. Focus should also be on improving the relevancy of regional programs to the landscape – both structurally and biophysically.

Policymakers should also focus on reducing the incompatibility of conservation practices with farmer values and needs. Education and outreach are essential to alerting farmers to how conservation practices can be easily integrated into their farms. Furthermore, district conservationists play a key role in hands-on assistance and relationship-building with the farming community. As program bureaucracy increases, as it has over the last several decades, NRCS staff are becoming more tied to desk work. This will have a serious detrimental affect on the promotion of new conservation practices. Programs should remain as simple as possible, while still meeting conservation objectives, and NRCS staff should continue to serve a hands-on role in promoting awareness of conservation programs.

It is also valuable to consider the stewardship ethic highlighted in these case studies and corroborated by Chouinard (2006). These stewardship motivations are being hampered by the lack of future stability. Since many conservation innovations have delayed returns, it is essential for farmers to feel that it is worth sacrificing profits because of their long-term role as land stewards. Landowner-farmer relationships are fueling this problem, since most farmers rent most of their land and long-term leases are becoming increasingly difficult to secure. Conservation and economic considerations are taking place at two different time scales – conservation requires a long-term vision while current instability in agriculture is requiring farmers to function in a high-risk, short-term mindset. Conservation programs should not only promote good conservation, but should provide long-term stability to farmers.
Incentive programs have been shown to serve a primary role in increasing the rate of adoption of conservation practices. The Conservation Security Program hasn’t required recipients to make many substantial changes to their operations, but it seems to be influencing non-recipients to adopt. The program would be more effective if it found ways to encourage recipients to make more substantial enhancements and had greater expectations for “good actors” to “advertise” their conservation successes to other farmers through visual displays on their farms or through outreach to other farmers.

In conclusion, many farmers are already anticipating a change toward more conservation focus in the Farm Bill and it is causing them to shift toward more conservation-oriented practices. It will be the challenge of future Farm Bills to capture this opportunity to support farmers in a way that promotes long-term stability in agriculture, while achieving environmental objectives.
VII. LITERATURE CITED


