NORTHERN ILLINOIS UNIVERSITY

CONSERVATION PRACTICES ADOPTION BY AGRICULTURAL LANDOWNERS

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE
DOCTOR OF PHILOSOPHY

DEPARTMENT OF POLITICAL SCIENCE

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DEKALB, ILLINOIS
AUGUST 2003

ACKNOWLEDGEMENTS

I owe much gratitude to my family for standing by me through this endeavor, especially Jim and Delaney for their tireless devotion and patience. Great appreciation goes to my parents for their faith and my grandparents for teaching me to work hard and never give up, no matter how difficult the task.

I would like to thank my course work committee, particularly Dr. Culhane, who were always willing to go the extra mile to advise and motivate me through this program and the numerous moves along the way. Thanks also go to my dissertation committee for diligent review of draft, after draft, after draft. I appreciate their candor and perspective. I am particularly grateful to Dr. Esseks for agreeing to take on this project and his enthusiasm to help me grow as a scholar. I would also like to thank the American Farmland Trust for their support.

Moreover, I would like to thank the farmers who took time out of their very busy schedules to try to help me understand their operations. They not only gave me a significant amount of data for this paper, but they also gave me a great deal of insight into their farming lives. The conversations with them were invaluable. Finally, I would like to thank God for surrounding me with such generous and wonderful people.

CHAPTER 1
RESEARCH METHODS

Introduction

Agricultural pollution of surface and ground water is a serious problem in the United States. The United States government plans to spend nearly $13 billion over the next six years (FY 2003-2008) to prevent and clean up pollution derived from crops, livestock, and other aspects of contemporary American agriculture (Rey, Penn, Knight, and Little, 2002). These conservation policies rely on the cooperation of the individual farmer to be effective. Yet, not enough is known about what influences agricultural landowners to adopt conservation measures. The factors that promote agricultural landowners to adopt appropriate conservation measures (or have their farm operators implement) must be explored to provide information on the ability to change behavior and the policy tools that are most effective to increase agricultural land stewardship. Such information helps to test the validity of present government conservation programs and to develop any needed reforms.

Two different research methodologies are used to investigate conservation practice adoption. First, the findings of an American Farmland Trust survey of 1,617 landowners in five states are analyzed via logistic regression to identify variables associated with an increased incidence of conservation practice use. Second, a subset of the original research population was re-interviewed over the phone. Most previous studies of conservation adoption have relied entirely on standardized surveys. However, it has been suggested that due to the inability of statistical models based on such surveys to predict adoption behavior, a more exploratory approach must be taken (Napier, 2001). Therefore, through open-ended questioning, I asked farmers, why they did or did not adopt conservation practices

Why Is Conservation Adoption Important?

Agriculture as an industry causes significant environmental harm. States designate agriculture as the top stream and river polluter in the nation. Agriculture's negative effects on the environment are numerous. Soil, organic, and inorganic fertilizers contribute approximately 65 percent of the nitrogen load from the Mississippi Basin that enters the Gulf of Mexico (Ribaudo, Horan, and Smith, 1999). Agriculture is at least partially responsible for the decline of 47 percent of the species listed by the federal government as endangered or threatened (Lewandroski and Ingram, 1999). Overall, non-point agricultural pollution causes loss of wildlife habitat; loss of water recreation opportunities; sedimentation of streams, reservoirs, highway ditches, and railroad lines; and higher costs to clean water for human consumption (Napier, 2001). It is hoped that USDA programs can prevent further environmental harm and restore environmental health.

Policy attempts to eliminate environmental harm from agriculture have not been entirely successful. The 1985 Food Security Act linked conservation standards to all USDA farm program benefits. Since at that time about 85 percent of agricultural producers participated in farm programs at the time, there should have been considerable abatement of agricultural pollution (Brady, 2001). Farm Bill updates approximately every five years maintained the link between conservation programs and government assistance, although some changes were made to moderate the requirements on farmers (Cox, 2001).

Current agri-environmental policies are not effective, because they may be contradicted by the farmer's need to keep up agricultural production, they are difficult to enforce, or they have been

temporary. The pressure to maintain a viable level of production to stay in business may cause some farmers to work around programs. While some land is brought out of production to meet the Conservation Reserve Program (CRP) objective to take fragile land out of production, other land is brought into cultivation. New crop types make it possible for farmers to grow on land previously unsuitable for farming. As land is put into CRP, this less appropriate land is brought into production. In Beadle County, South Dakota, 46,810 acres were enrolled in the CRP, while 29,561 acres were newly brought into production (Johnson, 2001). Depressed crop prices are another reason that CRP and Wetlands Reserve Program (WRP) lands may be brought into production. Brady (2001) finds indications that over the past few years land previously taken out of production has been converted back to agricultural land due to the depressed farm economy.

Additionally, regulations may have gaps or be unenforceable. Pesticide regulations restrict the kind of pesticides that can be used and the crops they can be used upon but not the amount that can be used. Applying too much of a permissible pesticide can result in over accumulation which can be environmentally harmful. Even if the amount were regulated, limits would be extremely difficult to enforce, as the United States Department of Agriculture (USDA) would have difficulty monitoring each farmer's compliance (Ervin, 1998).

Even those who tout agri-environmental policies as successful admit the gains are temporary. Progress has been made by current policies to stop agricultural pollution. Soil erosion decreased almost 40 percent between 1982 and 1997. Wetland protection and restoration have increased. The Swampbusters program, to prevent wetland conversion, discourages 1.5 to 3.3 million wetland acres annually from being converted into agricultural production (Claassen et al. 2001). However, current programs such as CRP do not offer benefits to permanently protect land. Farmers are paid to keep fragile land out of production for 10 to 15 contract years. Once the contract expires, the farmer can put the land back into production.

At the same time agri-environmental policies are seen as needing to be more effective, world trade agreements are increasing the U.S.'s reliance on these policies to support farm income. Trade agreements such as the Uruguay Round Agreement on Agriculture call for a reduction in domestic commodity price supports and export subsidies. However, conservation incentive programs are allowed as long as they do not encourage production of a particular crop (Claassen et al. 2001). Studying the adoption process gives insight into how to promote the adoption of conservation measures, as federal funding levels increase.

Why Is It Important to Focus on Individual Adoption?

United States agri-environmental policy relies greatly on inducing farmers to use appropriate practices, as well as to cease environmentally harmful practices, including stopping farming on certain environmentally sensitive land types. This study aims to contribute to understanding the factors that shape farmers' adoption decisions.

Agricultural adoption studies began with a focus on adopting technological innovations. These innovations were often initiated to increase production or save money. Later studies on the adoption of conservation techniques took models for adopting technological innovations and applied them to conservation practices. The utility of these largely voluntary models for adopting conservation measures should be re-evaluated, because landowners may have different motives for adopting environmental practices.

Furthermore, Napier questions the utility of relying on current agri-environmental programs, because their voluntary nature will not increase conservation adoption (Napier, 2001). It is interesting that Pampel and van Es made a similar assertion in 1977. Their study indicated that farmers who adopt commercial practices may not be the same farmers adopting environmental practices, and the predictors of commercial practices are not the same as predictors of environmental practices. They argued that since voluntary compliance with regulations is based on commercial incentives to adopt innovations, evidence does not support that the same mechanisms will work with environmental practices. Therefore, current models and the agri-environmental policies based on them are not expected to increase the policies' utility.

Why Is the Issue Important to Political Science?

Motivating individual farmers to apply conservation practices to their farm operations may seem an unusual political science research area. However, policy implementation and compliance are vital parts of the public policy cycle. Often, once legislation is passed, parties interested in influencing government action move on to other matters. Inducing compliance by how the policy is implemented is an oft-neglected area of study. However, public policies are intended to influence behavior. If people do not comply with a policy, it is practicably void (Anderson, 1997).

Agencies can modify policies or alter practices to increase compliance, especially those bureaucrats who interact directly with clients. The "Bottom-up" approach to implementation literature deals with the interactions of lower-level agency officials with their clients (Anderson, 1997). These "street-level bureaucrats" work directly with citizens and have a great deal of discretion in how they implement policy. They create routines, redefine tasks as set forth in policies and ration resources within the boundaries of their organization. Since these officials are professionals not politicians, they are somewhat removed from public scrutiny. Freedom from oversight combined with vague and contradictory mandates basically allows street level bureaucrats to create policy through their implementation of it (Weatherley and Lipsky, 1977).

Street level bureaucrats face two contradictory trends. They are perpetually in a position in which they must reconcile a high demand for services with offering individualized assistance. When new demands are placed on them, they must find a way to prioritize and conserve resources to meet all the demands placed upon them. These administrators ration services as their workload increases and policies do not offer guidance on priorities. (Weatherley and Lipsky, 1977). It is beneficial for these bureaucrats to have scientific and technical information to provide guidance on distributing resources, when policy falls short (Anderson, 1997). The intent of this paper is to help make agri-environmental

policy more effective by looking at factors to improve implementation. It will help explain whom lower-level officials should target, and how they should be approached.

Research Design

A descriptive research design will be used for this study. The examination is not being used to evaluate a program intervention, such as by comparing groups with and without technical assistance. Rather, it is used to explain the phenomenon of agricultural conservation practice adoption (Salkind, 2000).

The research design consists of two main components to look for factors that influence conservation measure adoption: survey data and focused interviews. The surveys are used to examine the characteristics of agricultural landowners/operators who adopt conservation measures. Surveys can be used to observe the frequency of variables and the likelihood of a relationship between them. However, they do not have much direct explanatory value (Salkind, 2000). The interviews can better explain why certain characteristics increase the likelihood of adoption (Yin, 1994). Instead of just knowing which independent variables are correlated with each dependent variable, it is important to understand the motivation behind adoption (Rogers, 1983). Also, these interviews are used to investigate interesting findings from the survey and to explore questions that were not included in the survey. A qualitative interview can be used to reconstruct the farmer's experience in adopting a conservation measure, allowing a factual, detailed description of her experience (Rubin and Rubin, 1995).

Research Questions

The adoption of a conservation measure is typically perceived as a decision process that can be modeled. Previous research has developed multiple models to analyze the adoption process. The initial model in the literature is based on the sociological diffusion approach. Individuals will change their behavior, when they learn a new practice will benefit them. They must first be made aware that a problem exists and be presented with a way to resolve it (Napier, 2001).

The second model developed to explain adoption is based on social learning theory. Like the diffusion model, social learning theory posits that humans tend to act in ways that benefit them. Over time, established behaviors are those that have been reinforced by awards and avoidance of punishment. If a current behavior offers a reward, the farmer will be hesitant to change it out of fear that the reward will cease. A new behavior must be shown to offer even greater rewards than the current behavior (Napier, 2001).

The previous models focus on the adopter's characteristics. They do not include farm structure barriers to adopting conservation practices. Later researchers developed a structural theory to explain barriers to adoption such as limited resources or local mistrust of conservation practices (Napier, 1997).

Since none of the above models are capable of completely describing the conservation adoption process, they are combined to form a holistic adoption model that includes structural factors such as economic resources, public policy, and technological aptitude with information and owner characteristics (Napier, 2001).

Several multifaceted models have been developed. They begin with exposure to and understanding of a new practice. Next, the individual considers information on the practice's advantages or disadvantages. Finally, the individual decides to accept or reject the practice based on the information considered (Taylor and Miller, 1978; Rogers, 1983).

Ervin and Ervin (1982) developed a model to explain soil conservation adoption based on the above diffusion model, changing the first stage to recognition that soil erosion is a problem, instead of exposure to new practices. Recognition is influenced by landowner characteristics such as education and farm experience and land characteristics. Education programs can increase the perception that erosion is a problem. Second, the landowner decides to adopt a broad group of erosion control practices. Landowner characteristics such as education, along with land characteristics like the perceived degree of erosion and economic factors like the farmer's debt to asset ratio should influence whether the landowner decides to adopt a particular practice. Practices that require installing structures like terraces may be more expensive, so farmers with high debt may be less likely to adopt them. Third, the landowner decides the amount of erosion control effort, which is based on the effectiveness and extensiveness of the practice he adopts. This final stage is influenced by landowner characteristics such as management ability and the land's physical factors. Erosion control practices that are more effective often cost more to apply. Therefore more effort may result if the farmer's financial position is healthy and government cost sharing is available.

Sinden and King (1990) developed a model based on Ervin and Ervin's model, changing the final stage to the decision to resolve the erosion problem or not. Their first stage is influenced by the same factors as Ervin and Ervin's, the land's erosion status and the farmer's personal attributes such as years farming. Their second stage includes the land's erosion and farmer's personal attributes, as well as economic factors. However, this model adds the farmer's motivation to address the problem. Their final stage is very different from Ervin and Ervin's. It is influenced by the perception of the erosion problem, recognition that the problem is worth solving, and institutional factors such as commodity prices and subsidies for adopting conservation measures.

Also, Vanclay (1992) developed a very similar model. The first stage, stimulus, is the occurrence of land degradation. He adds a different second stage, attitude toward the environment. The final stage is response, whether to adopt the conservation practice.

Napier and Brown (1993) change the model by altering the second stage and rewording the third to be more complex. Their second stage is the identification of the pollution source. Their third stage is willingness to take care of the problem instead of active adoption of a measure. Willingness to take care of the problem is influenced by whether the farmer feels pollution is a threat to his family's health. It is tempered by previous investments in their production system that may make it difficult to adopt a new practice.

Camboni and Napier (1993) use aspects of the previous models, but they do not divide their model into the same kinds of stages as previous researchers. Instead they break it down into its component parts. The farmer should realize there is a problem and that a solution is available. She should understand that the solution is relevant to her needs and will benefit her. Second, the farmer must have the knowledge and skill to incorporate the model into her operation. Finally, government programs will impact the process by offering subsidies for high production of certain crops.

Critics of diffusion models argue that the models treat all innovations as similar. Yet, the commercial practices the models have been developed to explain are different from the environmental practices they are now being used to describe. The characteristics of environmentally beneficial practices may make them less readily adopted than their commercial counterparts (Pampel and van Es, 1977).

Empirical testing of the above models has shown limited and inconsistent support for the expected relationships. Later studies have abandoned the attempt to divide factors influencing adoption into stages, instead imputing them into overall regression models with still limited success (Turrell and McGuffog, 1997). This study will explore three areas that are expected to impact the use of conservation practices. Variables from the preceding models will be combined with previously untested variables to try to form a better explanation of why landowners use conservation practices. Looking at areas of expected influence will not limit the results as much as trying to place them in a preconceived model. This more exploratory approach is expected to be more fruitful in developing new issues that will affect the use of conservation practices.

First, the decision to use a conservation practice is shaped by the characteristics of the landowner, such as age, education, whether the landowner is the operator, and retirement status. Next, the decision to adopt is influenced by features of the farm such as the size of the operation, the income derived from the farm, and the farm product. Finally, the decision to use a conservation practice is influenced by factors that are external to the farm operation. These features include information, non-agricultural development in the area, government programs, and production contracts [among other aspects of the farm's relationships with buyers of its products]. Since standardized surveys have had limited ability in explaining adoption behavior, some of the questions will be investigated using both qualitative and quantitative data-gathering methods.

Landowner Characteristics

1. Landowners with more education are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Three studies support a positive relationship between education and adopting conservation measures. Ervin and Ervin (1982) found education was significantly related to the number of conservation practices adopted or farmers' conservation efforts. Farmers who are more educated are more likely to use contouring, minimum tillage, and hay or pasture rotations. In turn, education is negatively related to farm experience indicating that more experienced farmers will have less education and are less likely to implement conservation measures. Bultena and Hoiberg (1983) supported Ervin and Ervin's findings. In a survey of 285 Iowa farmers, they found a significant difference in education levels between later adopters of conservation tillage and non-adopters. Caswell et al. (2001) found education increased the adoption of nitrogen testing, splitting nitrogen applications, and professional pest scouting. Education did not affect the adoption of crop rotation, any soil erosion control practice, or soil conservation practices to protect water quality.

Finally, Turrell and McGuffog (1997) found farmers without training on handling agricultural and veterinary chemicals and those who did not have a formal education were less likely to rinse their chemical containers. Government regulations in Australia require all containers that held agricultural or chemical containers to be pressure rinsed or triple rinsed prior to disposal, because un-rinsed chemical containers pose a significant environmental and health threat.

One study did not support a relationship between education and adopting conservation practices. In a 2001 study of farmers in Iowa, Ohio, and Minnesota, Napier did not find education to be a predictor of using conservation practices. The only exception to this lack of relationship was the adoption of precision farming by more educated farmers.

The survey question "What is the highest level of education you have completed?" will be used to find out the survey respondent's level of education (American Farmland Trust, 2001:15). Logistic regression will be used to see if the answer to this question impacts the likelihood that the farmer will positively respond to questions about conservation practices, holding other possible explanatory traits statistically constant.

2. Landowners who are older or close to retirement are less likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ range land.

Age and retirement status are believed to influence adoption, because of their influence on planning horizons. Older farmers may have shorter planning horizons, so they may be less concerned about the long-term negative effects of resource depletion (Bromley, 1980). In a study of 117 Iowa farmers, Korsching, Stoferahn, Nowak, and Wagener compare the difference in means of age between those who adopted minimum tillage and those who did not. The average age of adopters was 49.9; the average age of nonadopters was 55.1 years (t=2.73) (1983). Carlson and Dillman (1983) found a negative relationship between age and adopting erosion control practices.

Age may be an independent determinant, or it may be related to education and years as a farm operator, as older farmers may be less educated and operating the farm for a longer time. This hypothesis is investigated by two survey questions. First, "What year were you born?" and second, "Are you currently retired?" (American Farmland Trust, 2001: 14-15). Again, logistic regression will be used to test if the answers to these questions impact the likelihood that farmers will respond positively to questions about whether they have conservation practices.

3. Landowners who perceive pollution as being problematic in their region are more likely to

report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

If landowners perceive pollution as being detrimental to themselves or their operation, they should be more likely to adopt measures to stop it. Most adoption models begin with the perception that there is a problem to resolve. Once the problem is noticed, the landowner adopts a measure to resolve it. However, two researchers point out why evidence of degradation may not prompt a response. Rikoon and Heffernan (1989) explain that the deep loess soils and heavy use of chemical fertilizers in some parts of Missouri mask erosion problems by compensating for soil losses. Vanclay (1992) points out that a great deal of erosion damage causes farmers to feel they cannot control it. Conversely, a small amount of damage can be attributed to multiple causes, and the landowner may not feel action is needed to alleviate it.

Previous studies support that perception of agricultural pollution's negative effects shapes opinions about conservation measures and their adoption. Napier and Napier (1991) found awareness of agricultural pollution to be correlated with a favorable feeling toward conservation compliance. The ability of pollution to threaten the landowner's family was part of viewing it as a problem. Respondents who felt their families' health was threatened by groundwater pollution saw groundwater pollution as being a more serious problem and were more supportive of measures to force farmers to adopt practices that would protect groundwater from pollution (Napier and Brown, 1993). Also, previous research supports that the degree of perceived or actual soil erosion is positively related to adopting soil conservation measures (Ervin and Ervin, 1982; Sinden and King, 1990; Camboni and Napier, 1993).

This relationship will be explored through open-ended interview questions. Instead of being directly asked if they adopted conservation measures because of perceived environmental problems, interviewees will be asked why they adopted conservation measures. If perceived environmental damage is a problem, respondents should answer as such without being led to do so. Since there is so much evidence supporting the relationship between perceived environmental damage and adopting conservation measures, the more interesting question to explore in the open-ended interviews is why this relationship exists. Do farmers consider the environmental or economic consequences of pollution, or both?

4. Landowners who are not operators and never have been operators are less likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ range land.

Few of the previous studies tested the relationship between operating the land and adopting conservation measures. Schaller (1993) asserted landowners who are not operators are less likely to support conservation measures, because they are physically removed from the land. They may not be aware of environmental harm from farming, or they may not feel the potential pollution will affect them. Also, non-operators may be owners of industrial farm operations, who may lack a stake in the land's long-term productivity. Industrial farms are typified as large, single crop operations making extensive use of non-labor farm inputs such as chemical pesticides and fertilizers. These operations are believed to be more harmful to the land. They are contrasted with owner-operated farms in which the farmer is believed to have a personal stake in the land's sustainability, to farm harmoniously with nature, and to be concerned with her neighbors and future generations. Unfortunately, data does exist to support Schaller's assertion.

Esseks and Kraft (1989) supported a relationship between tenure status and applying conservation practices. They found a tendency of the surveyed operators to use more practices on land they owned compared to land they rented for both structural and non-structural practices. This relationship may partially be attributed to the size of the owned land versus rented land (used as a proxy for the differences in characteristics of the owned versus rented land), the landowner's age (farmers over the age of 50 were less likely to apply practices to rented land), and the percentage of rented land in cash leases (which tie up the farmer's income, possibly making it financially difficult to apply practices).

However, Bultena and Hoiberg (1983) did not find a relationship between tenure status, whether the farmer owned the land he operated, and adopting conservation measures. They found no significant difference in the proportion of land owned and operated among early, later, and non-adopters. Also, Napier (2001) did not find land tenure status to be a significant predictor of the ratio of pounds of fertilizer applied to bushel of grain produced. Fertilizer application rates are important, since nutrient contamination of water is a noteworthy environmental problem. Finally, Caswell et al. (2001) did not find tenure status to be related to nitrogen testing. They offered the explanation that nitrogen testing does not offer long-term benefits, so landowners and renters benefit from them equally. However, tenure status was negatively related to crop rotation, crop scouting, and soil conservation practices.

Studies thus far examined operators who were not owners, not owners who were not operators. It remains to be seen whether owners who are not operators require those who operate their land to implement conservation measures. This question will be investigated through the following survey questions.

"Are you an operator of any of the agricultural land you own, that is, by yourself or with others, do you make the decisions about the day-to-day operation of the farm, and when to market the crops or animals?" Other questions are, "Who makes the day-to-day decisions?" and "Who else makes the decisions?" A question exploring the ownership relationship is, "Do you own the land: by yourself or with your spouse, in a partnership including persons other than your spouse, in a formally constituted corporation, or in some combination of the above?" (American Farmland Trust, 2001: 13) Landowners in the focused interviews who rented out land were asked if they required the renter to apply conservation measures. Those who rented land from another landowner were asked if they were required to implement conservation practices.

5. Landowners who live closer to their agricultural land are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

The literature supports two potential reasons for why closer proximity to the land may increase the adoption of conservation practices. First, landowners close to the land may be more aware of agricultural pollution. Second, landowners close to the land may be directly affected by agricultural pollution.

Proximity to the land may contribute to the adoption of conservation practices, because it increases awareness of agricultural pollution. While previous studies examined perception of a pollution problem as an important factor in adopting conservation measures, none of them has tested proximity to the land as a factor in affecting perception (Napier and Napier 1991; Bultena and Hoiberg, 1983; Westra and Olsen, 1997).

Napier and Brown (1993) were the closest to investigating this relationship. Respondents in their survey who perceived fertilizers and pesticides in groundwater as threatening their families' health felt groundwater pollution was a more important environmental problem and were more willing to force farmers to protect groundwater by changing production practices.

Some researchers argue knowledge of erosion is not enough to cause farmers to support conservation measures. Farmers know what causes soil erosion and they understand the steps necessary to resolve it. However, due to social and economic reasons, they refuse to implement conservation measures. Since landowners perceive most conservation benefits accrue to others, it is difficult to convince them to adopt conservation measures (Napier and Brown, 1993). Their knowledge of the environmental problem is tempered by the costs of resolving it and the lack of perceived benefits to them.

While previous studies allude to a relationship between proximity to land and applying conservation measures, the relationship is not directly measured. This study will use the survey questions, "Is your primary residence on any land attached to the land you farm?" And, if not, "How often in the past year did you visit any of the farmland you own?" (American Farmland Trust, 2001:15)

6. Landowners who are more likely to report the use of practices to protect land from soil erosion,

to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland feel differently about farming and their responsibility to the land than landowners who do not.

An ongoing theme throughout the literature is that farmers who adopt conservation measures feel differently about farming than those who do not. Farmers who adopt environmental conservation techniques are believed to be motivated by feelings of social responsibility and an attachment to farming. Conversely, other farmers may only adopt measures that make their farms more economically viable, as they might view farming as strictly a business venture (Pampel and van Es, 1977).

Pampel and van Es (1977) found factors such as capital, farm size, farm sales, and education were related to adopting commercial practices, not environmental practices. On the other hand, years spent farming was found to be the best predictor of adopting environmental practices. The longer one farmed, the more likely he was to adopt profitable and unprofitable environmental practices. They used factor analysis to find farmers were innovative commercially or environmentally, not both. The findings of Pampel and van Es (1977) are supported by a group of interviews with a nonrandom sample of farmers known to have adopted conservation techniques in North Dakota, Kansas, and South Dakota. All these farmers adopted conservation measures, because they enjoyed the protected land or felt a responsibility to the land or the public. (Frieberg, March, 1996).

However, other studies contradict their findings. Ervin and Ervin (1982) did not find conservation attitudes or farm orientation to be significant in conservation effort or the number of conservation practices adopted. Conservation effort was defined as the difference between the estimated farm erosion rate without conservation practices and the rate expected from adopting conservation practices. Since practices have different rates of erosion control, it is valid to differentiate between effort and number of practices. Sinden and King (1990) used the expected benefit, passing the land on to the future, to measure stewardship ethic. While passing the land on to the future increased the likelihood the landowner would recognize an erosion problem needed to be solved, it did not influence conservation effort or the number of practices used. Vanclay (1992) made a similar finding. Landowners, who scored high on stewardship scales, were not more likely to adopt conservation measures. Yet, while the New South Wales Soil Conservation Service felt 45 percent of the farmers in the area had inadequate soil conservation practices, the same group of farmers did not feel they had serious erosion problems.

The influence of ownership objectives in the adoption of conservation measures is investigated both in survey questions and open-ended interviews. The survey instrument included these questions about possible environmental objectives:

> How important to you is the objective of protecting your land from soil erosion? Not at all important, slightly important, moderately important, or very important?
>
> How important to you is the objective of protecting or improving wetlands on your farm? Not at all important, slightly important, moderately important, or very important?
>
> How important to you is the objective of protecting or improving wildlife habitats on your farm? Not at all important, slightly important, moderately important, or very important?
>
> How important to you is the objective of protecting streams and other bodies of water from pollution from farming activities on your land? Not at all important, slightly important, moderately important, or very important?
>
> From the list of objectives I just asked you about, which one would you consider the most important to you… protecting your land from soil erosion, protecting or improving wetlands on your farm, protecting or improving wildlife habitats on your farm, protecting streams and other bodies of water from pollution…

> From the list of objectives I just asked you about, which one would you consider the second most important to you… protecting your land from soil erosion, protecting or improving wetlands on your farm, protecting or improving wildlife habitats on your farm, protecting streams and other bodies of water from pollution… (American Farmland Trust, 2001:2-4)

Farm Features

7. There is a relationship between farm-size or landowner's income from agriculture and reporting the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Adopting conservation measures can be expensive and risky. Not only can the practices be costly to implement, but also they may require changes in the overall production system. A farmer's current production system is based on past investments in training and equipment. Adopting a new system requires changes in the current system, creating a need for more training and equipment (Nowak, 1992; Napier and Brown, 1993).

Additionally, adopting a measure may create a risk for the farmer. Changes in production practices may cause unknown changes in outputs, thereby reducing farm income. It is believed farmers with strong economic positions are more capable of absorbing the financial cost and risk of adopting conservation practices. If adopting conservation measures might make farming financially unviable, the farmer is less likely to do so (Napier and Napier, 1991).

Findings in this area are largely inconsistent. The relationship between farm economic position and adopting conservation measures is further complicated by the different ways farm economic position is operationalized. Ervin and Ervin (1982) tested for the influence of the farmer's financial position on adopting conservation measures. They found neither debt concern nor total cropland acres affected willingness to adopt conservation measures.

Carlson and Dillman (1983) found both farm size and income, as indicated by gross farm income categories ranging from under $5,000 to over $250,000, to have moderate positive relationships with erosion control adoption. In one of the only qualitative studies looking into this relationship, Rikoon and Heffernan (1989) found that farmers would not follow through with highly erodible land compliance planning, if they felt participation would create a financial hardship or require severe changes in their operation. These individuals felt they could not find a conservation plan option that fit their financial and equipment resources and their crop rotation plans. When Sinden and King (1990) redefined the economic variable as a third-party rating of the "landholder's ability to invest capital to obtain a high yield, safe return," they found this investment rating was positively related to the decision to adopt conservation measures. Moreover, wheat yield and livestock carrying capacity, potential proxies for farm size, were positively related to adopting conservation measures.

Two studies offer mixed results. Camboni and Napier (1993) found different relationships between farm economic factors and adopting conservation measures. No-till was more likely to be adopted by farmers with fewer cultivated acres. Chisel plowing with one-third ground cover at planting was more likely to be adopted by farmers with more acres under cultivation. Farmers more likely to adopt filter strips had higher off farm employment and a higher debt to asset ratio. Caswell et al. (2001) found the number of acres operated to be positively related to nitrogen testing, integrated pest management (IPM), and soil conservation practices. However, the number of acres operated was not related to crop rotation.

Completely counter to the previous studies are the findings of Turrell and McGuffog (1997). They offer evidence that the relationship between conservation and income is inverse. In an Australian study, farmers who operated a farm larger than 3,500 hectares were less likely to rinse their chemical

containers than those with smaller farms. They did not offer a potential explanation for their findings.

In his more recent studies, Napier (2001) simply found no relationship between farm size, debt-to-asset ratio, or farm income and the adoption of conservation measures. He found one caveat to this lack of relationship with precision farming. Farmers with higher farm income and larger farm size were more likely to adopt precision farming. This relationship between farm operation size and adoption of practices is explored using the following survey questions.

About how many total acres of farmland including pasture do you own?

Please stop me when I get to your level of typical total gross receipts from agriculture… under $10,000 dollars, under 25,000, under 50,000, under 75,000, under 100,000, under 150,000, under 175,000, under 200,000, $200,000 or more (American Farmland Trust, 2001:14)?

Please consider all sources of income, before taxes for everyone living with you in 2000. Please stop me when I get to that annual income level… under $10,000 dollars, under 20,00 under 30,000, under 40,000, under 50,000, under 60,000 under 75,000, under 100,000, $100,000 or more (American Farmland Trust, 2001:17)?

The relationship will also be investigated via the focused interview questions.

8. There is a relationship between the respondent's mix of farm products and reporting the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Most of the reviewed studies looking at the influence of farm product differentiate only between cash grain crops (or commodity crops) and other crop types. Few discriminate among operations such as orchards, ornamental crops, and livestock operations. The emphasis on commodity and cash grain crops is due to their tendency to be erosive and to rely on environmentally harmful practices. Commodity crops are believed to discourage conservation practices due to two characteristics of commodity subsidy programs. First, only specific crops are eligible, such as feed grain, wheat, cotton, and rice. Soil conserving crops, like forages and legumes, are not eligible for payments. Moreover, since payments are based on past years' yields, planting non-eligible, soil conserving crops reduces the base upon which future payments are made. Second, since commodity programs pay based on yield, they encourage farmers to use chemical fertilizers and pesticides that increase yield (Schaller, 1993).

It is typically believed that farmers with high debt tend to raise cash grain crops to ensure an annual, steady return on their investment. These cash grain crops are commonly believed to be erosive. Farmers who depend on this income return every year tend not to have the resources to invest in conservation measures, especially the more expensive structural practices (like terraces and diversions) (Ervin and Ervin, 1982).

As with many other areas, findings are mixed. Ervin and Ervin (1982) investigated reports from the USDA Soil Conservation Service in Monroe County, Missouri that cash grain farmers used fewer conservation practices, because they emphasized short return profits. When they tested this relationship, they found ownership of cash grain farms was inversely related to the number of conservation practices adopted and conservation effort. They conjectured this relationship existed, because cash grain farmers did not consider hay or pasture rotations as options. They must try to maximize income from all their land every year. Napier and Brown (1993) drew similar conclusions. Farmers specializing in grain production were less concerned about groundwater pollution and less willing to support a government policy of forcing farmers to change practices to protect groundwater.

Camboni and Napier (1993) found the opposite. Farmers who adopted no till and chisel plowing with one-third ground cover at planting gained more of their farm income from grain. Conversely,

farmers who adopted deep plowing had a higher percentage of income from animals.

Caswell et al. (2001) found mixed results also. Farmers with soybeans and row crops were more likely to use nitrogen testing and split nitrogen applications. Farmers with row crops were more likely to use soil conservation practices, yet were less likely to use no-till. Farmers with animals were less likely to use nitrogen testing and split nitrogen applications. Farmers who grew cotton and fruits and vegetables were more likely to use IPM.

The relationship between farm product and adopting conservation measures is investigated in a series of questions in the survey.

In the last two years, either in 2000 or 2001, has any livestock like beef, calves, dairy cattle, hogs, sheep, poultry, or horses been raised on your land?

In the last two years, were any orchard or vineyard crops like fruits or nuts raised on your land?

Were any field crops like wheat, hay, corn, soybeans, grain sorghum, cotton, vegetables, or rice raised on your land in the last two years?

Any ornamental crops like shrubs, trees, turf grass, sod, or flowers? Are there any other kinds of agricultural activity on your land in the last two years?

In Texas and California they are asked “Are any fruit or vegetables grown in fields” (American Farmland Trust, 2001:1-2)?

External Characteristics

9. Landowners who have information about available conservation measures are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Similar to government financial incentives, information is externally introduced into the adoption process. For example, some government programs offer subsidies, while others offer technical assistance. Instead of being intrinsic to the farmer or his operation, information is available from outside sources.

Farmers seek to reduce uncertainty about conservation innovations through information. A landowner cannot be expected to adopt a practice of which he has never heard. Farmers who know about a practice cannot be expected to adopt it unless they understand its expected costs and benefits, including the potential benefit of helping the landowner solve a considerable environmental problem (Napier and Napier, 1991).

Like other variables, information’s effectiveness to influence adoption decisions is dependent on other factors. Information cannot be effective unless there is an understanding of why farmers do not adopt. It must be adapted to the specific needs and conditions of the farmer. Education and technical assistance that is effective for early adopters is not going to be as influential for late or non-adopters; they are subject to different circumstances (Nowak, 1992).

Nowak (1987) found that information as conceived as contacts with extension personnel, the NRCS, Agricultural Stabilization and Conservation Service, the Soil and Water Conservation District, and the number of field days visited increased the amount of variance explained in conservation tillage but not contour planting, strip cropping, grass waterways, and buffer strips. Caswell et al. (2001) found that having received advice from an outside source increased the likelihood of using nitrogen testing, splitting nitrogen applications, rotating crops, and using IPM.

Rikoon and Heffernan (1989) found that if NRCS District conservation officers emphasized the individual nature of conservation plans, they reduced anxiety that the plan would not work. They also found different information sources appealed to different groups of adopters. Those who adopted conservation practices early were more likely to use SCS publicity and the mass media. Middle and later adopters depended more on neighbors, family, and friends. Finally, unanswered questions about the conservation compliance program or a negative rumor about the consequences of program participation prevented people from participating in conservation compliance.

Since the issue of information sources is not addressed in the survey, it will be addressed in the open-ended interviews. When a respondent answers that they have adopted a certain practice, they will be asked how they learned about it.

10. The landowner having the objective of passing the farm to future generations affects whether landowners are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitats, or to minimize overgrazing or other damage to pasture/ rangeland.

Evidence in this area is contradictory and ambiguous. Each researcher tests a different relationship. Ervin and Ervin (1982) found plans to transfer the farm to a child were not significantly related to the number of conservation practices implemented or the effort to implement conservation practices. However, Carlson and Dillman (1983) found operating the farm with a son was related to adopting erosion control measures and other kinship arrangements were less strongly related to adopting erosion control and other types of innovations. They also found farmers who expected one of their children to farm were more likely to adopt erosion control practices. While the two studies appear to entirely contradict each other, they only test one similar relationship.

This relationship will be measured by the survey question: “How important to you is the objective of have the next one, two, or more generations of your family owning and benefiting from the land? Would you say, very important, moderately important, slightly important, not at all important?” Also, out of eight total options “from the objectives I just asked you about, which one would you consider the most important to you… your descendents owning and benefiting from the land?” “From the objectives I just asked you about, which one would you consider the second most important to you… your descendents owning and benefiting from the land?”

11. Landowners who farm with a family member are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitats, or to minimize overgrazing or other damage to pasture/ rangeland.

In addition to expecting a family member to inherit the land, it is possible that sharing the operation with a family member will increase the odds of using a conservation practice. Carlson and Dillman (1983) found operating the farm with a son was related to adopting erosion control measures, while other kinship arrangements were less strongly related to adopting erosion control and other types of innovations. The question, “Who makes the day-to-day decisions?” will be used in conjunction with, “Who else makes the decisions?” to determine if the landowner responding that decision making is in the family is related to using a conservation practice (American Farmland Trust, 2001:13).

12. Landowners in the path of development are less likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Nearby or adjacent residential development may negatively or positively impact the farmer’s decision to adopt conservation practices. Development pressure affects the landowner’s planning horizon as well as the available network of service businesses to support agriculture. Equipment needed for conservation practices or equipment repair services may not be available locally, or the remaining agri-business dealers may not be willing to carry needed products. Moreover, if there are not other farmers using conservation practices, the farmer is not likely to adopt a new practice such as a residue

management system. The farmer needs a local support system to provide equipment, service, and advice (Nowak, 1992).

The new neighbors brought in by developing rural areas may force farmers to modify practices to avoid nuisance complaints from non-farm neighbors. Modifications may include different pesticide applications, manure storage, etc. (Michigan Department of Agriculture, 2001). None of the empirical research reviewed for this study tested the relationship between development pressures and adoption of conservation practices. It will be tested, in part through the survey question: "Please think ahead 5 years from now and about the status of your agricultural land. Do you expect that five years in the future… First, all of that land will either be farmed or lie fallow, Second, all of it will be developed for housing or other non-farm uses, or third, some combination of developed non-farm use and farmland either used or lying fallow?" (American Farmland Trust, 2001:15).

This issue will also be addressed in the open-ended interviews. The farmer will be asked if their operation has been affected by local development. If a farmer indicates development pressure as being a reason he does or does not adopt conservation practices, he will be asked to explain his motivation.

13. If the government shares in the cost of conservation measures, landowners are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Different government programs are believed to have varying effects on the adoption of conservation practices. Some programs are believed to inadvertently counter conservation practice adoption. Other programs should promote conservation by providing education, technical assistance, and payments for adopting conservation programs.

A general belief is that if the government shares in the cost of conservation measures, landowners are more likely to implement/support them (Ervin and Ervin, 1982). If economic factors prevent landowners from adopting conservation measures, they may also provide an incentive to adopt. However, complete agreement does not exist as to the direction of this relationship. Producers still must pay part of the cost of adopting conservation practices in cost sharing programs. Landowners may only adopt practices that reduce costs, or they may need some other incentive to adopt (Claassen, et al., 2001).

Ervin and Ervin (1982) found that while participation in technical assistance programs did not affect the number of conservation practices adopted nor erosion control efforts, operators with more government subsidized acres had greater erosion control efforts. Sinden and King (1990) found the probability of applying conservation measures was increased by enrollment in a local land conservation project that provided a 50 percent subsidy and low interest loans for the remainder of the cost. Camboni and Napier (1993) found farmers adopting no-till more frequently participated in government loan and subsidy programs. Caswell et al. (2001) found that receiving technical assistance and having crop insurance increased the likelihood of using split nitrogen applications, and nitrogen testing, professional scouting, soil conservation practices. Receiving technical assistance increased the likelihood of rotating crops. However, there is contradictory evidence. Napier (2001) did not find a relationship between adopting conservation practices and receiving technical assistance, economic subsidies, or participation in government conservation programs.

No support exists for the opposing relationship. Since this question so directly applies to political science, it will be addressed in the survey questions and focused interviews. Survey questions addressing the relationship follow.

> In the year 2000 did you personally receive any payments directly from the federal government to compensate for crop or livestock losses due to disastrous weather like drought, flood, or hail?
>
> In the year 2000 did you receive payments directly from the federal government to offset the effects of low agricultural market prices, such as Market Transition Act payments, production flexibility contract payments, non-recourse commodity loans, or loan deficiency payments?

How important is it or would it be, for the government to help with the cost of insurance policies that insure against damage to crops from drought, flood, hail, or other severe weather? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be, for the government to give payments to you to offset low market prices for crops? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be, for you to get technical assistance and loans to diversify the mix of crops or livestock raised on your land? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be for you to have technical assistance and cost sharing to minimize the amount of chemical pesticides or fertilizers used on your agricultural lands? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be for you to have technical assistance and loans to produce organically grown foods? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be for you to have technical assistance and cost sharing to minimize water and odor pollution from livestock? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be for you to have technical assistance and cost sharing to minimize water pollution from crop production? Would you say that it is … not at all important, slightly important, moderately important, or very important?

How important is it or would it be for you to have technical assistance and cost sharing to protect or improve wildlife habitat? Would you say that it is … not at all important, slightly important, moderately important, or very important (American Farmland Trust, 2001:16)?

Focused interviews will also be used to explore this relationship in a much less directed manner. Farmers will be asked what contributes to their adopting a conservation practice or not adopting a practice to see if they mention government cost-sharing and/or technical assistance. Also to be explored is whether either income-support payments or subsidized crop insurance has any influence on application of conservation practices.

14. Farmers with production contracts with large food processors are less likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Many farmers produce their crops according to contracts they have with large food processors. These processors determine how the crops are produced, including the pesticides applied to them and their harvesting schedules. Since they stress profit, they may not invest in land conservation. Therefore, farmers under these contracts may not have the latitude to adopt new practices (Burch, Rickson, and Annels, 1992).

Conversely some processors may require conservation measures to be applied in their production

contracts. This area has not been explored by studies reviewed for this paper. Since it is a new area and investigates a potentially complex relationship, it will be examined in the focused interviews. It can also be partially investigated through open-ended responses to the survey questions, "Who makes the day-to-day decisions, a farm manager, the operators of the farmland, or someone else?" "Who else makes the decisions?"

Limitations of Previous Studies

Previous studies on the adoption of conservation measures are restricted in their ability to explain the adoption process. Their findings and generalizability are limited. They contradict each other in their definition of the variables under study. Finally, they are sometimes imprecise in their definitions and data collection methods.

Limited Findings

Statistical analyses thus far have had a limited ability to explain the adoption of conservation measures. Nowak found that multiple regression models at best explained 33 percent of the variance in adopting conservation tillage (Nowak, 1987). Ervin and Ervin (1982) explained 31 percent of the variance in the number of soil conservation practices adopted and 26 percent of the variance in soil conservation effort. At the other extreme, Pampel and van Es (1977) were only able to explain 15 percent of the variance in the adoption of profitable conservation practices and 1 percent of the variance in unprofitable practices. Statistical studies have shown to be somewhat better at explaining variance in opinions toward conservation. Napier and Napier's (1991) model was capable of explaining 55.3 percent of favorability toward conservation compliance.

Two studies were performed using logistic regression. The odds ratios are reported. They estimated the multiplicative change in the likelihood of adopting a conservation practice associated with a one-unit increment in the independent variable under review holding the other independent variables in the equation statistically constant. Sinden and King (1990) found the cost required of the conservation practices (1.766) and being in the Keepit Project increased the likelihood the farmer would try to solve their erosion problem. Their livestock carrying capacity (.225) and the distance to Manilla decreased the likelihood they would solve their erosion problem.

Turrell and McGuffog (1997) found a one-unit increment in eight of their 26 variables increased the likelihood that farmers would not rinse their chemical containers. The eight variables consisted of whether the farmer had any lack of formal training in the use of agricultural chemicals (2.33), had a tertiary (college education) (1.63), raised livestock (3.16), had no additional adults involved in production (1.85), had a farm over 3500 hectares (2.02), felt rinsing was not important to ensure chemicals are not wasted (4.18), felt rinsing was not important to ensure the containers can be safely disposed (3.49), disagreed that the amount of chemical left in the container after it is emptied is not a threat to the environment (1.82). Overall, Turrell and McGuffog admitted their model did not fit the data well. It was only capable of predicting 12.7 percent of the cases of non-rinsing.

This lack of explanatory power is attributed to the fact that conservation is a dynamic process that cannot be well explained by "static reduced form models." Performing cross-sectional analysis in this area typically yields low explanatory power (Ervin and Ervin, 1982). The decision process is actually continuous and dynamic (Sinden and King, 1990). It is hoped that the use of focused interviews will better illuminate the dynamic nature of the adoption process. For example, instead of being asked standardized questions, farmers will be asked why they adopted a particular practice and how they

adopted it to form a complete picture of their adoption situation.

Measurement Problems

First, some measures could be better construed. Sinden and King (1990) gave the respondents a list of 14 potential benefits that give them the most satisfaction. If the respondent chose passing the farm on to the future as a "fully productive resource" as one of the five benefits that gave him the most satisfaction, he was coded as being a steward. Some of the measures are simply vague. For example Napier and Napier (1991) examined variables correlated with conservation compliance. While conservation compliance is generally the creation of and compliance with a conservation plan to prevent erosion on highly erodible land, it should be defined accurately for an empirical study. Different farmers may conceive of it in different ways. Their own study reported that 69.8 percent of their respondents had little or no knowledge of conservation compliance. Poorly constructed measures lead to questions as to whether the proxy variable really measures the underlying trait.

Second, it is difficult to compare findings from these multiple studies, because they all measure the variables differently (Ervin and Ervin, 1982). One example is the different measures used for the economic ability to adopt conservation measures. Bultena and Hoiberg (1983) used total 1981income from the sale of farm products and number of acres in farm unit. Carlson and Dillman (1983) used income and total acres farmed. Ervin and Ervin (1982) used only the total numbers of acres operated, while admitting total cropland may be an insufficient measure of net farm income. Caswell et al. (2001) also used acres operated. Korsching et al. (1983) used the respondents' reported gross farm income averaged over three years from 1977 to 1979. The differences in measuring the variables make it difficult to compare the findings of one study to another.

Almost every study looks at a different conservation measure or a different group of conservation measures. Turrell and McGuffog (1997) looked at the practice of rinsing out chemical containers. Pampel and van Es (1977) looked at the adoption of grassed or sod waterways, crop rotation, reduced tillage, contour farming, terracing, and planting trees. Sinden and King (1990) looked at stream bank protection, grassed waterways, dams, fence re-alignment, pasture establishment, crop rotation changes, and changing from crops to livestock. Nowak (1987) looked at only conservation tillage. One of the problems with using a specific set of conservation practices as the measure of applying conservation practices is that not every practice is applicable to every farm (Ervin and Ervin, 1982). For example, some farmers do not have significant slopes to their land, so they may not need grassed waterways. Or they do not need to farm on the contours.

Napier and Brown and Napier and Napier studied opinions toward conservation instead of actual adoption of practices. Napier and Napier (1991) looked at favorability toward conservation compliance. Napier and Brown (1993) examined attitudes toward groundwater pollution. It is quite possible that the landowners' actions differ from their attitudes.

Another issue with inconsistency of measures is that in some studies the same practice is categorized in different ways. For example, Nowak (1987) defined conservation tillage as a profitable conservation practice, in contrast to the classifying contour planting, strip cropping, buffer strips, and grass waterways as unprofitable practices. Pampel and van Es (1977) classified chisel plowing as profitable commercially, while sod waterways, crop rotation, and reduced tillage are classified as environmentally profitable practices. Not only do these two studies conflict with each other in their classifications, but also other researchers do not make the distinction between profitable and unprofitable practices. They looked at conservation tillage as the only conservation practice or grouped it with other variables (Ervin and Ervin, 1982; Bultena and Hoiberg, 1983; Carlson and Dillman, 1983; Napier, 2001).

This study will not be able to entirely sidestep the above mentioned measurement problems.

However, it will use multiple measures of income that will allow its findings to be compared to some of the aforementioned studies. Also, it does not attempt to classify conservation practices or limit itself to a particular practice. Instead farmers are allowed to specify the practice they use on their land given the objectives they report as having.

Limited Variability

Many of the studies only look at a single geographic area, a particular practice or group of practices, or specific crops. Some of the studies look at one region with very particular circumstances such as being subject to extensive government conservation programming or suffering high erosion rates. Bultena and Hoiberg (1983) looked at farmers in Iowa. Carlson and Dillman (1983) looked at eastern Washington and northern Idaho. Ervin and Ervin (1982) looked at the highest priority county in Missouri for controlling agricultural water pollution. Sinden and King (1990) studied Manilla Shire, Australia. Almost all of the studies took place in the Midwest region of the United States – Missouri, Iowa, Ohio, and Illinois (Pampel and van Es, 1977; Nowak, 1987; Rikoon and Heffernan, 1989; Napier and Napier, 1991; Napier and Brown, 1993). Four researchers offer more than a statewide perspective. Napier (2001) looked at Ohio, Minnesota, and Iowa, Turrell and McGuffog (1997) included all farmers in Australia, and Esseks and Kraft (1989) looked at six study areas in Colorado, Iowa, Wisconsin, Illinois, Missouri, and Tennessee. Caswell et al. (2001) offered the most comprehensive coverage. They analyzed areas in Alabama, Arkansas, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maryland, Mississippi, Nebraska, Pennsylvania, South Carolina, Tennessee, Texas, and Washington.

Most of the studies surveyed limited operation types. Bultena and Hoiberg (1983) looked at corn-soybean and corn-corn rotations. Carlson and Dillman (1983) researched wheat, barley, peas, and/or lentil growers. Napier and Brown (1993) studied corn, soybeans, and wheat operations of which some sold animal products as a secondary crop. Caswell et al. (2001) looked at small grains, corn, cotton, potatoes, wheat, peanuts, soybeans, and animal operations. Limited variability in the studies makes it difficult to generalize beyond the study area's specific circumstances or practices that can be used for particular crops.

This study attempts to overcome these limitations in two ways. First, the study is carried out in samples of urban-edge agricultural landowners in five different states allowing for generalizability beyond one area. Second, the types of crops grown are varied. Some examples are catfish, citrus, livestock, and palm trees.

Questionable Data Gathering Methods

Turrell and McGuffog (1997) pointed out that several of the studies do not report their data gathering methods. Ervin and Ervin (1982), Nowak, (1987), Camboni and Napier (1993), and Sinden and King (1990) did not report how they gathered their data. Reporting data gathering methods is important as face to face surveys, phone interviews, and mail surveys often have different response rates, which will affect the study's generalizability.

Other studies use surveys from multiple time periods. Bultena and Hoiberg used personal interviews from 1976 and surveys from 1977, but it is unclear how the two data sources are combined. Nowak (1987) surveyed all farmers in two water sheds 4 times over 2 years, but it seems as if all four surveys are combined into one data set, as the data analysis does not have a time component. Furthermore they did not specify if they are looking only at adoption during the time period of study,

nor do we know if the surveys have the same questions over time.

Study Population

The total population for this study is agricultural landowner operators from 10 urban-edge counties in five states – Michigan, Wisconsin, Texas, California, and New York. The 10 counties were randomly chosen from a pool of agriculturally significant counties subject to urban influence. The urban influence component is present, because the survey was originally intended to look at the influence of urban development on farmland owners. This stipulation limits the ability to generalize the findings of this study to landowners in non-urban influenced areas. The agricultural significance of the counties was established by reference to the 1997 U.S. Agricultural Census. The selected counties:

Comprise between 24 percent of total farms and ranches in Wisconsin to 49 percent in Michigan,

Comprise between 18 percent of all acres in farms or ranches in Texas to 44 percent in Michigan, and

Contain between 21 percent of the aggregate value of agricultural products sold in Texas to 52 percent in Michigan[1] (Esseks, Drozd, Gilbert, and Kraft, 2002:4).

Counties subject to urban influence are those that:

Have 10 percent or more of their land in agriculture as of the 1997 U.S. Agricultural Census,

Agricultural land composed at 20 square miles at the time of the 1997 U.S. Agricultural Census, [2]

As of the 1990 U.S. population census 25 percent or more of the county's total land was subject to "urban influence", and[3]

The degree of urban influence is classified as "high" or "medium" for at least 5 percent of total county land (Esseks et al. 2002).

The 1,617 landowners surveyed in the American Farmland Trust study were randomly selected from agricultural property owners in the 10 randomly selected counties. Eighty-two percent responded through phone interviews, 18 percent responded via mail back surveys. States with a higher percentage of unlisted phone numbers had lower response rates and required a greater reliance on mail back surveys. Response rates are 31 percent in California, 39 percent in Texas, 48 percent in Wisconsin, 46 percent in New York, and 49 percent in Michigan (Esseks et al., 2002).

The protocol for choosing study participants is very different for the surveys and the qualitative interview participants. Interviewees for the qualitative interviews who are knowledgeable about distinct parts of the adoption process must be chosen. These individuals must meet three requirements. They have to know the process under study, they must be willing to be interviewed, and finally, they must represent the potential range of perspectives on the issue (Rubin and Rubin, 1995).

The goal in choosing cases for qualitative interviews was to choose a wide variety of operation

sizes and types and a diversity of conservation practices to increase the cases' ability to represent all operation types. The cases are sorted based on income, operation size in acres, the number of conservation practices, and operation type by product. First, farmers or ranchers with a farm income at least $100,000 the previous year[4] are selected. Second, the highest and lowest income farmers with the most conservation practices and the least practices are chosen.

Third, the largest and smallest operations with regard to acreage are chosen – again I went down the list of largest operations until I found one with the most practices and then one with the least practices; the same process was used to pick two farmers with low acreages. Fourth, the operations with the most and least conservation practices are chosen, trying to find average size operations. Within this category, the most active practices are sought – such as stream bank stabilization, buffer strips, and rotating cattle pastures. Practices like following the instructions on the herbicide label and respondents who list the same practice for every category, such as listing strip cropping for erosion control, animal waste control, and keeping pesticides out of the water are avoided.

Finally, operations with product types that were not included in the previous categories are chosen. This category is saved for last, because the usual farm operation types are already represented. For example, most Michigan operation types are already listed in the previous categories, but since some cases are left over, a Christmas tree farm is chosen. It is more important for representativeness to have a diversity of sizes of field crop operations and livestock operations than to represent unusual crop types, because so few landowners report these crop types.

Data Collection

The two data collection methods are very different. The survey data consists of responses to an American Farmland Trust survey of urban-edge farmland owners in five states. There are 1,617 respondents in California, Michigan, New York, Texas, and Wisconsin. The Northern Illinois University Public Opinion Lab performed the interviews. The researcher was allowed to develop some of the questions for this survey that investigate the aforementioned hypotheses. First, the researcher performed a review of conservation adoption literature. Next, the researcher developed hypotheses she wanted to investigate supported by the literature. Dr. Esseks then considered these hypotheses when developing the actual survey questions. Therefore many of the hypotheses the researcher wanted to investigate are included in the survey.

The focused interviews were guided by a limited number of questions the respondent was asked to explore in-depth. The questions were open-ended. While the survey data was derived from a very specific set of questions given in the exact same wording and manner to every participant, the interview questions changed as new areas of adoption were brought up and each farmer was asked about those practices with which he was most familiar. Earlier interviews tried to get a wide variety of ideas, themes and explanations. Later questions narrowed the range of the topic. The design changed as the researcher learned from the interviews. Instead of acting as a step-by-step guide for the project, the research design was used to remind the researcher of the original motivation for the study (Rubin and Rubin, 1995).

Data Analysis

The two data sources have very different methods of data analysis. The survey responses will be analyzed via the statistical method logistic regression. The focused interviews will be analyzed via analysis of content.

Logistic regression can be used to develop a simple and accurate model of the relationship between the independent variables and the dependent variable. It is ideal for analyzing survey data, because it can be used to model many variables on different measurement scales. In logistic regression, the independent variables can be continuous and categorical, while the dependent variables can be categorical (Garson, 2001). Furthermore, its assumptions are more lax than Ordinary Least Squares regression (OLS). Logistic regression does not assume a linear relationship between the independent variables and the dependent variable. The variables do not have to be normally distributed. Finally, it does not assume homoscedasticity (Garson, 2001). Logistic regression does have some of the assumptions of OLS regression. All relevant variables must be included in the model. Otherwise the common variance they share with the included variables may be attributed to the included variables, or the error term may be inflated. Conversely, all irrelevant variables must be excluded, or the common variance they share with the relevant variables may be incorrectly attributed to the relevant variables. Also, the higher the correlation between the relevant variables and the irrelevant variables, the greater the standard errors of the regression coefficients for the relevant variables (Garson, 2001).

Sinden and King (1990), Turrell and McGuffog (1997), and Caswell et al. (2001) use logistic analysis in similar studies because their surveys include dichotomous and categorical responses. Therefore, it is ideal for analyzing the American Farmland Trust survey, since all the dependent variables are binary and the independent variables are continuous, dichotomous, or subject to being re-coded into two categories. The dependent variables are responses to questions about whether the farmer has a particular practice or not.

Logistic regression will be used to build multivariate models of factors that contribute to conservation practice adoption. Responses to the following questions will be used as the dependent variables. Landowners are asked about whether they use conservation practices that have been identified as being important in the literature.

> This year does any of the farmland you own have applied to it one or more methods that aim to minimize soil erosion? What methods are being applied to minimize soil erosion?
>
> This year does any of the farmland you own have applied to it one or more methods that aim to minimize the flow of chemical fertilizers or pesticides into surface water or groundwater? What methods are being applied to minimize the flow of chemical fertilizers or pesticides into surface water or groundwater?
>
> This year does any of the farmland you own have applied to it one or more methods that aim to minimize the flow of livestock waste into ground or surface water? What is being done to minimize the flow of livestock waste into ground or surface water on your farmland?
>
> This year does any of the farmland you own have applied to it one or more methods that aim to protect or improve wildlife habitats? What is being done on your farmland to protect or improve wildlife habitats?
>
> This year does any of the farmland or ranchland have methods applied to it that aim to minimize overgrazing or other damage to pasture or rangeland? What is being done to minimize overgrazing or other damage to pasture or range land (American Farmland Trust, 2001: 6-7)?

After a multivariate model is fit to the data, the model must be assessed by testing the variables' significance. Then the values of the coefficients must be interpreted to find what the estimated coefficients tell us about the research questions. First, what is the functional relationship between the independent and dependent variable? Second, what is the unit of change for the independent variable (Hosmer and Lemoshow, 1989)?

Focused interview data analysis must be as rigorous as quantitative data analysis. While the researcher interprets the interviews, the interpretation must be firmly grounded in the evidence. The researcher has a responsibility to show her interpretations do not exceed the data upon which they are based. "A clear, consistent model" of the adoption process will be developed as information is gathered, analyzed, winnowed and tested (Rubin and Rubin, 1995).

Data analysis of the qualitative interviews is an iterative process. It will occur as the interviews take place. The first step in qualitative data analysis is coding the data. Data are examined response by response, gathered into categories and then reassembled into themes and arguments. Initially, a few main coding categories are created from preliminary interview readings. Continued coding of data into categories necessitates new categories for data that does not fit into initial categories and changed categories as new evidence shows a previous category is really two separate categories. After all the data are coded into categories, analysis will be done within and across categories (Rubin and Rubin, 1995).

Themes are found by looking for similarities across the interviewees' interpretations of their situation. Once a set of themes is chosen, interviews are searched for confirming or disconfirming evidence to ensure they are grounded in the data. Theory building in qualitative interviewing begins as themes are drawn from the initial interviews and explored and modified in later interviews. Testing these themes as the interviewing progresses helps winnow ideas, dropping those that are not supported. At the same time, theories are modified to fit new scenarios (Rubin and Rubin, 1995).

Once some themes have been developed, later interviews are held in diverse settings to see how far theories extend and whether they should be changed. Two principles must be followed to extend the results of qualitative interviews. First, interviewing is continued until additional interviews do not add significantly to what has already been said. Second, there is an attempt to try to extend information to different sites and different circumstances. Do similar themes and concepts hold elsewhere where people are similar to those already interviewed, and do themes hold with people dissimilar to those already interviewed (Rubin and Rubin, 1995)?

The iterations stop, when a point of "theoretical saturation" has been reached. At this point, the data supports a small number of integrated themes and additional interviews no longer add ideas or issues (Rubin and Rubin, 1995).

Ethical Issues

Surveying and interviewing individuals requires following ethical guidelines. These guidelines are especially important when asking people to speak openly to you about their experiences. The researcher must avoid deception, ask permission to record comments, be honest about the intended use of the data, and ensure the interviewee will not be harmed emotionally, physically, or financially. The researcher must keep in mind the potential stress involved in asking people to explain in detail decisions they made many years ago and should be willing to spend the time necessary to discuss less stressful issues at the end of the interview to reduce stress (Rubin and Rubin, 1995).

Study Limitations

One of the biggest shortcomings of diffusion research is its pro-innovation bias. The belief that innovations should be diffused and adopted is pervasive. Innovations are always viewed as improvements. This bias means rapidly diffusing practices are studied more than slowly diffusing practices. Moreover, there is more information about adoption rather than rejection and continued use than discontinuation. Furthermore, there is a tendency to hold individuals responsible for their problems instead of the system. Non-adopters are blamed for non-adoption. They are irrational, uneducated, or traditional, if they are resistant to change. Part of the emphasis on blaming the individual may be because it is perceived as easier to change the individual than the system (Rogers, 1983). This study will try to obviate this problem by allowing the focused interviewee to discuss his situation and explain in his own words why he feels unable to adopt and the factors influencing his situation.

Both data sources suffer limitations. Survey data have two main threats. First, there is the possibility the interviewer will bias the interviewee's responses. The interviewer may inadvertently, even subtly influence the interviewee to respond a certain way. In turn, the interviewee may attempt to respond in a manner that is pleasing to the interviewer. The second problem is the self-selection bias. The persons participating in the survey may differ greatly from those choosing not to participate (Salkind, 2000).

Focused interview data also suffer some restrictions. Inaccuracies arise as respondents have trouble recalling their reasoning for implementing certain measures. Response bias may occur as the interviewee tries to answer the way they think the interviewer expects them to answer. The interviewer must be careful in this case to word questions so as not to lead the interviewee but allow him to provide his unfettered commentary on the topic (Yin, 1994).

The final issue of interviewer bias is complicated. Yin is correct in warning that if questions are not constructed well, they may contain some bias (Yin, 1994). While it is important to keep bias out of the questions, it is not necessary to maintain a completely neutral interview. Rubin and Rubin (1995) contend that neutrality is not a realistic or desirable goal. First, it is not possible for a person to set aside all bias and preconceived notions. Second, the researcher must convey enough empathy to encourage the interviewee to tell personal experiences. As long as the bias is recognized, its ability to limit the study should be minimized.

CHAPTER 2
LOGISTIC REGRESSION ANALYSIS

Introduction

Logistic regression analysis is used to test relationships in the survey data. Of particular importance is the testing for relationships found in previous studies of conservation practices applied to agricultural land. This study's 25 separate models are grouped into tables according to five types of conservation practice. For example, filter strips can be used to prevent soil erosion, stop agricultural chemical runoff, and provide wildlife habitat. However, a practice such as installing bird boxes can only be used for wildlife habitat.

An attempt is made to find independent variables that persist in multiple models to see if any relationships endure despite dramatic differences in geographic areas. Reporting some variables as having a more narrow effect is not meant to question their validity in the models in which they are significant. Rather, it is an effort to differentiate between those variables that qualify for multiple models and those that do not to identify areas of research that may be fruitful in multiple locations.

The number of cases in each model varies according to the incidence of missing values. Another cause of variation in *n* size occurs in the analyses of two types of livestock-related practices. Only surveyed owners with livestock operations on their land were asked about conservation measures for livestock waste and pasture/range management.

Some hypothesized causes were associated with the application of two or more types of conservation practices. For example, education is predicted to increase the odds of using a practice to reduce soil erosion, minimize agricultural chemicals in water, and protect or improve wildlife habitat. However, it must be pointed out that there is not a single instance in which the same hypothesized causal variable qualified for the logistic regression models of all five samples for every practice. This lack of complete consistency in findings shows that there are probably wide variations in causal conditions by state and practice. When possible, these variations will be discussed with information from the focused interviews and previous literature. However, explanations for every variation may not be available at this time. Other studies have faced the same challenge.

Unlike the focused interviews, the survey data includes both landowners who are operators and those who are non-operators. As is evidenced in Table1, the majority of the landowners are operators. Non-operators may be retired and allowing a son, daughter, or other family member to operate the land as their business partners. Or, they may lease the land. Finally, as indicated in the focused interviews, they may still perform the majority of the decision making for the land, but they consider another family member to be the land operator. The non-operators may request or require the land operator to implement or maintain conservation practices. In some cases, the landowner is no longer involved in the farm operation at all. It was hypothesized that non-operators as a group would be less likely to report conservation practices being applied to their farmland, because an owner-operator is more likely to have a long-term interest in the land's productivity (compared to a non-owner operator) that tends to result in more conservation effort. This hypothesis was supported in eight of the state models.

It was decided to include in the analysis of the survey data the responses of both owner-operators and landowners who lease out their land and, thereby capture a wide variability in ownership circumstances. Table 2 shows that a significant percent of landowners in each state lease their land. However by comparing Tables 1 and 2, it is obvious that the same landowner may lease and operate the land. The ownership relationship is further complicated as indicated by landowners in the focused interviews, because some of them lease land they own to other operators, while leasing land to operate from other owners. It is now evident that the owner/operator relationship is far more complicated than a

simple dichotomy.

Table 1. PERCENT OF LANDOWNERS WHO ARE FARMERS OR RANCHERS					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Percent of Landowners Who Are Farmers or Ranchers by Occupation	32.5	26.9	39.5	15.5	34.5
Percent of Landowners Who Are Operators	75	65	74	68	63
N	323	327	329	322	316

Table 2. PERCENT OF LANDOWNERS WHO LEASE LAND

	California	Michigan	New York	Texas	Wisconsin
Percent of Landowners Who Lease Out Land	40.3	33.3	24.6	27.9	25.7
Percent of Landowners Who Require Operators to Apply Conservation Practices in Leases	21.6	14.2	15.9	17.1	29.4
Percent of Landowners Who Verbally Ask Operators to Apply Any Conservation Practices to Farmland or Ranchland	26.8	19.2	23.4	26.6	30.2
N	323	327	329	322	316

Previous evidence as to the effect of whether the operated land is rented or owned has contradictory results. Two studies support the relationship that owned land is likely to have more conservation practices applied to it than rented (Bultena and Hoiberg, 1983; Esseks and Kraft, 1989), while another study does not find that kind of relationship (Napier, 2001). Caswell et al. (2001) did not find a relationship between owning the operated land and using practices such as nitrogen testing, splitting nitrogen applications, and biological pest control. They found a negative relationship between owning the operated land and using a professional scout for pest management. However, none of these studies looked directly at the relationship between being an operator versus a non-operator. They all look at the other side of the relationship-- whether the operator treated owned land differently from rented farmland. Therefore, this other relationship is investigated here**.** Relationships between being an operator or having been an operator and using a practice to reduce the flow of agricultural chemicals into water and using a practice to protect or improve wildlife habitat are only found in the Michigan sample. The landowner being a farmer or rancher is predicted to increase the odds of using a practice to protect or improve wildlife habitat by 2.476 and the odds of using a practice to reduce chemicals in water by 2.889 (see Tables 6 and 10 at end of chapter).

Hypotheses for Demographic Variables

1. Landowners with more education are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, and to minimize overgrazing or other damage to pasture/ rangeland.

The first demographic hypothesis receives limited support. In 7 of the 25 models of urban-edge agricultural landowners, years of formal education are predicted to increase the odds of using a conservation practice, as shown in Tables 4, 6, and 10. An additional year of formal education is predicted to increase the odds of using a soil erosion control practices by 1.211 in the New York sample, in Texas by 1.155, and in Wisconsin by 1.148, holding other variables in the model constant. In the New York sample an additional year of formal education is predicted to increase the odds of using a practice to protect or improve wildlife habitat by 1.142 and in Texas by 1.157. An additional year of formal education is predicted to increase the odds of using a practice to minimize chemical pollution in water by 1.119 in the Texas sample and by 1.159 in Wisconsin.

These three categories of practices are similar in that some practices can be used to fulfill all three objectives. A practice such as filter strips can be used to stop soil and nutrients from flowing into water as well as provide habitat for wildlife. Moreover, no-till leaves crop residue on the field that can be used to hold soil and nutrients in place as well as provide food for animals.

Three out of five previous studies that I identified in my literature search support this potential, positive relationship between education and using conservation measures (Ervin and Ervin, 1982; Bultena and Hoiberg, 1983; Turrell and McGuffog, 1997). Conversely, Napier (2001) did not find education to be positively related to using soil conservation practices. While Caswell and others (2001) found education to increase the adoption of nitrogen testing, splitting nitrogen applications, and professional pest scouting, education did not impact the adoption of crop rotation, any soil erosion control practice, or soil conservation practices to protect water quality.

2. Landowners who are older or retired are less likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, and to minimize overgrazing or other damage to pasture/ range land.

One finding common across all this study's models of urban-edge agricultural landowners is that age of the respondent does not predict the use of conservation practices on his/her agricultural land. This finding counters two previous studies that found negative relationships between age and adopting conservation practices. Korsching, Stoferahn, Nowak, and Wagener (1983) found in their sample that adopters of minimum tillage were younger than non-adopters. Carlson and Dillman also found an inverse relationship between adopting erosion control practices and age in their 1983 study. The difference may be that the current study investigated the use of conservation practices on land that respondents owned, and some respondents were not also the operator of their agricultural land. However, when I controlled for status as an operator or non-operator, age still did not make a statistically significant difference.

Retirement status as a causal influence has not been tested in studies reviewed for this paper. Similar to age, being retired may affect the landowner's planning horizon. Therefore, it was hypothesized to have a negative effect. It receives some support in this study's state models, and it typically has an effect opposite from what was expected, as shown in Tables 4, 6, 8, and 10. In one model it has the expected negative effect. Being retired is predicted to decrease the odds of using a soil erosion control practice in the California sample by .348, holding other variables in the model constant. Yet in the four other cases where it qualified, being retired is predicted to increase the odds a practice is used. The landowner being retired increases the odds of using a practice to minimize the flow of livestock waste into water in the California sample by 10.938 and in Texas by 5.802. In Texas, the

landowner being retired increases the odds of using a practice to minimize agricultural chemicals in water by 2.733. The landowner being retired is predicted to increase the odds of using a practice to protect or improve wildlife habitat by 4.073 in Michigan.

Support for a positive relationship between retirement and conservation practices is found in the focused interviews. Retired landowners adopt manure management practices, because they save time by eliminating the need to spread manure every day. Furthermore, a Michigan landowner alluded to a lesser desire to make a profit as the reason to protect wildlife habitat. Since he is retired, he no longer has to use every piece of his land for production.

4. Landowners who are not operators, and never have been operators, are less likely to report the use of practices or to require the operator to use practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, and to minimize overgrazing or other damage to pasture/ range land.

Whether the landowner is a farm or ranch operator has a varying influence in each state, as shown in Tables 4, 8, 10, and 12. Being a farm operator or having been a farm operator is predicted to increase the odds of using a practice to prevent livestock waste from going into water and using a practice to control soil erosion in three out of five state samples. It increases the odds of using a practice to prevent livestock waste from going into water in California by 14.957, in New York by 3.698, and in Texas by 10.617, holding other variables in the equation constant. The landowner being an operator or having been an operator is predicted to increase the odds of using a soil erosion control practice by 2.765 in California, 2.859 in Texas, and 4.444 in Wisconsin. Conversely, having a professional occupation (such as being a doctor, lawyer, or professor) decreases the odds of using a practice to minimize damage to pastures in Texas by 0.170.

5. Landowners who live closer to their agricultural land are more likely to report the use of practices or require their operators to adopt practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, to minimize overgrazing or other damage to pasture/ rangeland.

It is hypothesized that absentee landowners are less likely to adopt conservation measures, on the assumption that working on the land or living close to agricultural land affects the use of conservation measures on it. The absentees are defined as those landowners who do not live on the land (that is, within a mile of their closest agricultural parcel) or do not farm it, so they may not be affected by or notice evidence of agricultural pollution or soil erosion. However, the bi-variate analysis did not find that being an absentee landowner impacted the use of conservation measures and therefore this relationship was not tested via logistic regression analysis.

Whether the landowner hopes to enjoy recreation on the land with his family is another potential measure of the effect of proximity. Yet, it has limited effect. Desiring this kind of life-style amenity increases the odds of using a conservation practice in four of the 25 logistic regression models as evidenced in Tables 6, 8, and 10. The landowner having the objective of self and family enjoying recreation on the land is estimated to increase the odds of using a practice to protect or improve wildlife habitat by 2.353 in the California sample, 3.792 in Michigan, 2.469 in Texas, and 2.072 in Wisconsin, holding other independent variables constant. Some of the landowners in the focused interviews who mentioned preserving wildlife habitat by planting grasses, restoring wetlands, or leaving food for animals said they did so for hunting, fishing, or wildlife observation purposes for themselves or family members.

Furthermore, in Michigan the objective of self or family enjoying recreation on the land increases the odds of using a practice to minimize the flow of livestock waste in water by 5.496. However, the landowner having recreation as one of top two objectives is estimated to decrease the odds of using a practice to minimize the flow of agricultural chemicals in water by .347 in Michigan and 0.412 in Wisconsin. It should be noted that, unlike agricultural chemicals, livestock waste probably has a more unattractive odor and it also tends to draw flies. Some landowners in the focused interviews

state the odor and flies as the reason to knife livestock waste into the ground, instead of letting it sit on top of the soil. Therefore livestock waste may be viewed as more inhibiting of recreation than agricultural chemicals.

Unexpected Demographic Findings

Gender is an interesting demographic variable that has not been considered in publications reviewed for this paper. Gender was not hypothesized to influence the odds of using a conservation practice. However, it is a demographic variable in the survey that appeared to be significant in the bi-variate testing, so it was tested in the model to try to meet the logistic regression assumption that all relevant independent variables be included in the model (Garson, 2001). While it has limited frequency of qualifying for the regression models, it is estimated to have a substantial impact in the cases it does show an effect. In four out of five models in which it is significant, being male is positively related to using conservation practices, as displayed in Tables 4, 6, and 12.

First, the landowner being male is predicted to increase the odds of using a practice to minimize agricultural chemicals in water, by 3.545 in the New York sample, and 2.397 in Wisconsin, holding other variables in the equation constant. Cross tabulations show in Wisconsin 25 percent of female landowners earning more than $87,500 use a practice to prevent the flow of agricultural chemicals water, while 27.5 percent earning less than $87,500 use such a practice. In Wisconsin, 57.9 percent of male landowners earning more than $87,500 use a practice to reduce the flow of agricultural chemicals in water, while 31.6 percent earning less than $87,500 use such a practice. Cross tabulations show in New York 46.7 percent of female landowners earning more than $87,500 use a practice to prevent the flow of agricultural chemicals water, while 7.7 percent earning less than $87,500 use such a practice. In New York, 58.1 percent of male landowners earning more than $87,500 use a practice to reduce the flow of agricultural chemicals in water, while 24.4 percent earning less than $87,500 use such a practice. A similar pattern is seen in Michigan. The landowner being male in Michigan is predicted to increase the odds of using an erosion control practice by 2.107 and the odds of using a practice to minimize agricultural chemicals in water by 2.392. In Michigan, 70.6 percent of female landowners earning more than $87,500 use a practice to prevent soil erosion, while 30.3 percent earning less than $87,500 use such a practice. In Michigan, 85.1 percent of male landowners earning more than $87,500 use a practice to prevent soil erosion, while 51.3 percent earning less than $87,500 use such a practice. In Michigan, 47.1 percent of female landowners earning more than $87,500 use a practice to prevent soil erosion, while 15.8 percent earning less than $87,500 use such a practice. Also, 67.2 percent of male landowners earning more than $87,500 use a practice to reduce the flow of agricultural chemicals in water, while 33.3 percent earning less than $87,500 use such a practice. Therefore, there appears to be an interaction between income and gender. Male and female landowners with higher incomes are more likely to report conservation practices than their lower income counterparts. Moreover, male landowners at both income levels are more likely to report the use of conservation practices than their female counterparts at both income levels.

Yet, in Michigan, being male is estimated to decrease the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 0.222. In Michigan, 21.4 percent of female landowners earning more than $87,500 use a practice to minimize overgrazing or other damage to pasture/range land, while 33.3 percent earning less than $87,500 use such a practice. In Michigan, 11.1 percent of male landowners earning more than $87,500 use a practice to minimize overgrazing or other damage to pasture/range land, while 17.7 percent earning less than $87,500 use such a practice. In this case, there appears to be a negative relationship between being male and income and using practices to reduce range damage.

Hypotheses for Attitudinal Variables

6. Landowners who have stewardship objectives for their land are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, to minimize overgrazing or other damage to pasture/ range land than are landowners who do not have such objectives.

The hypothesis that landowners who have stewardship objectives for their land are more likely to have conservation practices applied to it is not consistently supported in the logistic regression models of urban-edge agricultural landowners, as shown in Tables 4, 6, 8, and 12. The surveyed owners had three chances to indicate that, among their ownership objectives, were ones to prevent harm to their land (see "eros," "pollut" and "steward" in the list of variables in Appendix A). In eight models, the owner having one of these stewardship objectives increases the odds of using a conservation practice. The objective of protecting the land from soil erosion is predicted to increase the odds of using a soil erosion control practice in California by 6.053 and in Michigan by 3.285, holding other variables in the model constant. Also, the objective of protecting bodies of water from agricultural pollution is estimated to increase the odds of using a soil erosion control practice by 3.964 in California and in Wisconsin by 4.456.

Four other relationships are each found in one model. In California, the landowner having the objective of protecting the land from soil erosion is predicted to increase the odds of using a practice to prevent pasture damage by 7.391, holding other independent variables in the model constant. Conversely, in New York the landowner having the objective of protecting bodies of water from agricultural pollution is estimated to decrease the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 0.184. It may be that livestock owners in New York, who grow crops, are unlikely to graze. The objective of protecting the land from soil erosion in Michigan is predicted to increase the odds of using a practice to minimize agricultural chemicals in water by 7.362. The landowner having stewardship as one of the top two objectives is predicted to increase the odds of using a practice to minimize the flow of livestock waste in water by 2.469 in New York. In Wisconsin, the landowner having stewardship as one of top two objectives is predicted to increase the odds of using a practice to protect or improve wildlife habitat by 2.677. Compared to the odds ratios of other dichotomous independent variables, these attitudinal variables show relatively large effects.

On the other side of the issue is the idea that landowners who see their farm as strictly a business venture do not use conservation measures as frequently probably because the latter are not seen as sufficiently profitable (Pampel and van Es, 1977). It is not consistently supported either, as evidenced in Tables 6, 10, and 12. The landowner having the objective of earning money each year by operating the land him/herself is predicted to increase the odds of using a practice to reduce agricultural chemicals in water by 1.845 in Texas. In California, the landowner having making money from farming as one of top two objectives increases the odds of using a practice to minimize the flow of agricultural chemicals in water by 1.943. Conversely, in the Michigan sample the landowner having the objective of seeing the land's dollar value increase over the years is estimated to decrease the odds of using a practice to minimize the flow of agricultural chemicals in water by 0.257

The landowner having a monetary objective also affects the likelihood of using a practice to prevent damage to range and pastureland. In Michigan, having increasing the land's dollar value as one of the top two objectives is predicted to increase the odds of using a practice to prevent damage to pasture by 6.102. Conversely, in New York the owner having the objective of increasing the dollar value of land over time is estimated to decrease the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 0.375), and in Wisconsin it decreases the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 0.445. The difference between Michigan, New York, and Wisconsin are confusing, because cattle owners in Michigan, New York, and Wisconsin are more likely to keep their animals in confined operations than those in California and Texas. However, in New York and Wisconsin the relationship between the objective of increasing the

land's dollar value and using a practice to minimize damage to pasture is positive. I could not test the effect of confined operations rather than use of pasture because the data set lacked a survey question on this issue.

The landowner having increasing the dollar value of land as one of the top two objectives is estimated to decrease the likelihood of using a practice to protect or improve wildlife habitat by 0.206 in California. It may be that landowners who want to increase the value of their land do not feel their land is suited for wildlife habitat. Or the land's value is high enough that they feel they cannot spare any for wildlife habitat; they must use it all for production.

No clear pattern for the causal effect of an underlying stewardship ethos or a profit ethos is given in the studies reviewed for this paper. Pampel and van Es (1977) found a difference between farmers who are environmentally innovative versus those who are commercially innovative. Their work was supported in a group of non-random interviews with farmers in Kansas, North Dakota, and South Dakota (Frieberg, 1996). But, two other studies found no support for such a relationship (Ervin and Ervin, 1982; Sinden and King, 1990).

10. The landowner having the objective of passing the farm to future generations affects whether landowners are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitats, to minimize overgrazing or other damage to pasture/ rangeland.

The hypothesis that landowners who expect someone in the family to inherit the farm are more likely to use conservation measures is not supported by the logistic regression models for the state samples of urban-edge agricultural landowners. A positive relationship between the objective of having future family generations benefit from the land and a conservation practice exists only in one model, using practices to reduce soil erosion in Michigan by a factor of 2.268, holding other independent variables in the equation constant, shown in Table 4. In Michigan, having the objective of future family generations benefiting from the land is estimated to decrease the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 0.322, holding other independent variables in the model constant, as seen in Table 12.

Hypotheses for Farm Feature Variables

7. There is a relationship between farm-size or landowner income from agriculture and reporting the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, to minimize overgrazing or other damage to pasture/ rangeland.

A consistent finding across all state models of urban-edge agricultural landowners is that farm size is not predicted to affect the use of conservation practices in any model. Some researchers found a positive relationship between farm size and conservation practices (Carlson and Dillman, 1983; Caswell et al., 2001). Conversely, other studies have found a negative relationship between farm size and conservation practices. Camboni and Napier (1993) found farmers with fewer acres were less likely to adopt no-till. Turrell and McGuffog (1997) found farmers with acreage over 3,500 hectares were less likely to rinse their chemical containers. Finally, Napier (2001) found no relationship between farm size and adopting conservation practices.

Another common finding in my study is the limited support received by income in the conservation models. Gross income from agriculture is estimated to increase the odds of using conservation practices in four models of urban-edge agricultural landowners in California and New York, as seen in Tables 4, 6, 10, and 12. Income from agriculture at least $100,000 is estimated to increase the odds of using a soil erosion control practice in California by 1.182 and in New York by 2.311, controlling for other independent variables in the model. Gross income from agriculture at least $100,000 is estimated to increase the odds of using a practice to minimize the chemicals in water by 4.742 in New York. In California, gross income from agriculture at least $100,000 is estimated to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 2.421.

Finally, higher gross income from agriculture is estimated to decrease the odds of using a practice to protect or improve wildlife habitat by 0.511 in Wisconsin. Previous studies looking at income do not have consistent findings. Carlson and Dillman (1988) found a moderately positive relationship between farm income and adopting erosion control measures. Also, Sinden and King (1990) found the "landholder's ability to invest capital to obtain a high yield, safe return" was positively related to adopting conservation measures. Napier (2001) did not find a relationship between debt-to-asset ratio or farm income and the adoption of conservation measures.

8. There is a relationship between the respondent's mix of farm products and reporting the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, to minimize overgrazing or other damage to pasture/ rangeland.

The findings in this study offer limited support for a relationship between type of agricultural product and using conservation measures. While in 5 of the 25 models farm product is predicted to increase the adoption of conservation practices, no single farm product is a statistically significant factor in more than two of the five models, as seen in Tables 6 and 10. Contrary to some previous studies that found a negative relationship between growing field crops and conservation practices (Ervin and Ervin, 1982; Napier and Brown, 1993), growing field crops increases the odds of using a practice to reduce chemicals in water in the Texas sample by a factor of 2.145, controlling for other independent variables in the model. Camboni and Napier did find support for this relationship in their 1993 study. According to landowners in the Texas focused interviews, growing field crops in Texas often requires high chemical inputs, while cattle in Texas are often raised on large ranges with little chemical use.

Raising livestock is predicted to decrease the odds of using a practice to minimize the flow of agricultural chemicals in water by 0.469 in California, holding other independent variables in the model constant. Cross tabulations show that in California 46 percent of livestock owners with field crops use a practice to prevent the flow of agricultural chemicals water, while 37.5 percent without field crops use

such a practice. Also, 32 percent of landowners without livestock and with field crops use a practice to prevent the flow of agricultural chemicals water, while 27.5 percent without field crops use such a practice. Therefore, there appears to be an interaction between livestock and field crops, in which landowners with both in the California sample are more likely to use practices to prevent the flow of agricultural chemicals in water.

Three different crops are predicted to increase the odds the landowner will use a practice to protect or improve wildlife habitat. Raising ornamental crops is predicted to increase the odds of using a practice to protect or improve wildlife habitat by 2.669 in Michigan, holding other independent variables in the equation constant. Orchards or vineyards are predicted to increase the odds of using a practice to minimize the flow of agricultural chemicals in water by 2.203 in Wisconsin and the odds of using a practice to protect or improve wildlife habitat by 5.452 in New York. This type of operation may provide better wildlife habitat, because landowners are interested in leasing orchard land to hunters (Palmer and Bromley, 1992). Last, growing fruits and vegetables is predicted to increase the odds of using a practice to protect or improve wildlife habitat 4.009 in Texas. I have not found an explanation for this relationship, and it may be the result of the association of this farm product variable with an unmeasured variable.

Unexpected Farm Feature Findings

In 21 out of 25 models, there is a relationship between two or more conservation practices, as seen in Tables 4, 6, 8, 10, and 12. If the landowner has one conservation practice, the odds of using another practice are predicted to increase in every state, although the combinations of practices vary. These relationships are not analyzed in depth, because often a single practice will serve multiple conservation goals. That is, the landowner will report having a practice to serve two separate objectives, when it is the same practice.

Logistic regression found significant relationships between preventing soil erosion, on the one hand, and either keeping chemicals out of water or improving wildlife habitat, on the other. The landowner having a practice to minimize water pollution from agricultural chemicals is estimated to increase the odds of using a soil erosion control practice in Michigan, California, New York, and Wisconsin. The landowner having a practice to protect land from soil erosion increases the odds of using a practice to protect or improve wildlife habitat in Michigan, New York, and Wisconsin.

Also, the landowner having a practice to protect land from soil erosion is positively related to using a practice to minimize the flow of livestock waste in water into California and New York. Finally, the landowner having a practice to protect or improve wildlife habitat increases the odds of using a practice to minimize the flow of agricultural chemicals into water in Michigan and California, and it increases the odds of using a soil erosion control practice in California, New York, and Wisconsin. A buffer strip may prevent soil erosion, keep agricultural chemicals out of water, and provide habitat for birds. Minimum tillage can be used to reduce the flow of chemicals and soil off the land, and either no-till or minimum till leaves a crop residue that animals can eat.

The landowner having a practice to minimize water pollution from livestock waste is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land in New York and Texas. The landowner having a practice to protect or improve wetlands increases the odds of using a practice to protect or improve wildlife habitat in California. Often landowners see wildlife habitat and wetlands as serving the same purpose. They consider wetlands habitat for birds. By the same token, wooded areas that provide wildlife habitat may be left alone if they are too wet to farm. Out of the 49 California landowners who use practices to protect or improve wetlands, 36 also have practices to protect or improve wildlife habitat. In 13 cases, the same practice is listed as “the main method being applied this year ” for both, such as fencing cattle out of areas, leaving or creating ponds, and placing the land in conservation easements. The landowner having a practice to minimize overgrazing or other damage to pasture/rangeland is the only practice tested that is not predicted to be associated with other practices. Perhaps preventing pasture damage is performed for reasons unique

only to it.

It is unlikely that the positive relationships between practically unrelated practices are causal. For example, using practices to minimize water pollution from agricultural chemicals probably does not cause the application of practices to minimize pasture or range damage in Texas and Wisconsin, or vice-versa. Yet the same landowner may apply or encourage his/her tenant to use practices for both minimizing water pollution from agricultural chemicals and minimizing pasture or range damage, because the owner has a stewardship ethos. Therefore, a particular kind of person will adopt multiple, unrelated practices.

Hypotheses for External Characteristics

11. Landowners who farm with a family member are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitats, to minimize overgrazing or other damage to pasture/ rangeland.

Having decision making in the family is predicted to increase the odds of using a conservation practice in 4 of the 25 models. It is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 11.956 in Michigan and by 4.411 in Texas. Also, it is predicted to increase the odds of using a practice to protect or improve wildlife habitat by 8.600 in California and 7.676 in Texas. The limited support for the relationship between having decision making in the family and using conservation practices is shown in Tables 10 and 12. Previous research indicates that farming with a child makes farmers more likely to adopt erosion control practices (Carlson and Dillman, 1983).

12. Landowners in the path of development are less likely to report the use of practices on their land to protect it from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

The survey data does not support the hypothesis that landowners in the path of development are less likely to have conservation measures on their land. Whether the landowner feels his land will be developed, lie fallow, or be farmed in five years did not prove to be a significant predictor in the bi-variate testing. None of the studies reviewed for this paper has tested this relationship, although it is suggested (Nowak, 1992; Nelson, 1998).

Hypotheses for Government Assistance

13. If the government provides financial or other assistance to their farm operations, landowners are more likely to report the use of practices to protect land from soil erosion, to minimize water pollution from agricultural chemicals, to minimize water pollution from livestock waste, to protect or improve wildlife habitat, or to minimize overgrazing or other damage to pasture/ rangeland.

Two types of responses are used to test this relationship. First, whether the landowner holds the attitude that governmental assistance is important. The second response is whether the landowner received government assistance for crop damage or low crop prices in 2000. In all states, for at least one of the five types of conservation practices, the landowner holding the belief that government assistance is important for at least one aspect of the farm operation is predicted to increase the odds of using a conservation practice, as seen in Tables 4, 6, 8, 10, and 12. The relationship with this kind of attitudinal variable is much more widespread than with the receipt of aid. The difference is most likely due to the greater variety of specific types of aid mentioned in the attitudinal questions versus just the two types in the questions about the receipt of aid. Overall, there is wide variability in the types of conservation practice and government assistance across the models. A distinction can be made between attitudes toward government assistance for conservation practices and attitudes toward government financial assistance for the farm operation.

In New York, the landowner feeling government help to minimize water pollution from crop production is important has an estimated significant impact on the odds of using a soil erosion control practice by 2.213, holding other independent variables in the model constant. In Texas, the landowner feeling government help to minimize the use of agricultural chemicals is “very or moderately important” is estimated to increase the odds of using a soil erosion control practice by 2.058, holding other independent variables in the model constant (see Table 4). These relationships make sense, because soil erosion is a form of water pollution from crop production. Moreover, four Texas landowners in the focused interviews alluded to wanting to decrease the use of chemicals required by the use of minimum tillage systems.

The landowner believing government help to produce organic crops is important increases the odds of using a soil erosion control practice by 2.010 in the California sample of urban-edge agricultural landowners. However, the landowner believing government help to produce organic crops is important decreases the odds of using a soil erosion control practice by .514 in New York. This relationship is almost the opposite of the preceding relationship.

Three specific types of government assistance are related to using practices to prevent agricultural chemicals from entering water (see Table 6). First, believing government help to minimize the use of agricultural chemicals is “very” or “moderately important” increases the odds of using a practice to reduce agricultural chemicals in water by 1.918 in California and by 2.239 in Wisconsin, holding other independent variables constant. Second, the landowner’s belief that government help to minimize water pollution from crop production is “very or moderately” important is predicted to increase the odds of using a practice to reduce the flow of agricultural chemicals into water by 2.673 in Michigan and by 1.708 in New York. These relationships are similar. Moreover, they are expected since, landowners may be more interested in assistance for practices they have. In the focused interviews, some landowners mentioned that structures to reduce water pollution from agricultural chemicals are expensive to build; therefore, government assistance is important for these practices. One example is silage tanks. The tanks prevent liquid silage from seeping into water. Other examples are terraces and buffer strips that must be built or planted.

Third, believing that it is “very or moderately important” to have government help with insurance against weather damage to crops increases the odds of using a practice to minimize agricultural chemicals in water by 2.078 in California (see Table 6). Two landowners in the focused interviews mentioned that reducing chemical applications makes their crops more susceptible to

environmental damage. It makes sense that these landowners would be more interested in government assistance to protect them from this type of loss.

The belief that government help to minimize water and odor pollution from livestock is important increases the odds of using a practice to minimize the flow of livestock waste in water by 7.621 in California, 3.365 in New York, and 2.407 in Wisconsin (see Table 8). This relationship is expected as landowners are likely to support assistance for practices they have. Similar to practices to keep chemicals out of water, practices to keep livestock waste out of water often require the use of costly structures. One of the most oft mentioned practices to keep waste out of water is a manure storage lagoon, which can be very expensive. Many landowners in the focused interviews who have built such structures or are considering building them mention receiving government cost sharing. Conversely, some landowners who have not built such structures state cost as the reason.

The landowner believing government help to produce organic crops is important increases the odds of using a practice to minimize overgrazing or other damage to pasture or rangeland by 2.674 in California (see Table 12). This first relationship may be explained by the inability to use chemical fertilizers on organic crops. Organic landowners may therefore not be able to restore pasture with such chemicals, but need help with other restoration. Believing that government help to minimize the use of agricultural chemicals is very important is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 3.025 in New York. It could be that landowners who graze would like government assistance to pursue a less input intensive form of farming.

Government assistance with zoning is related to the use of conservation practices for livestock operations in California and New York (see Table12). Believing that local government zoning to permit livestock operations to expand to economical levels is “very” or “moderately important” is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 3.180 in California. The landowner feeling local government zoning to limit conflicts with non-farm neighbors by restricting the number of non-farm homes is very important is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 11.312 in New York. It is possible that these relationships are artifacts of landowners with livestock operations being interested in livestock zoning policy. Cattle operations seem particularly sensitive to conflicts with neighbors, due to the related odor and pests. Therefore, livestock farmers may be more likely than non-livestock farmers to be interested both in these kinds of assistance and in applying a practice to limit damage to their pasture/range land. There is no causal connection, but a relationship may exist through a third variable.

Contradictory associations are seen for government assistance for agricultural-value property tax assessment in New York and Texas (see Tables 10 and 12). The landowner holding the belief that government help with agricultural-property tax assessment is very or moderately important is predicted to decrease the odds of using a practice to protect or improve wildlife habitat by 0.282 in New York. The reason this relationship occurs only in New York is open to investigation. In Texas, feeling that agricultural-value property tax assessment is very or moderately important to the owner is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 6.010. While this relationship makes sense, I can only speculate as to the reason why it is found in Texas and not other states. Texas livestock owners typically graze, and the operations are large lending them to be concerned about tax assessment rates

Believing that government help to protect or improve wildlife habitat is “very” or “moderately” important is estimated to increase the odds of using a practice to protect or improve wildlife habitat in California by 2.638, Michigan by 2.554, New York by 3.695, and Wisconsin by 2.284 (see Table10). Again, this relationship is expected as landowners are interested in assistance for practices they have. Landowners may feel it is important for the government to help them pay for planting grasses, building bird boxes, or creating ponds on their land.

Further, the landowner feeling government help with agro-tourism is important increases the odds of using a practice to protect or improve wildlife habitat by 3.164 in Michigan and by 4.184 in Texas (see Table 10). Interestingly, some landowners in the focused interviews promote hunting on

their land as a form of agri-tourism. For example, a Michigan landowner has planted filter strips for a pheasant hunting preserve. Moreover, a landowner in Texas leaves crop residue in his sorghum fields for birds to promote commercial hunting on his land. Overall, landowners interested in direct marketing or agri-tourism may be more interested in the health of their land and its appearance to attract consumers.

Residual Findings for Attitudes toward Government Assistance

Some of the findings in the area of government assistance are perplexing. The relationships are not logical. Four of these relationships have to do with livestock practices (see Table 8). In Michigan, the landowner believing government payments to offset low market prices for crops is "very or moderately important" increases the odds of using a practice to reduce livestock waste in water by 3.099, and believing government help to diversify the mix of crops is important is predicted to increase the odds of using a practice to minimize pasture damage by 3.678. In Wisconsin, believing government help to market crops directly to consumers increases the odds of using a practice to minimize the flow of livestock waste in water by 2.421, and believing government help to diversify the mix of crops decreases the odds of using a practice to minimize the flow of livestock waste in water by 0.345.

Three other puzzling relationships are found (see Tables 10 and 12). Believing that government help to protect or improve wildlife habitat is very important decreases the odds of using a practice to protect the land from soil erosion by 0.554 in New York. In Texas, feeling that government help to protect or improve wildlife habitat is very important is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 2.066 and believing that government help to market products directly to consumers is important increases the odds of using a practice to minimize water pollution from agricultural chemicals by 2.188 in Texas. These relationships may be the result of unknown third variables.

Whether the landowner receives government assistance is not as widely associated with using conservation practices in the models of urban-edge agricultural landowners as attitudes toward government assistance. It may be that the assistance mentioned is not sufficiently related to conservation practices. In nine of the 25 models having received government payments to offset low market prices in 2000 is predicted to increase the use of conservation practices, as seen in Tables 4, 6, 8, and 12.

In six models, the landowner having received such government assistance is related to the use of conservation practices for livestock operations. If the landowner received government payments to offset low market prices in 2000, the odds of using a practice to minimize the flow of livestock waste in water are estimated to increase by 6.778 in California and 3.533 in New York, holding other independent variables constant (see Table 10). The landowner having received government payments for weather damage to crops is predicted to increase the odds of using a practice to minimize overgrazing or other damage to pasture/range land by 3.040 in New York and 2.762 in Wisconsin (see Table 12).

The landowner having received government payments to offset low market prices in 2000 decreases the odds of using a practice to minimize overgrazing or other damage to minimize damage to pasture/range land by 0.230 in New York and 0.339 in Texas (see Table 12). Cross tabulations show in New York 49.1 percent of livestock owners with field crops receive government assistance to offset low agricultural prices, while 9.1 percent without field crops do so. Also, 28.2 percent of landowners without livestock and with field crops receive government assistance to offset low agricultural prices, while none without field crops do so. In Texas 27.9 percent of livestock owners with field crops receive government assistance to offset low agricultural prices, while 5.9 percent without field crops do so. Also, 44.4 percent of landowners without livestock and with field crops receive government assistance to offset low agricultural prices, while none without field crops do so. In both cases, landowners with

field crops are more likely to receive government assistance to offset low market prices. These landowners are less likely to graze their livestock.

Government assistance to offset low market prices increases the odds of using conservation practices in three more models. If the landowner received government payments to offset low market prices in 2000, the odds of using a practice to minimize agricultural chemicals in water are predicted to increase by 1.903 in Texas and in Wisconsin by 3.328 (see Table 6). The landowner having received government payments to offset low market prices increases the odds of using a practice to reduce soil erosion control in Texas by 1.858 (see Table 4). Landowners in the open-ended interview cited qualifying for government programs as the reason for using erosion control and manure management practices 15 times. Some government subsidy programs (such as the Food Security Act of 1985 and the 1996 Federal Agricultural Improvement Reform Act) require landowners to implement soil conservation measures on highly erodible land in order to receive program benefits. Therefore, it makes sense that receiving government assistance to offset low market prices and to pay for weather damage to crops would be related to using erosion control practices. The negative relationship between having received government assistance for low prices and using practices to prevent pasture damage is confusing.

As discussed earlier in the chapter, these relationships between government assistance for conservation practices and using the practices are supported by three previous studies in which government subsidized acres, subsidies for conservation practices, and other participation in government programs led to farmers adopting soil erosion control and other conservation measures (Ervin and Ervin, 1982; Sinden and King, 1990; Camboni and Napier, 1993). However, Napier (2001) found no relationship between using conservation practices and receiving technical assistance, having economic subsidies, and participating in government conservation programs.

Conclusion

The logistic regression models fail to support many of the literature based hypotheses, offer support for others and new relationships, and identify avenues for future research. Some of the hypotheses receive no support at all. Age, being an absentee owner, number of acres, and proximity to development do not affect the likelihood of using a conservation practice. Proximity to development is shown to positively influence the use of conservation practices in the focused interviews. Therefore, age, number of acres, being an absentee owner may not be fruitful areas of future research.

Other hypotheses from the literature receive limited or mixed support. Demographic variables receive stronger support than farm feature variables in the logistic regression models. Education receives support in seven out of 25 models. Retirement status receives positive support in four models. Being or having been a farm operator increases the odds of using a conservation practice in eight out of 25 models. Whether the land is relatively accessible to the owner receives support in four of the 25 models, as measured by the landowner desiring himself and his family to enjoy recreation on the land.

Ownership objectives offer support for the hypothesis that landowners using conservation practices feel differently about farming than those who do not. The landowner having some kind of conservation objective increases the odds of using a conservation practice in eight models in four states. Having a soil erosion control objective prompts the use of conservation practices in four models. A different ownership objective qualified for each of the other four models.

Having a monetary objective increases the odds of using a conservation practice in three models and decreases it in four. Unfortunately, an explanation is not immediately evident to explain why the relationship between monetary objectives and conservation practices is positive in three cases and negative in four. For example, increasing the land's dollar value as one of the top two objectives has a positive influence on using a practice to prevent pasture damage in Michigan but a negative effect in New York and Wisconsin. It is highly likely that due to the constraints of the survey questions, a stewardship ethos was not fully captured in this study. Overall, the findings in the area of ownership objectives are intriguing enough to elicit further investigation into measuring the possible effect of a stewardship ethos.

Hypotheses using farm feature variables to measure the ability or inclination to use conservation practices are not well confirmed. Income is positively related to using a conservation practice in only four models. Four different farm products receive support in one model each. However, the same product is not supported in more than one model. Family involvement as measured by the desire to have future generations farm and decision making being in the family receives support in five models total. These areas merit further investigation to find out what factors mediate their effect and in which situations they may influence the use of conservation practices.

Relationships between positive attitudes toward government assistance for certain types of conservation practices and using such practices are supported in almost every model. Landowners interested in government assistance to minimize the use of agricultural chemicals use practices to reduce the flow of chemicals into water in California and Wisconsin, those interested in government assistance to reduce water pollution from crop production are more likely to use practices to reduce agricultural chemicals in water in New York and Michigan. Landowners interested in government help to minimize water and odor pollution from livestock are more likely to use practices to reduce the flow of livestock waste in water in California, New York, and Wisconsin. Finally, if the landowner is interested in government assistance to use practices to protect wildlife habitat they are more likely to use these practices in California, Michigan, New York, and Texas. The groupings of these relationships show that landowners are interested in government support for practices they use. The idea that landowners would be more likely to implement conservation measures, if they received aid specifically for them merits further investigation.

The logistic regression equations resulted in two unexpected relationships. The first is the

relationship between gender and using conservation practices. While this relationship is not widespread, being male has a strong positive impact in four models. There appear to be differences between men and women that cause men to be more likely to use (or report the use on their land of) certain types of conservation measures.

The most prevalent relationships are between conservation practices. Nearly every conservation practice is related to at least one other in almost every model. The landowner having a practice to minimize water pollution from agricultural chemicals is estimated to increase the odds of using a soil erosion control practice in Michigan, California, New York, and Wisconsin. In Michigan, New York, and Wisconsin, the landowner having a practice to protect land from soil erosion increases the odds of using a practice to protect or improve wildlife habitat. Finally, the landowner having a practice to protect or improve wildlife habitat increases the odds of using a soil erosion control practice in California, New York, and Wisconsin. These relationships are not believed to be causal. Often a landowner will use the same practice to meet more than one conservation goal. Yet, the practices are separate and unrelated in some cases. These unexpected relationships may be due to the influence of a third unknown variable. It is possible that certain landowners are more prone to using conservation practices of varying types than are other landowners.

While some interesting patterns were found in the data, the pseudo R-squared value shows moderate strength of association between the independent and dependent variables in the model (Garson, 2001). Future work must build better models, probably by means of largely open-ended interviews that identify likely causal relationships that may then be tested with larger survey samples, as indicated by Napier in his 2001 study.

Logistic Regression Tables

SOIL EROSION CONTROL PRACTICES [5]

TABLE 3. PERCENT OF LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE SOIL EROSION CONTROL PRACTICES					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Percent of Landowners Whose Agricultural Land Has One or More Soil Erosion Control Practices	45.5	54.2	58.3	44.5	39.5
N	323	327	329	322	316

TABLE 4. CHARACTERISTICS OF FARMLAND OWNERS AND THEIR OPERATIONS THAT DIFFERENTIATE LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO PROTECT IT FROM SOIL EROSION: STATISTICALLY SIGNIFICANT ODDS RATIOS BY STATE

	California		Michigan		New York		Texas		Wisconsin	
Demographic Characteristics	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Age in years										
Gender			2.107	.020						
Years of formal education					1.211	.003	1.155	.009	1.148	.071
Respondent is retired	.348	.015								
Respondent is a farmer or rancher							2.859	.026		
Respondent is an operator or was one in the past	2.765	.093							4.444	.001
Attitudinal Characteristics										
Objective of protecting the land from soil erosion	6.053	.009	3.285	.100						
Objective of protecting bodies of water from agricultural pollution	3.964	.027							4.456	.005
Objective of having future family generations benefit from the land			2.268	.028						
Government help to produce organic food is very or moderately important	2.010	.038			.514	.068				
Government help to minimize water pollution from crop production is very important					2.213	.021				
Government help to protect or improve wildlife habitat is very important					.554	.085				
Government help to minimize the use of agricultural chemicals is very important							2.058	.007		
Farmland Characteristics										
Total number of acres owned										
Income	1.812	.094			2.311	.084				
One or more practices applied to minimize water pollution from agricultural chemicals	2.127	.028	3.354	.000	3.643	.000			2.792	.003
Practice to protect or improve wildlife habitat	7.693	.000			2.253	.026			2.527	.005
Government Assistance										
Government payments in 2000 to offset low market prices							1.858	.063		
Government payments in 2000 for weather damage to crops										
Nagelkerke R Square [6]	.439		.345		.444		.174		.376	

PRACTICES TO MINIMIZE WATER POLLUTION FROM AGRICULTURAL CHEMICALS [7]

TABLE 5. PERCENT OF LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO MINIMIZE WATER POLLUTION FROM AGRICULTURE

	California	Michigan	New York	Texas	Wisconsin
Percent of Landowners Whose Agricultural Land Has One or More Practices to Minimize Water Pollution from Agriculture	32.1	37.2	33.5	20.8	36.5
N	323	327	329	322	316

TABLE 6. CHARACTERISTICS OF FARMLAND OWNERS AND THEIR OPERATIONS THAT DIFFERENTIATE LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO MINIMIZE WATER POLLUTION FROM AGRICULTURAL CHEMICALS: STATISTICALLY SIGNIFICANT ODDS RATIOS BY STATE

	California		Michigan		New York		Texas		Wisconsin	
Demographic Characteristics	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Age in years										
Gender			2.392	.022	3.545	.006			2.397	.024
Years of formal education							1.119	.094	1.159	.036
Respondent is a farmer or rancher							2.889	.050		
Respondent is retired							2.733	.038		
Attitudinal Characteristics										
Has objective of earning money each year by operating land him/herself.							1.845	.101		
Objective of protecting the land from soil erosion			7.362	.087						
Making money from farming is one of top two objectives	1.943	.073								
Recreation is one of top two objectives			.347	.012					.412	.014
Owner has objective of seeing dollar value of land increase over time			.257	.001						
Government help to market products directly to consumers is very important							2.188	.025		
Government help with insurance against weather-caused damage to crops is very or moderately important	2.078	.038								
Government help to minimize water pollution from crop production is very important			2.673	.010	1.708	.084			2.239	.017
Government help to minimize the use of agricultural chemicals is very important	1.918	.063								
Farmland Characteristics										
Total number of acres owned										
Field crops grown on land							2.145	.084		
Livestock is raised on land	.469	.035								
Has orchard or vineyard crops									2.203	.104
Income					4.742	.000				
Practice to prevent soil erosion on the land	2.116	.038								
Practice to protect or improve wildlife habitat	1.854	.106	2.038	.031						
Government Assistance										
Government payments in 2000 to offset low market prices							1.903	.083	3.328	.001
Government payments in 2000 for weather damage to crops					2.023	.081				
Nagelkerke R Square	.319		.388		.265		.192		.271	

PRACTICES TO MINIMIZE THE FLOW OF LIVESTOCK WASTE IN WATER[8]

TABLE 7. PERCENT OF LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO MINIMIZE THE FLOW OF LIVESTOCK WASTE INTO WATER					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Percent of Landowners Whose Agricultural Land Has One or More Practices to Minimize the Flow of Livestock Waste into Water	19.1	30.3	36.5	11.5	34
N	215	155	208	260	197

TABLE 8. CHARACTERISTICS OF FARMLAND OWNERS AND THEIR OPERATIONS THAT DIFFERENTIATE LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO MINIMIZE THE FLOW OF LIVESTOCK WASTE INTO WATER: STATISTICALLY SIGNIFICANT ODDS RATIOS BY STATE										
	California		**Michigan**		**New York**		**Texas**		**Wisconsin**	
Demographic Characteristics	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Age in years										

Years of formal education										
Respondent is retired	10.938	.012					5.802	.009		
Respondent is a farmer or rancher	14.957	.003			3.698	.025	10.617	.002		
Attitudinal Characteristics										
Objective of self and family enjoying recreation on the land			5.496	.049						
Stewardship is one of top two objectives					2.469	.032				
Government payments to offset low market prices for crops is very or moderately important			3.099	.061						
Government help to minimize water and odor pollution from livestock is very important	7.621	.000			3.365	.010			2.407	.051
Government help to market products directly to consumers is very important									2.421	.053
Government help to diversify mix of crops is very important									.345	.018
Farmland Characteristics										
Practice to minimize overgrazing or other damage to pasture/range land			4.830	.005	2.843	.027			4.537	.001
Total number of acres owned										
Income										
One or more practices applied to protect land from soil erosion	3.705	.029			5.081	.002				
Received Government Assistance										
Government payments in 2000 to offset low market prices	6.778	.017			3.533	.008				
Nagelkerke R-Squared	.585		.380		.457		.146		.285	

PRACTICES TO PROTECT OR IMPROVE WILDLIFE[9]

TABLE 9. PERCENT OF LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO PROTECT OR IMPROVE WILDLIFE

	California	Michigan	New York	Texas	Wisconsin
Percent of Landowners Whose Agricultural Land Has One or More Practices to Protect or Improve Wildlife	35.5	36.5	27.8	35.3	40.1
N	323	327	329	322	316

TABLE 10. CHARACTERISTICS OF FARMLAND OWNERS AND THEIR OPERATIONS THAT DIFFERENTIATE LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO PROTECT OR IMPROVE WILDLIFE: STATISTICALLY SIGNIFICANT ODDS RATIOS BY STATE

	California		Michigan		New York		Texas		Wisconsin	
Demographic Characteristics	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Age in years										
Years of formal education					1.142	.027	1.157	.040		
Respondent is retired			4.073	.004						
Respondent is a farmer or rancher			2.476	.055						
Attitudinal Characteristics										
Owner has objective of self and family enjoying recreation on the land	2.353	.058	3.792	.003			2.469	.055	2.072	.066
Stewardship is one of top two objectives									2.677	.001
Increasing dollar value of land is one of top two objectives	.206	.009								
Government help with agricultural-property tax assessment is very or moderately important to the owner					.282	.033				
Government help to protect or improve wildlife habitat is very important	2.638	.014	2.554	.007	3.695	.000			2.284	.011
Government help with agro-tourism is very important			3.164	.002			4.184	.001		
Farmland Characteristics										
Has orchard or vineyard crops					5.452	.001				
Has ornamental crops			2.669	.048						
Has fruits or vegetables being grown on it							4.009	.056		
Decision making is in the family	8.600	.003					7.676	.000		
Income									.511	.102
One or more practices applied to protect land from soil erosion			5.332	.000	2.413	.011			3.173	.000
One or more practices is applied to minimize water pollution from agricultural chemicals	2.078	.057								
Practice to protect or improve wetlands	5.699	.001								
Received Government Assistance										
Government payments in 2000 to offset low market prices										
Nagelkerke R Square	.450		.370		.274		.415		.270	

PRACTICES TO MINIMIZE OVERGRAZING OR OTHER DAMAGE TO PASTURE/RANGE LAND[10]

TABLE 11. PERCENT OF LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO MINIMIZE OVERGRAZING OR OTHER DAMAGE TO PASTURE/RANGE LAND					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Percent of Landowners Whose Agricultural Land Has One or More Practices to Minimize Overgrazing or Other Damage to Pasture/Range Land	40.7	18.1	25.5	57.9	20.8
N	204	155	208	259	197

TABLE 12. CHARACTERISTICS OF FARMLAND OWNERS AND THEIR OPERATIONS THAT DIFFERENTIATE LANDOWNERS WHOSE AGRICULTURAL LAND HAS ONE OR MORE PRACTICES TO MINIMIZE OVERGRAZING OR OTHER DAMAGE TO PASTURE/RANGE LAND: STATISTICALLY SIGNIFICANT ODDS RATIOS BY STATE

	California		**Michigan**		**New York**		**Texas**		**Wisconsin**	
Demographic Characteristics	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.
Age in years										
Gender			.222	.012						
Years of formal education										
Respondent is retired										
Respondent has a professional occupation							.170	.006		
Attitudinal Characteristics										
Owner has objective of seeing dollar value of land increase over time					.375	.070				
Objective of protecting the land from soil erosion	7.391	.020								
Objective of protecting bodies of water from agricultural pollution					.184	.041				
Objective of having future family generations benefit from the land			.322	.084						
Objective of making money from farming is one of top two objectives									.445	.071
Increasing dollar value of land is one of top two objectives			6.102	.039						
Agricultural-value property tax assessment is very or moderately important to the owner							6.010	.045		
Government help to minimize water and odor pollution from livestock is very important					.261	.008				
Government help to produce organic food is very or moderately important	2.674	.032								
Government help to protect or improve wildlife habitat is very important							2.066	.037		
Government help to minimize the use of agricultural chemicals is very important					3.025	.032				
Government help to diversify mix of is very important			3.678	.029						
Local government zoning to permit livestock operations to expand to economical levels is very important	3.180	.005								
Local government zoning to limit conflicts with non-farm neighbors by restricting the number of non-farm homes is very important					11.312	.005				
Farmland Characteristics										
One or more practices applied to minimize water pollution from livestock waste					4.577	.003	4.646	.019		
Decision making is in the family			11.956	.036			4.411	.000		
Total number of acres owned										
Income	2.421	.084								
One or more practices applied to minimize water pollution from agricultural chemicals							7.583	.001	3.799	.002
Received Government Assistance										
Government payments in 2000 to offset low market prices					.230	.009	.339	.023		
Government payments in 2000 for weather damage to crops					3.040	.057			2.762	.053
Nagelkerke R Square	.286		.337		.404		.345		.126	

CHAPTER 3
FOCUSED INTERVIEW FINDINGS

Introduction

Along with the survey data, information has been collected through focused interviews. As is evidenced in the literature review chapter, there is disagreement in the literature reviewed for this study over which elements influence the adoption of agricultural conservation practices. It has been suggested that researchers speak to landusers about why they have or have not adopted conservation measures (Napier, 2001). This chapter is the result of such conversations with landowners. It is intended to explain discrepancies in the quantitative surveys and explore hypotheses that are more amenable to qualitative research, hopefully opening up new avenues of research.

A total of 54 open–ended interviews were performed. The average interview time was about 45 minutes. It was originally thought that 75 total interviews could be performed. However, the long days that farmers must work resulted in numerous call backs to set up interviews. Additionally, the interviews took much longer than the anticipated 30 minutes. Therefore, the target was changed to 50 interviews. Michigan has 12 interviewees, because it was the first state interviewed. California has 12 interviewees, because after ten interviews were performed, two landowners responded to letters of introduction, asking if they could be interviewed (see Table 13). Since generalizations are not made from these interviews as if they were representative samples of their populations, the data is not subject to the same sampling constraints as data for statistical analysis. However, as is indicated in the data collection section of Chapter 1, an attempt was made to choose interviewees from diverse backgrounds to broaden understanding of the circumstances behind conservation adoption.

TABLE 13. DISTRIBUTION OF INTERVIEWS

California	Michigan	New York	Texas	Wisconsin
12	12	10	10	10

While a list of questions was followed through the interview to direct the conversation toward the discussion of conservation measures, landowners were not limited in their responses. They were encouraged to expand upon their answers, and were asked why they chose to use certain practices or why they chose not to use others. The researcher tried not to lead or bias the landowners' responses, allowing them to speak as freely as possible. This style of focusing the interview topic, without limiting the interviewees' responses led to a large body of data that had to be analyzed methodically to interpret it without losing the original meaning.

The interviews were first analyzed for concepts. A concept "reflects the underlying ideas with

which people label their descriptions and understanding or their world" (Rubin and Rubin, 1995). Some concepts that arose in the interviews are soil type, cost sharing, and water scarcity. The concepts were then grouped into categories. Finally, themes were drawn from within and across the categories. Once themes were drawn within and across categories, analysis was performed to see if there were consistencies between states. It became evident that many of the themes hold across the states with varying degrees of persistence and at times in different contexts. However, some themes are state specific. First, themes that hold across two or more states will be discussed, after which state specific themes will be presented.

Measures Adopted Commensurate With Need

If a landowner is going to adopt a conservation practice, he must first feel it is needed. Landowners who do not feel their conditions require or encourage use of a conservation practice will probably not adopt one. To illustrate, one Michigan landowner tries to keep a cover crop in his orchards, unless the trees are very densely planted. When the trees are densely planted, they act as a ground cover to prevent erosion.

Landowners are unlikely to adopt erosion control measures, if they feel their land is not prone to excessive erosion. A California landowner explains that when she and her husband began developing their pasture, a government engineer graded the land to level it out for erosion prevention. They have not had to control for erosion since. All four of the interviewed New York farmers who do not use erosion control practices cite land slope and soil type as reasons not to apply erosion control practices. These farmers feel that since their land is flat, they do not need soil erosion control practices. In conjunction, a few of them cite their soil type as being gravel or honey loam soil which is not prone to washing away.

The same pattern is seen with interviewed farmers in Texas. One Texas landowner explains he does not have an erosion problem. His land is flat, and even eight to ten inches of rain do not cause erosion. He knows he does not have an erosion problem, because he does not see gullies or other visible effects of erosion. Another landowner in West Texas does not receive much rain, so he does not feel he needs to have an erosion control practice. Finally, one landowner does not use erosion control measures, because the orchards are so thick and jungle-like that they prevent wind erosion.

Among the surveyed owners in California, New York, and Texas with livestock, a common explanation for not using manure management strategies or range management strategies was that their cattle are in large pastures or ranges relative to their numbers. Two New York farmers do not adopt any pasture management strategies because they have a limited number of cows. They feel their range is large enough to support their number of animals. They also do not feel they need manure storage, as they have adequate land to spread the manure daily.

The same phenomenon is found in California. Many California landowners feel their acreage is large enough that they do not have to use manure management. One landowner explains that 100 cows on 600 acres do not necessitate a manure management plan. The manure on the surface breaks down on its own.

Many of the interviewed Texas landowners also have large acreage operations, so they feel they do not need manure management strategies. One Texas landowner explains that his cattle are spread out over 10,000, acres, so he does not need a manure management strategy. An additional Texas landowner feels he does not need a manure management strategy, because his operation is diversified enough that he always has a place to spread it. He can either spread in his own crops, or in other owners' surrounding orchards. However, he does not soil test. Manure spreading can be a conservation practice, when it is performed in conjunction with soil testing to ensure the soil is not overloaded with nutrients.

Soil testing is another practice that landowners choose not to use because they do not see a need

for it. Three surveyed landowners in California who do not use soil testing feel they do not need it, because they do not have yield problems. One farmer illustrates that he can farm 100 acres of land without having even 4 acres that do not grow. Another points out that he gets good crops, so he does not see a need to test and add more inputs. He further does not feel the need to soil test, because he has no intention of purchasing additional fertilizer. He uses his own organic fertilizer and does not need to purchase fertilizer. A Texas landowner does not soil test his fields because every time he has tested, the recommended rate of application was almost always the same. He uses his experience to determine how much nutrients he needs to use. These landowners do not see testing from the perspective of overloading the environment with nutrients; they see it from the perspective of not needing to add nutrients to increase yields.

It appears that in most cases, landowners do not adopt conservation practices, because they do not feel they need them. In all, 21 of the total of 54 interviewed owners used lack of need as a reason for not adopting at least one of the six to seven types of conservation practices discussed in the interviews (see Table 14).

TABLE 14. NUMBER OF TIMES LANDOWNERS CITE NOT USING A CONSERVATION PRACTICE DUE TO LACK OF NEED

	Wisconsin	New York	Michigan	California	Texas	TOTAL
Does not need practice		6		8	7	21
High cost of inputs and low price of product prevent adopting practice		2				2

Practices' Perceived Advantages

Expected benefits may cause a landowner to choose a new practice over one he already has. On the other hand, perceived benefits may be a reason to stay with not applying a conservation practice. For example, many farmers interviewed stay with the moldboard plow as they feel it provides good weed control and more nutrients. Table 15 shows the reasons landowners state as to why they stay with the moldboard rather than switching to conservation tillage.

TABLE 15 MULTIPLE REASONS LANDOWNERS CITE FOR USING MOLDBOARD PLOWS					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Weed control			5		
Pest control					1
Nutrients	1	1	1		1
Higher productivity					
Crop requirements			1		
Better tillage			1	1	
Familiarity	1		1		1

Reduce Expenses

One type of practice advantage is reduced expenses. The desire to keep expenses down may promote or inhibit adopting conservation practices. The main areas of cost reduction discussed in the interviews are chemical inputs, labor, and equipment. Table 16 shows the different conservation practices landowners mention using to reduce operation expenses.

TABLE 16. NUMBER OF TIMES LANDOWNERS CITE USING CONSERVATION PRACTICES TO REDUCE OPERATION EXPENSES

	California	Michigan	New York	Texas	Wisconsin
Split nitrogen			1		1
Manure storage	1		1		1
Crop rotation			1		1
No till		1	1	2	3
Minimum till	1	1		2	
Integrated pest management		1		1	
Reduce chemicals		1		1	
Spreads manure and soil tests				1	
Water conservation	2			1	
Level fields	1				

The desire to eliminate chemicals is partially due to their cost compared to the amount the landowner earns from crops. This reason holds for chemicals to protect crops from pests and weeds as well as nutrients to increase production. One Wisconsin landowner splits his nitrogen applications. He finds that he may be able to reduce the total amount of product he has to use compared to if he applied all the fertilizer at one time. Often, the price of nitrogen has gone down by the time he does the second application, providing him with further savings.

Landowners attempt many conservation practices to reduce the amount of fertilizer they must purchase. One New York farmer points out that using too much fertilizer costs money. He soil tests, so he is able to save money by using as little fertilizer as possible.

A California landowner circulates the water from his fish ponds to his rice paddies as a form of fertilizer to cut down on the cost of nutrient application. In a similar manner, one landowner irrigates his crops with water pumped from his manure lagoons. He is able to test the water to see how much nitrogen he is getting on the crops. This method prevents him from having to purchase nitrogen fertilizer.

The high cost of labor and equipment versus the cost of chemicals creates an interesting dilemma for farmers. They can either cut expenses by reducing chemical applications for weed control thereby increasing tractor tillage or pulling weeds by hand, or they can reduce expenses by increasing chemical applications and decreasing tillage. Table 17 shows the number of times landowners cite using conservation practices to reduce labor.

TABLE 17. NUMBER OF TIMES LANDOWNERS CITE USING CONSERVATION PRACTICES TO REDUCE LABOR					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Minimum till		1	2	2	3
No-till		1	1		
Conservation Reserve Program				2	

Among the surveyed owners in all five states, estimates of the relative cost savings for chemicals versus labor and equipment are key considerations in decisions to use minimum tillage or no-till. One Michigan landowner explains that he uses a chisel plow, because it is more economical and quicker. It is wider than the moldboard, and he does not have to be as careful with the row ends. Moreover, it can be pulled with a smaller tractor. Therefore, it saves him time and equipment costs. A Texas farmer claims that the cost of replacing tractors is so high that it is less expensive for him to replace tractors with chemical spray rigs using chemicals to kill grain stalks and control weeds instead of mechanical cultivation. The spray rig causes less strain on the farm equipment and can be pulled by an old tractor. Other farmers find that although they use more chemicals with no-till, they have savings as far as seed, labor and fuel. Round up is specifically mentioned as the chemical used for weed control by six of the fourteen farmers who use no till. No other chemical application is mentioned by name. Those who gave a reason for using Round Up cite its decreased cost.

Conversely, three of the ten farmers who use a moldboard plow mention reducing chemical applications or lower input costs. Other reasons are better weed control, better seed bed, and better nutrients. Two landowners use the moldboard, because they are used to it. It may be that farmers have not yet learned to reconcile the two competing pressures. A farmer in Texas and another in New York were able to use ridge till and no-till together to reduce chemical applications. The selective implementation of ridge till allowed the Texas farmer to alleviate many of the problems he had with no-till, such as the ground not being dry enough to plant. The ridges dry more quickly than flat land that is not tilled. He was able to band the fertilizers and pesticides to cut down on their use. The New York farmer who uses ridge till in combination with no-till explains that he is able to start planting his crops right away on some or most parcels; he does not have to cultivate first. While nutrients are increasing in his soil due to no-till, the ridge till allows him to plant in damp springs without cultivation. He can also use fewer chemicals.

Landowners have found other ways to reduce pesticide costs. A surveyed Michigan landowner uses an oil to cut his pesticide applications in half. The oil causes the pesticides to stick to the plants, so he does not have to re-spray. Crop oil is considered to be more environmentally friendly than synthetic pesticides and is allowed in organic operations (Pottorff, 2003). A different Michigan landowner uses Integrated Pest Management (IPM) to reduce his pesticide costs. He uses pheromones to capture insects to determine the level of the infestation. This practice allows him to spray when it is economically necessary and spray at more accurate intervals. He also uses pheromones to disrupt insects mating cycles. The practice is labor intensive, but less expensive in out of pocket costs. He estimates that he now uses half to one-third the amount of spray he used 30 years ago. A Wisconsin landowner also uses beneficial insects to control soybean aphids. It saves him money from not having to spray chemicals, and he appreciates not having to put a lot of chemicals in the environment.

Some landowners mention reducing chemical applications separate from cost savings. Reasons to reduce chemical applications other than saving money are to preserve wildlife, protect family and personal health, and help the local ecology. Table 18 shows the number of landowners using specific conservation practices to reduce chemical applications.

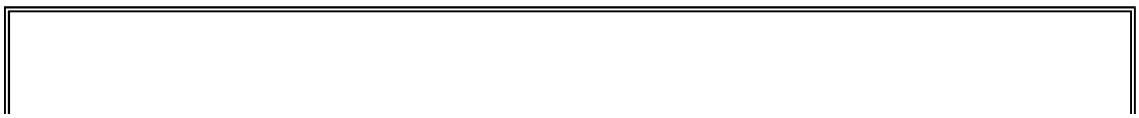

TABLE 18. NUMBER OF TIMES LANDOWNERS CITE USING CONSERVATION PRACTICES TO REDUCE CHEMICAL APPLICATIONS

	California	Michigan	New York	Texas	Wisconsin
Crop rotation		1	1		1
Ridge till			1		
Banding				1	

In this group of interviewees, using practices to conserve water is particular to California and Texas. A California landowner with rice paddies levels the fields to make sure the entire crop is evenly flooded. Not having high and low spots on the field decreases the amount of water he must use. Similarly, another landowner uses micro-irrigation to reduce cost by decreasing the amount of water he must pump into his orchard. A Texas landowner carefully monitors his irrigation system to stop the water at the row ends and prevent over watering.

It was hypothesized that the disparity between the high cost of farm inputs and the low price of farm products plays a role in the desire to reduce expenses. It is mentioned unsolicited in six of the total of 54 interviews. One farmer complains that inputs are becoming increasingly expensive, while milk prices have not risen since 1979. The relationship is not yet clear in its effect on conservation practices, because it is often made in a general statement and not related to any one practice. It will have to be explored more in later interviews.

Disease & Pest Control

Many landowners cite disease, weed, and pest control as reasons for using conservation practices (see Table 19). Yet, similar to many other practice advantages, disease, weed, and pest control problems may be reasons to use conventional practices.

TABLE 19. NUMBER OF TIMES LANDOWNERS STATE THAT THEY USE PRACTICES FOR DISEASE, WEED, AND PEST CONTROL

	California	Michigan	New York	Texas	Wisconsin
Crop rotation		1	2	2	2
Drip irrigation	1				
Controlled burns	1				
Rotational grazing	2				
Permanent pasture				1	

Disease, weed, and pest control are often cited in Michigan, New York, Texas, and Wisconsin as reasons to use crop rotation. One Michigan landowner uses crop rotation to control weeds and disease. He must rotate a crop with strawberries every five years, or the soil becomes overrun with disease. He does not want to fumigate, because it would kill beneficial organisms in the soil. A New York farmer rotates between alfalfa and corn to prevent the corn borer from establishing. A Wisconsin farmer alternates corn with soy beans and wheat because they do not attract or promote the same pests and weeds. If he plants red winter wheat in the fall, it also gives him income in the middle of the summer.

Additionally, surveyed California and Texas landowners use other conservation practices for weed control. One California landowner is converting from sprinkler irrigation to drip irrigation to reduce the number of weeds on his land. Another California landowner uses controlled burns in his pastures to reduce the number of weeds and promote the grasses to re-emerge. Two California landowners use rotational grazing to reduce weeds in their pastures. One landowner points out that if you allow the cattle to selectively graze, they will only eat clover allowing everything else to over-grow. A Texas landowner plants permanent pasture to prevent weeds in his pasture. The grass spreads quickly and eventually crowds out the weeds.

However, using a moldboard is a non-soil conservation practice that is often used for weed control. Ten of the landowners use a moldboard plow. As previously mentioned, landowners will use the moldboard to cut down on chemical applications. This practice is common in Michigan, New York, Texas, and Wisconsin. (See Table 18) One Michigan landowner has chisel plowed since the 1970's. However, he still uses a moldboard to remove orchard trees and prepare the ground for grapes. The moldboard breaks up the roots and weeds and buries the debris. He finds it especially useful in the fall to get rid of weeds such as wood ivy, Jerusalem artichoke, and Johnson grass.

Promote Soil Health

Other benefits for using a conservation practice are promoting soil health and the land's productivity (see Table 20). Promoting soil health can be seen as an advantage for either conservation or conventional practices. Landowners may alter their chemical application procedures to improve soil health. Two California landowners reduce the amount of chemicals they use for pest control to achieve this purpose. Excessive chemicals in the soil are bad, because they can seep into ground water, kill beneficial organisms in the soil, and flow off the land with soil and surface water collecting in water bodies. One California landowner uses low impact plant-derived pesticides with sugar to bait insects. It is combined with food grade oil that suffocates them. It is a practice that promotes the orchard's overall ecology. It is part of his organization's mission statement to protect the long-term viability and sustainability of the land.

Another California landowner has converted to an organic operation to improve his soil's health. He noticed that his trees were beginning to get "thrifty," and he was having difficulty getting seeds to germinate. He notices a difference in the soil health now, comparing its texture to butter and noting that the soil's organic content has greatly increased.

TABLE 20. NUMBER OF TIMES LANDOWNERS STATE USING PRACTICES TO PROMOTE SOIL HEALTH, EFFICIENT USE OF NUTRIENTS, AND OTHER ASPECTS OF PRODUCTIVITY

	California	Michigan	New York	Texas	Wisconsin
Crop rotation		2	2	1	
Minimum tillage			1	2	
No-till		4	1		2
Soil testing			1		
Organic farming	2				
IPM	1				1
Reduce chemicals	1				
Waterways			1	1	
Contour strips					2
Strip farm		1	1		1
Terraces				1	
Pasture rotation	3	1		2	
Plant pastures	1			1	
Fence livestock out of waterways	1				
Cover crops	1	2			
Careful irrigation	1				
Level fields	1				
Mulch	1				
Wetlands					1

Most interviewed landowners view promoting soil health as preventing erosion and increasing nutrients. A Michigan landowner uses cover crops to prevent erosion and keep the fertilizer from flowing off the fields in the winter. He allows rye or oats to get 6 to10 inches tall. He then sprays it with RoundUp to kill it. The plant stops drawing nutrients from the soil but still holds the soil together. In addition to preventing erosion, the practice, over time, allows the nutrients to build up in the soil, so eventually less fertilizer is needed. Over time, the better balanced soil also minimizes weeds. He uses fewer inputs and improves his land's ecology. Crop rotation is used to promote soil conservation and increase nutrients. Another Michigan farmer uses cover crops intermittently in his rotations to prevent crop failures. When he only planted pumpkins, they would not always emerge. He began to alternate them with rye. When he plants the pumpkins in rye, the rye preserves moisture and prevents weed build-up.

A similar practice is used with different crops in Texas. According to a Texas landowner if cotton is planted year after year, it will drain the land making it unproductive and allowing it to blow away. Conversely, rotating cotton with sorghum, will add humus to the soil**,** giving it nutrients for productivity and keeping it from blowing away.

Strip cropping is used to prevent erosion on rolling land owned by interview participants in Michigan, New York, and Wisconsin. A New York farmer explains the land is a resource that can last forever. As the topsoil gets thinner, production decreases. He can see the difference between people with deeper topsoil versus thin topsoil. Deeper topsoil grows better crops.

No-till and soil testing are also used for soil health. However, saving money is mentioned as much as soil health and conservation for using these practices. As one New York landowner puts it, you cannot grow crops on rock. Another New York farmer explains that he soil tests, even though his yield is good, because he does not want to drain the soil.

Different practices are used to maintain productivity for grazing operations. Three California

landowners use rotational grazing to increase production for their livestock operations. One landowner rotates the cattle into pastures after he irrigates. Rotation prevents the grass from being grazed down and keeps the cattle healthy and high producing. The second landowner uses pasture rotation and planting permanent pasture. Pasture rotation keeps the grass in the paddock from being eaten down to the point that it dies. Planting permanent pasture prevents fields from washing and stops gullies, allowing the land to be used more productively for grazing. A final California landowner uses rotational grazing to maximize the number of cattle on his land. He feels grazing an area with 1000 cattle can be increased to 1500 by rotational grazing. Since rotating the pastures allows the pastures to be free of grazing long enough to grow back, the overall pasture is more productive.

Interestingly, some farmers use the moldboard plow for tillage, because they think it nourishes the soil better. A New York farmer uses the moldboard plow because it turns the soil over better, providing him with newer nutrients. Conversely, the chisel plow only turns over the soil on top, not fully burying the residue. While a Wisconsin landowner tries to keep his highly erodible land in sod to prevent erosion, he still finds it necessary to use the moldboard. It better nourishes the soil, because the debris is buried.

The connection between productivity and conservation practices may seem intuitive. However, farmland owners who do not adopt conservation practices may not see the relationship, or they may feel their operation is productive without the practices. If a farmland owner does not see gullies or significant rills on his land, he may not see the need for soil conservation practices. By the same token, a farmer who keeps cattle in a large pasture may not see manure pile up, so he does not feel the need for a manure management plan.

Timing

Timing is a key reason for adopting conservation practices, since it is important for pest control, planting, and otherwise keeping the farm operation running smoothly. Timing is cited as the reason for using an entomologist to scout for pests. Spraying for pests must be done, before they have an opportunity to multiply and significantly damage crops. A Michigan landowner uses an entomologist to scout, because it is a more reliable method than following the calendar. Catching the pests in time saves him a great deal in chemical costs. According to one Texas farmer, the entomologist is obligated to give him a timely report on crop pests, whereas the chemical salesperson is interested in sales and may not produce a report in time to control pests, before they cause too much damage. Table 21 shows the number of times landowners cite using a conservation practices to deal with time constraints.

TABLE 21. NUMBER OF TIMES LANDOWNERS CITE USING A CONSERVATION PRACTICE DUE TO TIME LIMITATIONS

	California	Michigan	New York	Texas	Wisconsin
Split nitrogen applications			1		
Minimum till		1	1		1
Crop scout		1		3	
No-till		2		1	2
Manure storage			1		1

Timing is also cited as a reason for using no-till and minimum tillage. Farmers can plant more acres in less time, if they reduce their tillage. One Wisconsin farmer uses no-till to speed up planting. It allows him to plant beans right behind someone combining the wheat. Not only does it save him in time and labor, it also assures he will be able to get his crops in early enough to give them the maximum maturation time. Another switched from the moldboard to the chisel plow, because it was faster. Reducing erosion was a reason to keep the practice later. A Michigan farmer agrees that minimum till reduces labor**,** allowing him to farm more acres with less manpower. Moreover, as mentioned by a Texas farmer the sooner the seeds are in the ground, the more time they have to mature.

Saving spreading time is one of many reasons some landowners use manure storage. A New York landowner cites reducing the daily spreading of manure as the main reason he installed a manure storage pit 12 years ago. A Wisconsin landowner uses manure storage because he wanted to spread less often, and more nutrients are retained. However, many other considerations are also made. Another Wisconsin landowner has a manure storage system to save on equipment costs. He does not have to start the tractor and manure spreader every day. The three California farmers who use manure storage cite government regulations instead of saving time or money as the reasons they use manure storage facilities. One Michigan and one New York landowner also cite government regulation.

Limitations in Using Conservation Practices

Landowners are limited in their latitude to use conservation practices. Limitations may either

prevent them from adopting practices or force them to do so. Limitations range from individual landowner characteristics to external factors such as development, as shown in Table 22.

Age

A landowner's age may limit his ability to sustain the farm operations. It prompts landowners to adopt conservation measures that are simpler and less time consuming than conventional methods (see Table 22). A New York landowner uses minimum tillage, so he can farm his entire 800 acres by himself. Since he is the sole operator of such a large farm, he uses the same method for the 300 acres he owns and the 500 acres he rents. A Texas landowner expresses the same sentiment. He no longer grows crops that require pesticides because he is retired. A different Texas landowner enrolled some of his land in the Conservation Reserve Program (CRP), because he had health problems. He rented the land to the government under the CRP, until he was able to farm it again. He did not want to enroll the land in CRP, because he prepared it for cropping. He had it all in terraces to prevent erosion.

Although none of the landowners interviewed stopped using conservation practices or did not adopt them due to their age, one landowner did modify his practices. A New York landowner has limited his crop rotation because he is close to 70 years old, and he needs a simple rotation he can manage on his own. Overall, age does not appear to take the direction indicated in previous studies (Bromley, 1980; Carlson and Dillman, 1983; Korsching et al., 1983).

TABLE 22. NUMBER OF TIMES LANDOWNERS CITE NOT BEING ABLE TO ADOPT CONSERVATION PRACTICES

	California	Michigan	New York	Texas	Wisconsin
Erosion Prevention Structures					
- Lack of Labor			1		
Soil Testing					
- Lack of Labor			1		
- Cost	1			1	
No-till					
- New land in production		1			
- Crop requirements			2		
- Equipment cost		1	1		1
- Chemical cost					1
- Soil too heavy/clay			1		2
- Poorly drained soil		1	1		
- Low soil moisture	1			2	
- Ground does not freeze				1	
Must incorporate manure		1			
Manure storage		1	1		2
Rotational grazing				1	
- Lack of fencing for rotational grazing				1	
- Dry land				1	
- Pastures too big for # of animals					1
Crop rotation					
- Soil too wet for some crops					1

Cost

Many of the surveyed landowners said they are limited by cost, when considering using conservation practices. The cost of inputs-- labor, equipment, chemicals-- or the cost of making operation changes often force them to adopt conservation practices or prevent them from adopting them. Table 22 shows the number of times landowners cite they cannot use a conservation practice due to cost. Tables 16 through 18 show the number of times landowners cite they use a conservation practice to reduce cost. One Michigan landowner began using no-till because the high cost of fuel for conventional tillage and the need to increase the size of his operation necessitated a change, i.e., he could plant more acres with no-till. A Texas landowner also uses chemicals for weed control instead of tillage because farm equipment is so expensive. He cannot afford to replace his tractor to pull tillage equipment. However, a spray rig is lighter and can be pulled by an older tractor. He is not making a profit on his crops, because the price of equipment is so far out of line with the price of crops.

Conversely, equipment costs can prohibit landowners from using minimum till. Equipment costs prevent a New York farmer from adopting minimum till. He uses the moldboard on two-thirds of his land, because he is rotating from sod to alfalfa. The moldboard prepares a fine seed bed that is needed for alfalfa. He cannot afford to purchase another implement to use conservation tillage on the remaining third of his land.

Cost is a common reason for landowners not to use manure storage facilities. Some landowners in Michigan, New York, and Wisconsin have assessed the cost of manure storage and found it too expensive. A New York landowner has to increase his livestock operation without a lagoon because of cost limitations. He is pressured to increase his operation from 80 to 200 cows to compete with larger dairy operations. He must buy the $350,000-400,000 milking parlor, before he can install the manure storage lagoon. The lender will only loan him the money for the parlor expansion, not the manure storage facility. Three Michigan and Wisconsin landowners cite cost as the main reason they are not installing manure storage facilities.

More than one landowner has cited labor as a reason not to adopt conservation practices. Expense and labor are the reason one New York landowner does not take care of erosion on his land that eventually flows into the Chesapeake Bay. He feels it would be too expensive and labor intensive to put in riprap on river banks. Another New York farmer does not soil test as often as he feels he should, because, there are not enough hours in the day for his help to perform the work they already have. While one Texas farmer is beginning to use rotational grazing, he has not fully adopted it due to the cost and labor of installing more fences to create more separate pastures. He only rotates in the areas already fenced.

Crops

Some landowners are limited by crop characteristics. One New York farmer maintains that he must use moldboard tillage because he rotates sod and alfalfa. The moldboard breaks up the ground after the sod, so there is a fine enough seed bed for the alfalfa. Another farmer who grows alfalfa in New York concurs.

A New York landowner is limited as far as chemical applications on his land because he grows sunflowers for birdseed. He limits weeds by burning down the fields and using ridge till. He then only has to use Roundup after the fields are planted, instead of also having to use a pre-emergent herbicide.

While the limitations of crops are not broadly supported in the focused interviews, they merit further investigation. It may prove important to see how some landowners are capable of overcoming these limitations, while others cannot.

Production Changes

Landowners may be limited by changes in their production size or processes. Some operation changes elicit adoption of conservation practices. For example, a Texas landowner had to install a manure storage lagoon, because he increased his cow or steer herd size to 100.

Such changes may also prevent landowners from using conservation practices. A Michigan landowner maintains he needs to till, because he began contracting to inject municipal sludge in his fields. The injectors cut grooves into the land, so they must till the land afterward to get rid of the grooves. Operation expansion is another reason cited for not using conservation practices. Another Michigan landowner does not always use no-till, because he needs to till when bringing new land into production to work lime into the soil.

Residential Development

While many landowners are limited by their operations' features, others are limited externally. A pervasive limitation that forces some landowners to use conservation measures is residential development, as shown in Table 23. Its affect on conservation practices is multifaceted.

One consequence of residential develop is that farmers must run cleaner operations. A New York landowner discusses how he must make sure manure does not fall off the spreader, when he takes it through town. Two Wisconsin landowners incorporate fertilizer into their soil to keep residential neighbors from complaining about the smell. If the manure is knifed into the ground, the odor is reduced. Another Wisconsin landowner hires someone to spray his fields. Contracting the spraying allows him to transfer the liability to someone else.

TABLE 23. NUMBER OF TIMES LANDOWNERS CITE RESIDENTIAL DEVELOPMENT AS A REASON TO USE CONSERVATION PRACTICES

	California	Michigan	New York	Texas	Wisconsin
More careful manure transportation			2		
Limit chemical application		1	2	1	1
Change crops to limit chemical applications				2	
Manure incorporation					2

Landowners also modify their chemical applications to make them safe. Another New York landowner is surrounded by homeowners who bought 5 acre lots on previous farms. He rents his neighbors' land to grow hay. Instead of leasing large areas of contiguous land, he rents his neighbors "lawns" or back yards. He has to be careful, when he conveys manure and cannot spray for weeds on some of the land. He changes his crop rotation in some areas, staying away from certain crops due to chemical requirements and leaves hay on the land longer. A Texas landowner uses anti-drift-hazard techniques to prevent chemicals from floating into his neighbors' yards. He explains that his neighbors do not like their gardens to be killed, so he is very careful with drift out of respect for them.

Evidence on whether landowners maintain practices on rental land near development is

contradictory. One Texas landowner very close to a major metropolitan area still maintains conservation practices on the land he rents. The waterways and terraces already exist, and maintenance is minimal. He is not motivated by the incentive of keeping the land for future generations. Yet he would not let the farm deteriorate, just because it will not be around long. Only one landowner close to development, when asked, is not using conservation practices on rented land. A Texas farmer is not building waterways to resolve bad erosion or repairing washes on land he rents, since the land will probably be sold for development. He implements the practices on his own farm, because he likes the land and wants to do what is right. He would like to maintain its long-term productivity for his son.

Government Regulation

An external limitation common among many landowners is government regulation. Landowners either adopt conservation practices to meet current regulatory requirements or to pre-empt requirements in the works. While government regulation typically induces landowners to adopt conservation practices, sometimes it prevents them from using conservation practices. Table 24 shows the number of time landowners cite government regulations as the reason to use conservation practices.

Some landowners adopt conservation measures to comply with or pre-empt government regulations that require them to keep pollutants out of the environment. They feel compliance now can prevent future penalties. Some even fear non-compliance will cause their operation to be closed down.

TABLE 24. NUMBER OF TIMES LANDOWNERS CITE GOVERNMENT REGULATION AS A REASON FOR ADOPTING CONSERVATION PRACTICES

	California	Michigan	New York	Texas	Wisconsin
Manure storage	3	1	1		1
Manure management			2		1
Water testing	1				
Limit animal access to water			1		
Minimize pesticide use	1		1		
Organic farming	1				
Silage storage	1				
Maintain wetlands and woodlands		1	1		1
No-till					1
Minimum-till					1
Grass strips					1
Terraces and waterways				1	
Runoff prevention structure		1			

One way to keep pollutants out of the environment is to build storage structures. These structures can be extremely expensive, a factor that may prohibit their installation until it is required by law. California landowners with cattle in free stalls put in manure storage lagoons to contain waste. One landowner began to install lagoons to comply with the Clean Water Act of 1975. He must contain all the waste from his ranch to prevent a regulatory situation in which he could be fined and forced to

change his waste system. He also tests the water going into and coming out of his ranch. He is not required to test; however it prevents him from being accused of contaminating the water. Another landowner has two five-acre lagoons to comply with laws to protect groundwater. Previous to the regulation, he would flush the liquid waste from his free stalls into a canal that flowed into a river. The solid waste would be piled in the corrals until it was spread. He admits that government representatives do not allow that system of waste disposal anymore. The water from the lagoon is now used to irrigate his crops.

Manure management is also a regulatory issue in Michigan. One Michigan landowner is starting to build an earthen lagoon to hold livestock waste to prevent government regulation. He has noticed farmers losing lawsuits over manure management in Michigan, and the federal government is beginning to intervene in manure regulation.

New York landowners may perceive a similar regulatory environment. A landowner is working with the NRCS to build a temporary manure storage system. He is adopting the system for two reasons. First, cost share money is currently available in his watershed. Second, there is government regulation heading in his direction.

Another regulated contaminant that requires structures for containment is silage. According to one New York farmer, silage is acidic and will harm fish in a stream that runs through his land and eventually into Lake Ontario. The Natural Resources Conservation Service (NRCS) prompted him to build a storage tank. In addition to the tank, he is installing filter strips to block any silage that seeps out of the tank. The NRCS is working with him on installing the structure. A California landowner with a silage pit explains that the government can come out at any time and check his operation, and he fears the restrictions will become more stringent.

A second way landowners conform to government regulations is to change their operation practices. Two Wisconsin landowners altered their tillage to meet government soil loss requirements. One adopted minimum till in 1985, when regulations prohibiting erosive practices on hills were released. The other has been using no-till for 12 years to meet NRCS requirements.

A third way to comply with government regulations is inaction. Government regulation is often mentioned as the reason farmland owners do not work wetlands in Michigan, New York, and Wisconsin. A Michigan farmer explains that his government programs will be cut off, if he impacts a wetland. He feels caught between having to incorporate as much land as possible to keep his operation viable, and having to comply with government regulations. A New York farmer simply explains that you are not supposed to clear any more wetlands. If you are caught, you are in deep trouble. He describes a scenario in which a friend filled a wetland to build a house, and the government was going to make him tear it down to illustrate.

Government regulation not only causes compliance to prevent sanctions, it also creates rules that increase the cost of conventional farming. A California landowner began to grow organic rice to stay out of the government regulatory environment. Growing conventional rice required a lot of paperwork and compliance with regulations such as limiting spraying times. He felt the government was always looking over his should. Since the organic rice requires no insecticides or herbicides, he does not have the same regulatory issues.

Landowners also adopt conservation practices to prevent another form of regulation – those imposed as consequences of lawsuits. An official at a large nursery explains how his organization stringently monitors leased land, even requiring the lessees to disclose the chemicals they apply. This scrutiny is partially attributed to the company' overall philosophy to not degrade the land. At the same time, they are trying to prevent liability arising from mismanagement. Landowners in Texas are especially sensitive to issues of legal liability, as pointed out later.

Although unusual, it is possible for government regulation to prevent landowners from using conservation practices. Two surveyed landowners are not using conservation practices because of government regulations. A Michigan farmer is not entering land into the Wetlands Reserve Program due to the restrictions it would place on altering his wetland over time. He forgoes government payments for a wetland he created, because he would not be able to drain it in the future to bring more land into

production. A Wisconsin landowner cannot install a manure storage facility to his satisfaction due to government regulations. First, complying with the regulations makes the storage facility too expensive. He feels regulations increase the cost of the structure every year. Second, the regulations prevent him from putting the storage facility in a place that is close to his barn, because the area is over ground water or too close to a well.

Resources to Adopt Practices

Information

Just as the landowner is restricted in the practices he uses by financial and other limitations, he has resources that increase his options to adopt certain practices. Information is a resource used by many landowners to make practice adoption decisions. Other resources that increase the landowners' latitude to act are government assistance, down time, and technology.

Information is one of the most oft mentioned resources, because landowners were specifically asked about it. When landowners mentioned practices they use in the course of the interview, each was asked how they learned about it. Tables 25 through 29 allow a comparison of information sources between states.

TABLE 25. NUMBER OF TIMES CALIFORNIA LANDOWNERS CITE USING AN INFORMATION SOURCE

	Federal Government	Local Water Quality Committee	University Extension	Local Community	Private Source
IPM			1		2
Micro-irrigation			1		
Organic				1	2
Cover crops				1	2
Drainage structures				1	
Manure Storage	1	1		1	
Rotate Grazing			1	2	1
Pasture manage				1	
Hand pull weeds					1

TABLE 26. NUMBER OF TIMES MICHIGAN LANDOWNERS CITE USING AN INFORMATION SOURCE

	Federal Government	University Extension	Local Community	Private Source
No-till	1	1	2	2
Filter strips	1			
IPM		1		
Cover crops			1	1
Rotate crops		1	1	
Manure Storage	2			
Pesticide management building	1			
Reduce pesticides	1	1		
Wildlife habitat/wetlands	2	1	1	1
CRP	1			

TABLE 27. NUMBER OF TIMES NEW YORK LANDOWNERS CITE USING AN INFORMATION SOURCE

	Federal Government	Forestry Service	University Extension	Local Community	Private Source
Drainage structures				1	
Ridge till			1	1	
Minimum tillage				1	
No-till			1		
Strip crop	1			1	
Filter strips	1				
IPM		1			
Rotate crops	1		1		
Soil testing	1		2	1	1
Manure storage	1				
Restrict cattle access water	1				
Silage tank	1				
Reduce pesticides	1				1
Timber harvest		2			1
Wildlife habitat/wetlands				1	

TABLE 28. NUMBER OF TIMES TEXAS LANDOWNERS CITE USING AN INFORMATION SOURCE

	Federal Government	University Extension	Local Community	Private Source
Terraces	1		2	
Minimum till			2	1
No-till	1			1
Leveling	1			

Filter strips				
IPM	2			
Soil testing			1	
Manure management			1	
Rotate grazing				1

TABLE 29. NUMBER OF TIMES WISCONSIN LANDOWNERS CITE USING AN INFORMATION SOURCE				
	Federal Government	**University Extension**	**Local Community**	**Private Source**
Terraces			1	
Minimum till		2	3	3
No-till	1	1	2	1
Crop rotation		1		
Buffer strips			1	
Cover crops			2	
Contour strips	1			1
Reduce pesticides	1			
IPM		1		3
Soil testing				1
Drainage structures	2		2	
Inject manure	1			
Nutrient manage plan	1			
Manure Storage	1	1		1
Soil testing				1
Pasture manage			1	1

The surrounding community is an information resource for surveyed landowners in each state. They often learn about practices, because someone in their family or community used them. One California landowner installed ditches and drain pipes 30-40 years ago to prevent erosion and washes on his land, because it was a common practice used in the Sacramento Valley for the past 100 years. Two Michigan landowners learned to use no-till from their neighbors. They noticed it was quicker and wanted to try it. A Wisconsin farmer simply explains that cover crops are a local tradition to deal with local soil conditions.

Numerous landowners use practices, because their fathers used them. A California landowner, who uses cover crops to prevent erosion, asserts that his family has always been good stewards. He is the fourth-generation farmer in his family. Their land is as good in 1989 as it was in 1882. Another landowner contributes his use of conservation practices to his family. He uses rotational grazing, because his father used it. He feels it is part of the ranching heritage. He has, however, expanded on the knowledge base passed down from his father by attending seminars on rotational grazing.

A New York landowner automatically adopted drainage ditches and chisel plowing the ridges in his fields to keep land from washing, because he saw his father use them. Another New York landowner uses strip cropping and does not plow in the fall to control erosion, because his father used both practices. A different New York farmer obtains a deer management permit through New York State that allows him to control access to hunt on his land by issuing permits to hunters. His father began the program, and they "just kind of carried it on over the years." A Texas landowner recalls that his father, grandparents, and uncles all used terraces for as long as he could remember. They would use a "Fresno" – a dirt scoop pulled by a mule to build them.

Conversely, landowners can receive information from their children. A Texas landowner tried soil testing, because his son recommended it. However, the recommended nutrients were the same as when he did not test, so he abandoned the practice. He does continue collecting and spreading manure by his son's recommendation. He has not yet found changes as far as crop yields, but he has seen changes as far as cost reduction. This case shows that landowners may need to see the practices' benefits to continue using them. A Michigan landowner adopted crop rotation because his son recommended it. He noticed his pumpkin crops were failing. When his son recommended alternating cover crops with pumpkins, he tried it. Now he has high-producing pumpkin crops.

The government is another important information source. Landowners receive information from many different government sources. Some landowners receive information from state level government. Two New York farmers learned about woodland management from the state Forestry Service. One of them learned about biological insect control for gall (mites that eat at the base of tree needles causing deformities) from the same source. The other has a plan to manage logging on his land. The Forestry Service advised him to eliminate competition among the trees. Logging a portion now and saving the rest for later harvest.

Landowners from the focused interviews are more likely to receive information from the federal government. The Natural Resources Conservation Service (NRCS) is a national government organization through which many landowners gain knowledge of conservation practices. One Michigan landowner learned about the new Farm Bill provisions for a pesticide management program through the NRCS. A New York landowner mentions working with the NRCS on a temporary manure storage facility he plans to implement in a few years. A Texas landowner learned about installing terraces to keep his land from washing from the NRCS back in the 1950's. A Wisconsin landowner explains that his information on protecting water from pesticides comes from the NRCS. According to him, the NRCS is always "preaching" to him about environmental damage and the methods to prevent it. They are teaching him to create a pond and protect it from chemical incursion. He is also learning to prevent gully erosion.

The Farm Service Agency is another national source of information for landowners regarding government regulations and cost share programs for conservation practices. A Michigan farmer specifically mentioned getting information from the Farm Service Agency (FSA). They taught him to install a manure management system. The FSA first informed him of the regulations governing the allowable amount of manure per acre. They then helped him set up a nutrient management plan. According to a New York farmer, the FSA taught him to do a farm management plan that includes crop rotation and other conservation practices to qualify for government subsidy programs. A Texas landowner learned about new government cost share money available for land leveling from FSA. These two examples show that the landowners' recollection of information sources may be inaccurate. The FSA does not typically give technical assistance. This type of information is usually supplied by NRCS staff, university, extension or local conservation districts. Many of these landowners adopted practices many years ago; therefore they may confuse information sources.

Some landowners learn from direct participation in government conservation organizations. A California landowner learns about updates needed to comply with the Clean Water Act through a local water quality committee. A Michigan farmer put land in the Conservation Reserve Program, because he was on the local NRCS board. They were promoting the practice, so he had to use it.

Universities are another important source of information. A senior-vice president for a California company that uses micro-irrigation on its orchards learned about it through relationships with the University of California. His company cooperates with a university program of experimental plots to learn about new practices. He is also on a university research board.

Landowners in other states mention receiving information from university extension offices. In Michigan, one farmer is installing an earthen lagoon for manure storage. Many of the interviewed Michigan landowners attend extension meetings in the winter to learn about new practices. The county extension is providing him with information about the federal government regulations and the proper way to install the lagoon. He also learns about manure management by attending extension meetings in the winter. A Texas landowner learned about using no-till to reduce costs from an extension agent. Two New York landowners learned about soil testing from cooperative extension programs.

In New York, every one of the five landowners who mentioned getting conservation practice information from a university cited Cornell University as the source. Some landowners learned to use practices, when they were students at Cornell. One landowner learned to soil test when he was a student. A landowner previously mentioned for believing trees are ecologically important, attributes his conservation ethos to his years at Cornell. Other New York landowners learn about conservation practices through university experimental plots and Cornell University publications.

Most landowners use university information in conjunction with other sources. A Texas landowner learned about using beneficial pests to protect his crops through the University of Texas Extension and USDA's Agricultural Research Service. A Wisconsin landowner learned about no-till through the University of Wisconsin Extension and publications.

Local cooperatives are private sources useful for distributing information to keep landowners aware of changes in practices. Landowners often purchase supplies and services through their local cooperative. Some form relationships in which they find the cooperative to be a reliable information source. One California landowner decided to move to an organic operation, because he belongs to a cooperative that releases beneficial insects in his grove instead of using pesticides. A second California landowner belongs to a cooperative farm supply that gave her information on using grasshopper bait to keep the insects out of her pasture. While she found out about the advantages of using bait to keep the grasshoppers out of her pastures, she received the information to implement the practice from her cooperative. A Wisconsin landowner learned about using beneficial insects for pest control from serving on the board of directors of his cooperative.

Publications by themselves are not cited as often as the previously mentioned resources for being useful conservation information sources. A California landowner used publications and friends as a source of information for organic practices. When he and his father converted to an organic operation 10 years ago, his local university did not have sustainable agriculture information. Nor was he able to receive information from local agricultural government bodies. Instead he relied on books and friends. Once he started organic farming, others around him did also, and he eventually joined California Certified Organic Farmers. In New York, one landowner found out from a farm magazine about mowing his alfalfa to stop insect damage before it has a chance to get out of control.

While many landowners cite a single source of information for using new practices, they may have multiple information sources. Although, one Michigan landowner is the chairman of his local Farm Service Agency (FSA) board, he also receives information on practices from Extension meetings and trade publications. He used these multiple information sources to learn to build a wetland on his property and to build filter strips for wildlife habitat. A New York landowner gets advice for managing his woodland from his neighbor and a state agency's conservationist. He uses their advice to determine when to harvest timber to maintain his stand for the future. One landowner in Wisconsin uses conservation practices such as buffer strips and terraces as part of a family tradition. His father was conservation minded and willing to try new practices. However, he learned about putting in dams and structures to keep gullies from eroding from farm magazines, other publications, and a local implement dealer.

Visible Effects of Environmental Damage

One form of information is environmental. It is either the visible effects of environmental damage on one's own land or seeing potential environmental threats from surrounding farms. Some landowners decide to adopt conservation measures, because of feedback they get from the land.

Landowners can use visual information to decide if they need conservation practices. A California landowner used visual information to prompt protection of a creek on his land. If he does not keep the animals out of the creek, he can see where they knock the banks down. He rotates the animals out of the low pastures with creeks during the rainy winters. A New York landowner also talks about seeing erosion damage on his land. He saw washes forming or water collecting in dips in the fields. Based on this visible evidence, he either put in grassed waterways or seeded down areas washing. A Texas landowner adopted ridge tillage, because he got tired of seeing his land blowing away in the fall. Another Texas landowner, previously mentioned for cutting his pasture into 10 paddocks, realized he needed to adopt a pasture management system, because he could see the grass thinning out when the

paddocks were larger.

Visual information may come from outside the landowner's operation. A New York landowner explains how the mixture of large cattle operations in his area combined with occasional high nitrate readings in his wells causes him to test his soil to ensure he is not using too many nutrients. Conversely, a California landowner is not interested in using no-till after seeing an experimental plot planted with it. He was not impressed with the way the stand looked. When asked to explain, he simply said that he did not think the corn came up as it would in a tilled field. To confirm his belief, he mentioned that the owner of the experimental plot is also not using no-till this year.

A small amount of visible damage may not prompt landowners to correct it. One New York farmer admits to having an area of pasture between the gate and the barn that gets torn up by cows, when it is wet. However, he does not see the problem as great enough to necessitate any management practices.

Government Assistance

The government provides landowners with financial assistance for conservation practices as well as information. Financial assistance is often given in conjunction with regulations. While the government forces landowners to adopt practices through regulations, it may also provide incentives in the form of financial assistance for compliance. Table 30 shows the number of times landowners cite government assistance as the reason for using conservation practices.

Many landowners mention government assistance in conjunction with building structures. One Michigan landowner is putting up a pesticide management building to contain chemical spill when filling machinery for spraying. He is being reimbursed 75 percent under the new Farm Bill. While the cost sharing is an incentive to adopt the practice, he was told that if he did not adopt it, he would be closed down in 4 and one half years.

Another Michigan landowner and his father received government assistance to build a lagoon system for manure-polluted runoff. He realized he needed the system, because he saw water collecting in the area. The government money was a reason to take care of the problem in the right way. One New York landowner is working on a cement pad for a temporary manure storage facility, because the government is offering 75 percent cost sharing. Also he wants to pre-empt regulation of his operation.

TABLE 30. NUMBER OF TIMES LANDOWNERS CITE GOVERNMENT ASSISTANCE AS THE REASON FOR USING CONSERVATION PRACTICES

	California	Michigan	New York	Texas	Wisconsin
Manure Storage	1		1		
Land leveling	1			1	
CRP				1	
Water control structures					2
Runoff lagoon		1			
Filter strips		2			
Contour strips					2
Crop rotation			2		
Terraces				1	
Preserve woodlands/wetlands		1			

Pesticide management		1			

Other interviewed landowners adopt conservation practices to be eligible for government program benefits. A New York farmer began his soil conservation plan with the Farm Service Agency, when he received a wool subsidy. Although he does not receive the subsidy today, he is continuing the conservation plan to take advantage of other currently available subsidies. Two landowners in Wisconsin mention government cost sharing as a partial reason for adopting conservation measures. One landowner received government cost sharing to implement conservation measures that are required for government program benefits. After his cooperative wrote a nutrient management plan and a conservation plan that are required to receive program benefits, he put in dams to control water run off through a gully. The government pays 75 percent for him to install the water control structures. He admits that without cost sharing, he would not implement the practices.

Sufficient Time to Act

A landowner may have the desire, information, and resources to implement conservation practices. However, he may still not be able to do so due to other limitations. One Texas landowner explains that terraces cannot be created or maintained, while crops are in the field. He uses the winter season to install and repair terraces on his land, because the fields are not planted during the winter. A Wisconsin landowner had the same advantage. He put in waterways, when his land was in CRP. He did not have to work around crops when installing the water control structures.

Technology

Some technological innovations allow landowners to overcome climatic difficulties in using certain conservation practices. A Texas landowner is able to grow sunflower seeds, because a drought tolerant seed has been developed. He uses part of the sunflowers for bird habitat for hunters. Some of the interviewed Wisconsin farmers specifically mention the benefits of technology to deal with their climate. Two landowners were able to adopt no-till because of the evolution of plant genetics. One landowner explains that plant genetics allow him to plant in rough seedbeds. The other uses a hybrid corn seed that is cold tolerant. No-till does not open the soil preventing the ground from heating up as quickly as tillage.

Texas landowners also use Roundup to kill sorghum to keep it from draining moisture from the ground. They are prompted to use the Roundup, because they can harvest the sorghum sooner and retain soil moisture. Not only is no-till supposed to conserve soil, but also the crop residue attracts wildlife. While technological innovations help landowners adopt conservation practices, they do not appear to be an impetus for using them.

Soils and Climate

Characteristics of the land and the surrounding environment may influence the landowner's ability, as well as need, to use new practices. It is difficult to classify topography exclusively as either a limiting factor or a resource. It can either be a resource for adopting conservation practices or as a factor that limits their adoption.

Among the surveyed owners, soil type is mentioned as a reason to use and not to use a conservation practice (see Table 31). A New York farmer with poorly or moderately well drained soil uses ridge till. Otherwise, the soil would be too damp to plant. A Wisconsin landowner uses cover crops, because the soil is so light. It would blow away without them. Conversely, one California landowner points out that he must use a fumigant or a pre-emergent herbicide in heavier soils, because the weeds come up before the crops. The weeds are not as bad in sandier or rockier soil. Also, a New York farmer with high clay content soil uses the moldboard to break up the soil.

TABLE 31. NUMBER OF LANDOWNERS CITE NOT USING CONSERVATION PRACTICES DUE TO SOILS AND CLIMATE					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Land too steep or too wet		1			
- Preserve wetlands/woodlands		1	4		1
Ground frozen in winter					
- Manure storage			1		
Poorly drained soil					
- Ridge till			2		
Dry land					
- No-till				1	
Light soils					
- Cover crops					1
Sloped land					
- Contour stripping					1
- Cover crop	1	1			1

Land not suitable to farm typically induces landowners to adopt passive conservation practices. Some landowners do not work wetlands or woodlands because the land is not suitable to farm. A Michigan landowner does not farm his wetlands because they are so wet, the crops would die. Four interviewed landowners in New York do not farm wetlands or woodlands because they are too swampy, rugged, or steep to farm.

Weather is part of the natural environment that alters whether the landowner will use a conservation practice. A New York landowner put in a temporary manure storage facility to store manure for the wet months of March and November, when he cannot spread without fear the manure will run off. A different New York farmer uses ridge till, because he gets a lot of rain in June. Since the raised ridges dry faster than the surrounding ground, landowners can plant sooner.

For others, the multiple characteristics of their topography make the decision to use conservation practices complicated. One Wisconsin landowner finds that minimum till usually works for his soil and weather conditions. The minimum till allows him to go deeper into the soil breaking the hard pan. Moreover, the ground freezes and thaws in the winter breaking it up. However, they must still moldboard plow if there is an extremely wet fall. In that case, the chisel plow only cuts a slice through the soil, leaving it too wet for planting.

Another Wisconsin landowner has three difficulties in adopting no-till. First his soil is tight, red clay. It is poor for corn emergence. Second, he lives in Wisconsin, which is cold, and the seeds are sensitive to temperature. Third, no-till requires more chemicals, and his profit margin is currently low. His profit margin is low enough, that he does not feel he can experiment with new methods.

Ideology

The landowner's personal philosophy may contribute to the likelihood that he will adopt conservation practices. Pampel and van Es put forward this premise in their 1977 study. They suggested one group of farmers may farm, because they appreciate the amenities of rural life, while others may view farming strictly as a business enterprise. Those farming because they enjoy the

lifestyle are supposed to be more likely to adopt conservation practices. Farm philosophy as indicated in the focused interview data for this study is actually more complex than an appreciation for the personal benefits of a farm lifestyle, and therefore may be difficult to measure in a statistical study (see Table 32).

TABLE 32. NUMBER OF TIMES LANDOWNERS CITE USING PRACTICES FOR ENVIRONMENTAL GOALS					
	California	**Michigan**	**New York**	**Texas**	**Wisconsin**
Terraces					
- Keep drinking water safe				1	
Grassed water ways					
- Keep soil out of water			1		
Incorporate manure					
- Preserve wildlife	1				
Organic manure					
- protect children	1				
Fence livestock away from water					
- Keep manure out of water			1		
Ridge till					
- Reduce chemicals in the environment			1		
Lower chemical applications					
- Reduce chemicals in the environment	1		2		1
- Family and public eat food		1			
- Protect wildlife	1			2	
IPM					
- Prevent resistance in insects				1	
No-till					
- Food for wildlife				1	
Plant wildlife food		1			1
Maintain wetlands/woods					
- Water quality					1
- Wildlife		1	1		1
- Environment			1		
Organic farming					
- Environment `	1				
- Personal health	1				

Appreciation for Wildlife

Some farmers appreciate farm amenities such as scenery and wildlife; therefore, they adopt measures to provide these benefits. A New York farmer does not drain a wetland, because he enjoys the woods growing on it. Another farmer limits the pesticides he uses on sunflowers, so they can be sold as

wild birdseed. He began to grow seed because his wife likes the birds.

Two California landowners use conservation practices to protect wildlife. A landowner who refuses to let her operation go bad, although she is surrounded by development, hand pulls bull thistle. She prefers not to use chemicals, because she does not want to harm animals that eat the surrounding plants. A different landowner runs a spike tooth harrow over his pasture to break up manure. Breaking up the manure causes the nitrates and poisons to go down into the grass, instead of flowing into the water to potentially harm fish.

Some landowners preserve open space on their land for hunting. A Michigan landowner keeps open space for a pheasant hunting preserve. A Wisconsin landowner protects a wooded area on his land, so his family can hunt. Other interviewed landowners in Wisconsin, Michigan, and Texas mention hunting as a benefit for open space, but it is a side issue, not the main motivation for conservation. They may have land that would be difficult to farm, or crop residue that wildlife eat is left on the land by conservation tillage. A Texas landowner uses Roundup to keep sorghum from drawing moisture from the ground, so it is ready to harvest on time. Since the crop does not have to be cut to keep it from drawing moisture, the stalks provide hunting habitat for commercial benefit.

Stewards of the Land

In a similar tone, farmers adopt conservation measures, because they are conservation minded. They use conservation practices specifically to achieve environmental goals. One Wisconsin landowner believes he has a symbiotic relationship with the land. His family views themselves as temporary stewards. They protect woodlands, ponds, and meadows on their lands from pesticides by controlling runoff and keeping chemicals out of the areas. They also leave two percent of their crops at the end of the season for wildlife feed and habitat.

Other landowners are also specific in their objectives to protect the environment. One New York farmer has a forest management plan, because he feels trees are important for cleaning the air. He views himself as being "conservation-minded".

A few New York farmers interviewed are interested in preserving water quality. One farmer expresses a desire to keep soil out of waterways, ponds, and lakes (NY). He uses the same practices for his rental land as he does for the land he owns. He does not want to see the rental land lose soil any more than he wants to see his own land erode. Another New York farmer fences cattle to prevent water contamination. If the cows are allowed to walk up and down the stream freely, they will contaminate it with waste. If the cattle are fenced away from the streams, the streams can be cleaned up.

Finally, a Wisconsin landowner believes in promoting the best use of the land. Some of the land is too wet to farm. It is an oak savannah with large oaks and hickory trees. He feels it is better suited for pastures or houses. His philosophy is if land is meant to be farmed, it should be farmed it. If not, it should be left alone. This landowner makes a point that would be interesting to explore in future interviews. Now that he is older, he is not as "greedy" as he used to be. When he was younger, he would have "drained every wet spot, leveled every field, and plowed every tree". Now he is more interested in quality of life issues and the quality of his land as recreation for his grandchildren.

Protect Family Health

Some landowners see conservation practices in personal terms as ways to protect their families' health. One California landowner changed to an organic operation to promote his own health. He spent years of custom farming which required him to apply chemicals. He was in poor health, which encouraged him to try organic farming. Another California farmer uses fishing mulch instead of traditional fertilizers to protect his children who play in the area.

A New York farmer explains that she does not want to sell her farm to a big farm operation, when she and her husband retire. She has a neighbor with a 1000 cattle operation who is interested in her land. However, she is considering selling it to Mennonites, who are buying farms in her area for small scale operations. She is concerned that the manure spread by a larger operation would be too much, too close to her home, and it would contaminate their well water. She is especially concerned because her son and daughter both have homes near the farm.

Value of Land as a Resource

The landowner's personal philosophy can extend to how he feels about his land's resources. If the farmer feels the land and the inputs are valuable, he is likely to try to conserve them. One California farmer has a philosophy that dictates caring for the land, because it is how he makes his livelihood. He keeps his cattle in barns in the winter, so they do not tear up the ground. He also prevents the pastures from being grazed down and makes sure planting is complete before the first rain. These practices

prevent erosion. He believes that when you live from the ground, you must take care of it, or you will not live from it long.

One New York landowner appreciates the value he is getting from his manure pit by spreading the manure in the fall and the spring. He is able to keep the nutrients in the soil by spreading them when they can be incorporated. A Wisconsin farmer agrees with him. Manure increases the humus in the soil, thereby increasing the value of the land. You do not want to over-spread and have it flow into creeks. He does not need regulations to tell him the value of his resources. He feels every farmer is conservation-minded.

Another Wisconsin farmer feels the soil is a valuable resource. He keeps his rolling land in sod to prevent erosion. Topsoil must be preserved, since it is irreplaceable. It is difficult to raise crops on rocks. A final Wisconsin landowner, who uses no-till to save labor, fuel, and soil, emphasizes that without soil, agriculture will not be viable in the area in the future. It is important for the next generation of farmers.

The landowner's ideology can be mediated by practical concerns. One California landowner believes in farming in an environmental manner. However, he did not plant organic rice the past year because there was not a market for it. He also tries to avoid using pesticides. However, he will use them, if he has to do so. He explains that there is a line between what you need to do for the environment, and what you have to do to make a living. It would be interesting to investigate further the possibility of a conservation ethos combined with the factors that mediate this inclination.

Desire to Keep Status Quo

Conversely, there are farmers who do not adopt conservation measures, because they do not want to change. One New York farmer spreads manure every day, because he has a small farm and cannot afford a manure management structure. He prefers not to expand to allow the addition of a manure management structure. Spreading everyday is a non-conservation practice, since spreading on saturated or frozen ground causes the manure to run off the land.

Along somewhat similar lines are two landowners, one in Texas and another in Wisconsin, who use moldboard plows. Both use that type of plow, because they are comfortable with it and know how to maintain the equipment. These landowners, like the landowner above, prefer to stay with practices that are familiar to them. It is likely that this group may be one of the most difficult to induce to adopt conservation practices, since merely overcoming financial or technical barriers to adoption may not be enough to convince them to change.

Characteristics Specific to Individual States

Some findings are specific to individual states. Each state has a particular ecology and culture that causes some conservation-behavior-shaping traits to be expressed that are not expressed in other states. They are discussed below.

California landowners seem to have the most differences from landowners in other states. California farmers seem particularly interested in the investment value of their land. For example, one California landowner is very specific about the relationship between using conservation practices and the investment value of land. He has written in his lease that the lessees must return the land in the manner in which they received it. Before the land is turned back over to him, he can have its health evaluated by a third party. He wants to ensure that the land will not be tainted or contain any hazardous waste that will prevent it being developed. Land in Napa Valley has a very high rental value. A vice-president at a California agricultural company explains that the California citrus industry as a whole is

concerned about land as an asset. If they do not maintain the land's log-term sustainability, they will not have an asset to borrow money against. Another California landowner explains that his land's value is very high due to competition for development and agriculture. A final California landowner ensures that that the value of his vineyard is maintained in a rental contract because land value in the Napa Valley is so high. Landowners in other states do not mention their land in the same manner.

Another factor that was only mentioned in California is the long-term nature of some of the crops. Orchards and vineyards may yield harvests for many years, unlike several other crops that are planted on a single-year basis. According to the interviewee who is the vice-president of an agricultural company, the expected life-span of a California vineyard is 25 years, forcing the landowner to be very careful with its management. The cost of replanting a sick or diseased vineyard can be very high, and it takes time for it to start producing again. Planning must be done on a 10 year basis. It is not uncommon to have to live with a decision for 25 years. Therefore, they must consider the long-term viability of the land.

Finally, market limitations are a concern mainly mentioned by organic farmers in California. Two landowners grow organic and non-organic produce. Both determine how much organic produce they will grow based on the market's demand for organic products. Contrary to the non-organic market, the organic market is not price sensitive. If you produce more organic fruit, thereby lowering the price, you will not sell anymore product. One landowner previously mentioned prefers to grow organic rice. However, he has not been able to find a buyer for his organic rice in the past two years. Another limitation pointed out for organic crops is that they are riskier. For example, rain brings risk of greater pest infestation. If landowners have limited market access and greater exposure to risk, it is not surprising that they may be hesitant to grow organic products.

In addition, one Texas landowner did mention market restraint in relation to a hunting preserve on his land. He has opened up a portion of his land for hunting, but will not open all of it. The fear in his area is that if everyone opens his/her land for hunting, the market will be flooded. The fee or lease price will then go down, and no one will profit.

Water availability is a limiting factor mentioned by California and Texas landowners. Using irrigation is more likely to cause landowners to adopt conservation measures to conserve the expensive resource. One California landowner explains that his water use is not yet regulated. Conserving water is an economic issue. He uses drip-irrigation in sandier soils, because it concentrates water in the root zone, which is more cost effective. Another California landowner uses micro-irrigation for the same reasons. The water can go directly to the root zone lowering the total volume of water used, thereby reducing the cost.

Conversely, non-irrigated land can cause landowners to use conventional farm practices. Water scarcity prompts one California landowner to use the moldboard open up the ground to create a good seedbed. Moldboard plowing allows moisture and nutrients to sink into the ground better.

Landowners in parts of Texas are also limited by the dry, warm weather. They cannot use no-till, because tillage helps the limited moisture sink into the ground. Moreover, they do not get winter freezes that crack the ground allowing moisture to sink into the soil. Drought also affects the use of chemicals. One farmer only sprays for weeds during drought years, as they are more abundant during droughts.

Two Texas landowners try to overcome dry weather limitations by modifying their conservation practices. One landowner points out that drought makes it difficult for him to rotate his pastures. During the droughts, he will leave the cattle where they are feeding them grains. The other culls his herd during drought years to prevent overgrazing.

Finally, Texas farmers are much more concerned about lawsuits than landowners in any other state. A number of farmers switched from growing cotton to grains, because they could not use the pesticides needed to maintain cotton around houses in their areas. When one landowner was asked to explain why he could not spray around houses, he gave two reasons. First, he does not want to harm his neighbors. Second, if he harms a neighbor, he will be sued. While two California farmers mentioned being concerned about liability on their land. It was in reference to the future development potential of

leased land.

Conclusion

Conservation practice adoption is a multidimensional process. Numerous factors determine whether a landowner will use a conservation practice. Once the landowner has decided he wants to adopt a new practice, he must then consider a number of factors. He must consider whether he has the economic resources to adopt a new practice, whether the practice will work with his soil and weather conditions, and whether the practice will necessitate other changes in his operation. Often there are interceding factors that prevent him from being able to use a conservation practice such as time constraints, crop limitations, and limited markets. The multiplicity of factors combined with the potential interactions between them contributes to the complication in identifying features that contribute to adopting conservation practices.

Further complicating the adoption process is the inability to always separate the reasoning behind each practice. Often more than one practice can be used to achieve a certain goal. A landowner trying to maximize grazing output might plant permanent pasture, rotate grazing, and test the soil in the pastures before fertilizing them. Conversely, there is more than one reason to implement a particular practice. A landowner could install filter strips to prevent erosion, trap chemical runoff, and provide wildlife habitat. Overlapping practices and goals make it difficult to sort out a linear thought process that lead to adoption.

Despite these difficulties it is possible to make some generalizations about why landowners adopt conservation measures. First, the landowner must feel he needs the practice or that the practice will offer benefits. The landowner may feel he needs the practice due to deficiencies in, or threats to, his operation or government regulations. If landowners notice decreases in production or damage on their land, they may be prompted to adopt conservation practices.

Government regulation is a need that appears to pre-empt other considerations, especially in the cases of adopting structures to store manure, runoff, and silage. Landowners who cite government regulation as the inducement for adopting conservation measures fear significant penalties for non-compliance including loss of farm program benefits or closure of their operation.

Alternatively, the conservation practice may offer such benefits that the landowner decides to adopt it. Benefits include cost savings, increased production, soil health, or less tangible benefits such as environmental quality. Saving time and expense appear to be the primary reasons for adopting minimum and no-tillage systems. Another reason offered is to prevent soil loss. Improved productivity, soil health and reduced chemical applications for weeds and pests are the primary incentives for adopting crop rotation. Preventing erosion to keep topsoil that is valuable for production is the primary reason given for adopting practices such as terraces, waterways, and strip farming.

While all of these factors may induce landowners to adopt conservation practices, they may still not be able to implement them. Landowners are prevented from adopting conservation measures by several factors such as cost, crop type, production changes, and topography. Other than not perceiving a need to use a conservation practice, cost is one of the most common reasons not to adopt one. Cost can be increases in labor, new equipment purchases, increased chemical usage, or building structures. While labor and structural expenses are most often mentioned as reasons to not adopt water drainage structures and storage facilities for manure and other pollutants, other limitations are mentioned for using reduced tillage systems. Landowners perceive these systems as requiring more chemical inputs and new machinery.

In addition to cost, landowners may not be able to use reduced tillage due to the nature of their operation. They may grow crops that are not amenable to certain tillage systems. They may bring new land into production that must be tilled to remove roots and weeds. Finally, their soil type or moisture levels may prevent them from adopting reduced tillage practices.

An unexpected finding in the limitation area is that being retired and living near development does not limit the adoption of conservation measures. Older landowners may adopt conservation practices to save time and labor. While an attempt was made to only interview active operators, some interviewees indicated that they are retired. Typically, these retirees are still involved in the operation, although a son or daughter has taken over primary responsibility. Retired landowners do not feel their retirement status prevents them form adopting conservation measures. One even feels that he can use more conservation practices, since he does not have to worry as much about profit.

In addition to looking at inducements to adopt conservation practices and limitations that prevent adopting them, information is a necessary component in the conservation practice adoption process. Landowners could not adopt practices about which they know nothing. However, limited generalizations can be made from this interview data, because landowners do not always remember their exact information source. One generalization is that the landowners' environment plays an important role in whether he will adopt a conservation practice. Local tradition, family, and neighbors are all cited as information sources as well as the impetus for adopting conservation practices. The data indicates that if a landowner's father used the practice, it is very likely the landowner will continue it.

Second, information efforts by government agricultural offices and extension universities are effective in disseminating information about conservation practices. Landowners do use this information to make decisions about whether they will adopt conservation practices. Future research should focus on what aspects of the information received by the landowner induced him to want to try a conservation practice.

Overall, the focused interviews provide a more holistic picture of the factors that impact using a conservation practice. The landowner can describe his decision to use a practice from beginning to end. These recollections bring previously unknown factors in the use of conservation practices to light. Limitations such as drought, the planting and harvesting schedule, and the inability to get needed services in a timely manner are discovered. Incentives such as increasing orchard production with organic crops, protecting surrounding development from harm, and reducing the risks of pest invasions are also revealed. This more comprehensive view gives insight into why the statistical models are limited in their ability to explain the use of conservation practices.

A final caution must be made about the information in the focused interview data. It may sometimes be difficult for farmers to conceptualize the issues in the questions. A farmer may not consider daily why he/she uses conservation practices, just as an accountant may not consider why he uses a certain type of tax software, or a truck driver may not consider the type of engine used to pull his vehicle. Many farmers have been using a practice for 10, 20, or even 30 years. It may be difficult for them to remember why they adopted a certain practice or even why they continue to use it. Also, it is difficult for people to express vague feelings or complicated relationships. For example, many farmers say they use soil erosion control practices to prevent soil erosion. When prompted about why they do not want soil erosion, they may be confused about why they are being asked a question about something that to them is intuitive. It may be difficult to form an answer.

In closing, the focused interview data offer a perspective in addition to the standardized survey data. First, it is possible to draw themes across geographic areas due to the nature of the data analysis. It is the objective in analyzing focused interviews to draw themes across diverse areas. Therefore, themes were put together as categories held across different areas and under diverse circumstances.

CHAPTER 4
CONCLUSION

Findings

In looking at factors expected to shape the use of conservation practices in the five state samples of urban-edge landowners, it is found that previous models have limited ability to explain the variance in the use of agricultural conservation practices. The survey data indicate that, while the demographic characteristics being a farm operator, attitude toward farming, perception of agricultural pollution in the region, and education appear to moderately influence the use of conservation practices, living close to the land does not. Moreover, age and retirement status seem to have the opposite expected effect.

Farm features are not as well supported. Farm size has no noticeable effect. Landowner income and farm product impact a narrow range of models.

External characteristics receive varying levels of support. The landowner having information about conservation practices appears to be an important factor in adopting them, as is government cost sharing. Whether decision making is in the family is moderately supported. The objective of passing the farm to future generations is not supported, nor is whether the landowner has a production contract. Whether the farm operation is in the path of development is not significant in the regression models, but has the opposite expected effect in the focused interviews. While the predicted variables cannot fully explain the variance in the use of conservation practices, new variables that appear to be important have been illuminated.

Demographic Characteristics

A sizeable amount of demographic variables receive notable support in both the survey and interview data. It was hypothesized that being a farm operator would increase the likelihood of using conservation practices. These landowners are felt to be more knowledgeable of the land and interested in its long-term viability. Being a farmer or rancher increases the odds of using a conservation practice in 7 of 25 regression models.[11] Currently being a farm operator or having been a farm operator increases the likelihood of using a conservation practice in two soil erosion control models. Information from the focused interviews helps explain the moderate support received by this hypothesis. Some surveyed farm operators who rent land for their operations used conservation practices on the land they rent, because the landowner shares in the costs of the measures, the landowner requires the measures, or they -- the operators -- already have the equipment, so they might as well use the same practices on all the land. Therefore, landowners who rent land also have inducements to apply conservation practices.

In 7 of the 25 state models, formal education has a predicted, positive impact on the use of conservation practices. Education increases the odds of using soil erosion control practices, practices to

minimize agricultural chemicals in water, and practice to protect or improve wildlife habitat. It is notable that all of these practices are similar (grassed waterways prevent soil and chemicals from leaving fields and also provide wildlife habitat), and education does not influence less similar practices that apply to livestock operations.

Additionally, the focused interviews show a diversity of information sources other than university education. While some landowners specifically mentioned learning about conservation practices through their university education, others learned a great deal through continuing education efforts via publications, university extension seminars and field demonstrations, and government educational efforts (such as NRCS visits). Formal education may not be as important as accessibility to numerous information sources. Future research can further delve into the qualities of information that make it more convincing and the circumstances under which landowners use it in active pursuit of a new practice.

The hypothesis that landowners who adopt conservation measures feel differently about farming and their responsibility to the land than landowners who do not is not consistently supported.[12] The hypothesis really has two parts in the literature that are conceived to be in opposition to each other. First, landowners who hold an altruistic feeling toward their land are interested in conservation practices, because they preserve non-monetary land qualities which they value, such as unpolluted water or abundant wildlife. Second, landowners solely interested in profit will only use practices that make their operations more profitable, such as conservation tillage. The owner feeling it is important to protect the land from various environmental harms increases the likelihood that conservation practices will be used in 8 of the 25 models. In one model it has a negative impact. Moreover, numerous landowners in the focused interviews who use conservation practices do so, because it is part of their personal ideology to protect the land, the environment, wildlife, or people.

The focused interviews show numerous caveats to this hypothesis. First, there is overlap between the philosophies and practices. Most landowners are not strictly interested in profit or land preservation. They are interested in both. Or their interest in land preservation may be mediated by their need to earn a living. Also, many practices perform multiple roles. In different state samples, the same practice (such as grazing livestock) may be seen as increasing or not increasing the operation's profits. Finally, there are many intervening variables such as government regulation that may force landowners who are interested mostly in the land's profitability to use conservation practices that they do not regard as profit-enhancing.

The other side of the profit-motivation hypothesis-- that landowners with such motivation are less likely to adopt conservation practices-- receives inconclusive support.[13] In the regression models, there are three positive relationships and three negative relationships between having a monetary goal for the land and using conservation practices. Unfortunately, further analysis of the survey data (via cross tabulations) did not provide insight into why half the relationships are positive and the other half are not.

Again, the focused interviews provide explanation for this indistinctness. Some landowners feel adopting conservation measures is imperative to maintaining their land's value. Landowners with row crops try to prevent erosion and cattle farmers try to eliminate over-grazing. Even landowners who feel their land may be developed see value in reducing chemical use on the land to ensure that chemical pollution does not prevent the land from being used for residential or commercial development. Ultimately, landowners do not appear to pursue agricultural conservation or profit to the exclusion of the other. Consequently, landowners interested in profit also have incentives for using conservation practices.

The focused interviews support the hypothesis that the perception that soil erosion, water pollution, and wildlife loss are problematic leads to the use of conservation practices. Before a landowner adopts a practice, he must perceive a need for it. Some generalizations about the types of visual information that induces the use of certain practices can be made. Visual information that the soil is eroding prompts landowners to use grassed waterways, no till, cover crops, and contour stripping.

Information on nutrient overload such as high nitrate testing in wells causes landowners to use soil testing to economize on fertilizer use. Livestock damage to stream banks causes landowners to fence livestock out of streams. Finally, poor tree production can cause landowners to switch to organic orchards. Support for this hypothesis indicates that landowners may need to be made aware of the immediate relevance of water pollution and other environmental harm to themselves or their operation.

Some demographic hypotheses were completely unsupported. Variables measuring the landowners' lack of involvement in the farm operation do not fair well in the regression models. Whether the landowner's residence is attached to the land or whether the landowner visits the land is not supported as affecting the use of conservation measures. Nor does being an absentee owner have an effect on the likelihood of using a conservation practice. Having a professional occupation other than farming negatively affects the likelihood of using a conservation practice in only one regression model.

Two demographic variables looked at whether a shortened planning horizon would negatively affect the use of conservation measures. First, age is not supported in the regression findings as influencing conservation practice use. Yet, it has the opposite expected relationship in the focused interviews. Some older landowners use conservation practices to simplify their operations. They may reduce tillage, grow crops that require fewer pesticides, and enroll land in CRP to reduce their labor and expenses.

Second, the landowner being retired was expected to decrease the likelihood of using conservation practices. However, being retired, when it has an affect, has a positive impact on using conservation practices. In four out of the five logistic regression models, where it qualified, being retired increases the likelihood of using a conservation practice.[14] In one model, it decreases the likelihood. In the focused interviews no landowner mentioned retirement as a reason to not use conservation practices on land their land.

Farm Features

It is generally believed that landowners must have the capability to adopt conservation practices. They must have the money, technical aptitude, and labor. Two measures of the landowner's ability to use conservation measures are not widely supported. The first, farm income received limited support in the logistic regression models. It is predicted to increase the likelihood of using a conservation practice in four of the 25 state models, and it is predicted to decrease the likelihood in one model. In New York, it increases the likelihood of having a soil erosion control practice and a practice to minimize agricultural chemicals in water. In California, it increases the likelihood of using a practice to prevent soil erosion and a practice to minimize overgrazing, which can be considered a practice to reduce erosion on pasture land.

Income is a more complicated factor than the indicator used for this study, the amount of revenue from the farm operation. Landowners chosen for the focused interviews were only those whose gross revenue from agriculture was at least $100,000 in 2000 or a more typical year. Less than 30 percent of the landowners in each state sample met this criterion. However, some of these landowners have not been able to adopt manure storage facilities, because they cannot afford them. Other landowners have not been able to adopt no-till, because they cannot afford new equipment (e.g., no-till planters). It may be more effective to conceive of income as an attitudinal variable, such as the landowner's professed belief that he can afford to implement a new conservation practice.

Second, farm size as a measure of capability to adopt did not receive any support in the regression models. In the focused interviews, the only exception is a particular group of landowners. Landowners with small operations and limited income feel they cannot afford to implement conservation practices, because they cannot afford the equipment. Moreover, their size limits them from renting equipment. Equipment rental companies rent to small landowners after larger operators, forcing

them to delay their harvest. Otherwise, landowners with varying operation sizes seemed equally capable of using conservation practices.

One potential defect with this variable's predictive ability is that farm size is actually a more ambiguous concept than conceptualized in this study by the question, "About how many total acres of farmland including pasture do you own?" It was discovered in the focused interviews that landowners rent out land they own and may rent land from others depending on the land's location and the needs of their crops or livestock. A better conceptualization of this variable might be the number of acres operated and leased from another operator.

A consistent relationship is not shown between type of farm product and the use of conservation practices in the logistic regression models. Farm product is expected to increase the adoption of conservation practices in 5 of the 25 models.[15] While no single farm product is supported; orchards and vineyards, ornamentals, and fruit and vegetable operations are all supported as increasing the likelihood that landowners will have practices to protect or improve wildlife habitat.

Conversely, few landowners in the focused interviews mentioned not using conservation practices due to the nature of their operations. Some landowners cannot use no-till, because they need a fine seedbed to plant alfalfa. Another landowner only plants corn in some areas of his farm, because it can tolerate high levels of soil moisture due to its root structure. Otherwise, landowners growing row crops did not discuss any characteristics of their operations that prevented them from adopting conservation practices. Instead, they tend to adopt practices such as no-till to reduce operation expenses. Since landowners produce so many different farm products, this hypothesis needs further investigation to explore the various practices that are more amenable to different operations.

External Features

The hypothesis that information about conservation practices motivates landowners to adopt them is difficult to test. It is difficult to prove landowners first receive the information and then implement the practice. Out of the interviews for which a time sequence can be ascertained, 22 landowners used 32 practices based on information they received. Four landowners were interested in a practice, and then sought information about it. The interviewed landowners are informed of practices mainly through relatives, friends, government agencies, cooperatives, or university extension offices. Then, they implement those practices. Landowners adopt practices to alleviate both the economic and environmental effects of pollution. While it is difficult for them to express their rationale for wanting to stop soil erosion or to reduce chemical applications, those who were able to do so mentioned reasons such as increased production, improving water quality, and simplifying the operation.

It is important for future research to discern what attributes make some information more effective. This study points toward local sources being effective, because they are trusted by the landowner. Information from cooperatives and other local private sources appears to be productive, because it helps the landowner deal with a particular problem on their land. Government information is important as it teaches landowners about management practices for which cost-sharing is available or how to comply with regulations.

One attitudinal variable about ownership objectives received limited support in the regression models and more widespread support in the focused interviews. In only one model did the importance of the next family generation owning and benefiting from the land decrease the likelihood that the landowner would use a conservation practice.[16] In none did it increase the likelihood. In four models having decision making in the family increases the odds of using a conservation practice.

Yet family involvement in the operation receives more support in the focused interviews, because the complexity of the family relationship is manifest. Seven landowners used conservation

practices, because their fathers recommended them. In two interviews landowners said they used a practice due to input from their sons. Eight out of 54 landowners used practices to please a spouse, leave land for the next generation, or out of agreement with a sibling. While the landowner may be the primary decision maker, family involvement in farming can expand to include input from multiple family members through many venues.

Government sharing in the cost of conservation measures is another gauge of the ability to use conservation practices receives more widespread support than farm size and income. In the logistic regression models, believing government assistance with conservation practices is important increases the odds of using a practice in 19 out of 25 models.[17] It decreases the odds in three models. Four of these relationships are found in two or more states. Landowners interested in government assistance to minimize the use of agricultural chemicals use practices to reduce the flow of chemicals into water in California and Wisconsin. Those interested in government assistance to reduce water pollution from crop production are more likely to use practices to reduce agricultural chemicals in water in New York and Michigan. Landowners interested in government help to minimize water and odor pollution from livestock are more likely to use practices to reduce the flow of livestock waste in water in California, New York, and Wisconsin. Finally, if the landowner is interested in government assistance to use practices to protect wildlife habitat, they are more likely to use these practices in California, Michigan, New York, and Texas. Overall, it appears that landowners are interested in receiving assistance for practices they have.

While there are numerous relationships between attitudes about the importance of government assistance and using conservation measures, there are fewer relationships between actually receiving government assistance and using conservation measures. In 9 out of 25 models, there is a relationship between receiving government assistance to offset low market prices and government payments for weather damage to crops and using conservation practices. Six of these relationships are between receiving government assistance and having practices for livestock operations in California, New York, Texas, and Wisconsin. Three of these relationships are found in two states each. If the landowners received government payments to offset low market prices in 2000, the odds of having a practice to minimize agricultural chemicals in water are increased in Texas and Wisconsin. If the landowner received government payments to offset low market prices in 2000, the odds of having a practice to minimize the flow of livestock waste in water are increased in California and New York. Finally, if the landowner received government payments for weather damage to crops in 2000, the odds of having a practice to minimize pasture damage are increased in New York and Wisconsin.

In the focused interviews, 8 out of 54 interviewed landowners adopted ten conservation measures due to government cost sharing. Additionally, seven landowners adopted conservation measures to qualify for government program benefits such as price subsidies and crop insurance. Overall, it appears that government assistance, either in the form of crop subsidy eligibility for using certain practices and cost sharing to pay for applying practices is effective.

Development pressure does not have the expected negative influence. It does not affect the likelihood of using a conservation practice in the regression models. Furthermore, a negative relationship is supported in the focused interviews. Eight of the 54 landowners interviewed used more environmental practices as they became surrounded by residential development. Residential development forces them to cut down on pesticide use, prevent odor from livestock operations, and contain manure. Only one landowner decided not to implement conservation practices on land he rents due to development in his area.

Finally, the influence of production contracts is not evident in the focused interviews. Landowners were asked if they had a contract with a processor. Nine of the 12 landowners who responded that they had contracts did not feel the schedules or production requirements of their contracts influenced their use of farm conservation practices. The three landowners who had restrictions did not find the restrictions to interfere with the adoption of conservation measures. Two could not plant genetically modified crops, because their crops were exported to Europe and Canada. The third only planted

irrigated crops, because his crops went to a cannery that required irrigation. Otherwise, the landowners with production contracts appear as likely to use conservation practices as other landowners. They grow organic crops, use no-till and minimum till, scout their fields, and apply conservation plans.

Unexpected Findings

There are noteworthy unexpected findings due to the nature of the data gathering and analysis. The survey used for the logistic regression analysis included many variables not hypothesized to impact the use of conservation practices. Yet some of these variables proved significant in the bi-variate testing. Only two remained significant in the multi-variate testing. The focused interviews were conducted around a series of questions to which the landowner could respond as he or she chose. The open-ended nature of their responses allowed for a multitude of unanticipated responses.

First, gender arose as a significant variable in the logistic regression models. While it has limited frequency of qualifying, it is estimated to have a substantial, positive affect in four models.[18] In Michigan, New York, and Wisconsin, males are more likely to use a practice to minimize the flow of agricultural chemicals in water. Also, in Michigan being male increases the odds of using a soil erosion control practice. There are differences between males and females in the state samples, such as males are more likely to earn at least $100,000 a year from agriculture and are more likely to be the decision makers in the farm operation. Considering the differences between male and female landowners and the high percentage of female landowners in the state samples of urban-edge agricultural landowners, the impact of gender should be further investigated.

The second unexpected finding from the logistic regression analysis is the relationship between conservation practices.[19] Most of these relationships may be attributed to the similarity of practices and the use of one practice to achieve multiple goals (such as soil erosion control and reducing chemical flow into water). It is unlikely that the positive relationships between unrelated practices are causal. For example, practices to minimize water pollution from agricultural chemicals and those to minimize pasture or range damage in Texas and Wisconsin are not similar. Yet four such relationships exist. It is conjectured that landowners adopt multiple unrelated practices as the result of an underlying stewardship ethos. This idea receives modest support in the focused interviews. While a stewardship ethos may contribute to some landowners adopting conservation practices, other motivations exist.

The two data sources are very different, so they result in diverse findings. In addition to explaining differences between the expected and actual findings of the surveys, the focused interviews also add a great deal of new information to the models. They result in numerous unexpected findings. First, there are multiple motivations for adopting conservation practices. A significant reason is the reduction of operation expenses, including labor, time, equipment, and chemicals. Practices applied to cropland are usually those that reduce labor, equipment, and chemical input expenses. Practices applied to livestock operations typically reduce labor and time. Practices adopted to increase soil health and the land's productivity are applied on crop operations, animal operations, and orchards and vineyards.

Second, government regulation affects the adoption of numerous conservation practices. Government regulations typically cause landowners to use practices to prevent pollutants from entering the environment, protect wetlands, and reduce soil erosion. Different practices are used to comply with government regulations depending on the operation type. Cattle operations typically have to implement some kind of manure storage practice. Crop operations are usually required to apply run off prevention measures and erosion control practices. Landowners fear the penalties they will risk, if they do not comply with government regulations. They worry that they will be fined or their operations will be closed down.

Third, timing is a very important factor for landowners. The competitive nature of the agricultural market place forces them to try to plant their crops as quickly as possible, so they can mature and be

harvested at an optimal time. Conservation tillage and no-till may allow landowners to plant more acres more quickly. Timing is also a reason to use Integrated Pest Management (IPM). Landowners realize the importance of controlling pests, before they reach levels of damage that are too expensive to control.

Fourth, landowners who do not use conservation practices usually have practical reasons for not doing so. There are real limitations to their ability to adopt new practices. The needed equipment may be too expensive, they may not have the labor to install structures, or their crops may not be amenable to certain practices. Small operators feel limited by their inability to purchase equipment and pay for structures and the low priority they receive for renting equipment and obtaining scouting services. Since they work with very small windows for planting and controlling pests, these landowners are less likely to make use of these services.

Soil type and climate may be barriers to using conservation practices. Landowners with clay soil may need to use a moldboard to break it up for proper drainage and seedling emergence. Also, farmers experiencing drought and year round temperatures above freezing may not be able to adopt conservation tillage systems for similar reasons. However, soil type and climate are barriers that can be overcome, often through technology. Certain crop hybrids and modifications in tillage assist landowners in adopting practices despite topographical concerns.

Fifth, practices often work at odds with each other. Landowners with organic operations cannot use reduced tillage systems that require chemical weed control. Since they cannot use chemicals to control weeds, they rely on tillage and biological controls. Technology may also prove useful in helping landowners overcome the tendency of certain practices to work against each other.

A final limitation appears to be the landowner's comfort level with change. Some landowners are familiar and comfortable with their current practices; therefore, they do not want to change. This limitation usually applies to tillage systems, chemicals, and storage structures that require economies of scale for a return on their cost. This barrier is selectively limiting as the landowners may use other practices such as filter strips, cover crops, or crop rotation with which they are more familiar.

The logistic regression models show that it is difficult to build a model that holds across all five practices and across all five survey areas. Some similarities exist: for example, the relationship between education and the use of soil conservation practices, practices to keep agricultural chemicals out of water, and practices to protect wildlife. Otherwise, there is a great diversity in models for each state and each practice. This diversity leads to the need to further explore the differences between states.

It may be necessary to at this time abandon the search for comprehensive models to explain the use of all five types of practices. Instead, it may be necessary to develop different models for each state, each group of conservation practices, and each product type. The same approach may be necessary for different conservation practices, especially the difference between livestock practices and crop practices. While many landowners raise livestock and the crops to feed them, they encounter very different obstacles and incentives for adopting practices for the different aspects of their operation. Moreover, orchards and vineyards, because of the longevity of the crops merit separate investigation. Once better explanatory models are developed in each of the three areas, it may be possible to look for similarities across them.

The Viability of Diffusion Models

This study supports Napier's (2001) contention that diffusion models are limited in their ability to explain the use of conservation practices. Variables that are expected to determine whether the landowner becomes aware of the conservation practice and sees a need for it receive a limited range of support. Moreover, different variables are brought to the fore as impacting the use of conservation practices. An overview of the performance of factors specifically mentioned as influencing the use of

conservation practices in diffusion models is given here.

Farm experience is one of the initial variables believed to affect the use of conservation practices (Ervin and Ervin, 1982; Sinden and King, 1990). Farm experience quantified as being or having been a farm operator has a large odds ratio in the models for which it has an effect. Three of the eight models in which it has a significant effect are for minimizing the flow of livestock waste in water, which is interesting considering studies reviewed for this paper did not analyze conservation practices particular to livestock.

Formal education is significant in seven models. It does not have the impact predicted in previous diffusion models (Ervin and Ervin, 1982; Sinden and King, 1990). It is not a predictor in any of the livestock models. Education programs are also believed to affect the adoption of conservation practices in previous diffusion models. However, the focused interviews show that education's effect is more diverse than government or university education programs. It should be expanded to include interactions with local features, such as the history of conservation practices in the area and local culture, and farm service providers, such as cooperatives and other commercial chemical and service providers.

Whether the landowner is directly affected by pollution as indicated in Napier and Brown's (1993) model is not supported as measured by proximity to the farm operation. Yet it does receive support in the focused interviews and should be expanded to include the health of others. Many landowners are concerned with preventing harm to their neighbors.

Farm operation characteristics are an important factor as indicated in the diffusion models (Ervin and Ervin, 1982, Sinden and King, 1990). However, they are more varied and difficult to quantify than indicated in the previous literature. Diffusion models predicted a difference between adopters raising commodity crops and those not raising commodity crops predicting that those who raise commodity crops would be less likely to use conservation practices (Ervin and Ervin, 1982; Napier and Brown, 1993). However, this study did not support that hypothesis. Instead four different types of farm products were found to increase the odds of using a conservation practice in five models. Therefore, models need to be expanded to look at more operation types.

Additionally, two other farm features do not have widespread support that diffusion models suggested they would (Ervin and Ervin, 1982; Carlson and Dillman, 1983). In the logistic regression models developed for this study, operation size has no significant impact. Farm income has a better showing, proving significant in New York for the use of soil erosion control practices and practices to minimize agricultural chemicals in water and in California for soil erosion control practices and practices to minimize over grazing. In the future, farm feature characteristics need to include production schedules to truly understand the time restraints landowners have to work within to implement new practices.

Also, farm features need to include more environmental characteristics, such as irregular rains, freezes, and pest infestations. Dry land ranchers in Texas have significantly different conservation needs than confined dairy operators in Michigan. Landowners who suffer drought that hardens the ground have different limitations than those who experience freezes that break the ground. Different pest problems can impede landowners from adopting conservation measures or can promote them to do so.

One of the significant omissions from diffusion models is the structural feature of environmental regulations. Previous research looks at program incentives but not regulations requiring landowners to adopt conservation practices. Diffusion models include government assistance and whether the landowner grows crops for commodity programs (Sinden and King, 1990; Camboni and Napier, 1993). These two factors prove to be significant in this study. However, diffusion models do not consider the differing regulatory environments faced by agricultural landowners. This requirement to adopt conservation practices may be one of the most significant structural features omitted from previous diffusion models. Other important structural features that should be included are markets for crops and the availability of needed services. While variables included in diffusion models did not perform extremely well, some are useful in examining the use of conservation practices.

Policy Implications

The previous analysis suggests some policy recommendations. The first policy implication is that landowners may not abandon conservation measures, once they have initiated them. Previous researchers assert that landowners may stop using conservation practices as soon as government benefits end (Claassen et al. 2001 and Johnson, 2001). A number of landowners in the focused interviews use measures, because their father used them or they are a local tradition. Practices such as drainage structures, rotational grazing, strip cropping and terraces are standard procedures for them. These measures have become part of the landowners' operations.

They are likely to continue using practices, because once landowners have invested in the equipment and structures, they must recover the cost. Landowners who buy no-till equipment or pay to have a manure storage system are not likely to simply abandon these practices writing-off their initial expense. Also, once practices are instituted, landowners may realize benefits from them. The cost of maintaining a conservation practice is considerably lower than the cost of initiating it. Landowners commented that the cost savings from using stored manure or the increased soil productivity from no-till became reasons to continue the practices, although they were not the reasons they initiated the practices. Land enrolled in the Conservation Reserve Program (CRP) is an exception. Some landowners in the focused interviews indicate that they bought CRP land, so they could bring it into production once the contract expired.

Second, information appears to be effective in getting landowners to try new practices. Persuasive information comes from numerous sources. Government, neighbors, publications, relatives, and universities all play a role in the information process. Often government information comes in the form of informing landowners of new regulations.

Government information can be more effective in promoting the adoption of conservation practices, if it focuses on communicating the practice's non-conservation benefits to the landowner. Numerous landowners in the focused interviews indicated that conservation benefits are not the primary reason they adopted practices such as no-till, grazing management, and Integrated Pest Management (IPM). They adopted them because they save time and money or increase production. If the productivity benefits of conservation practices can be effectively communicated more landowners might adopt them.

Also, as indicated in previous studies, the information should be specific to the landowner's circumstances. Landowners are acutely aware of any disconnect between recommended practices and the circumstances of their operation. Many landowners adopt or do not adopt practices based on their local success or failure. Finally, the local landowners' needs should be taken into consideration. Landowners are more likely to adopt a practice if it helps them meet a current need, such as a pest problem or low production levels.

Third, government regulation works. Regulations are especially effective when combined with incentives and cost sharing. Landowners will adopt even the most expensive practices, if they fear government penalties. However, in writing regulations policy makers should consider how to properly quantify the landowner's ability to comply and target regulations toward specific groups of landowners. For example large, livestock operations are more capable of installing manure storage facilities than smaller operations. It may be more practical for the owner of a small livestock operation to soil test and spread manure appropriately than install a manure storage facility. Regulations should provide flexibility in how landowners meet conservation goals. One hundred percent compliance among all groups may not be possible.

Fourth, not every practice is suited to every operation. Not every livestock owner needs a manure storage facility and not every crop producer can adopt no-till. Landowners should be presented

with an array of conservation options that they can implement based on the characteristics of their operation. Incremental or partial adoption, leaving the door open for greater conservation in the future, is better than no conservation at all. Understanding the landowner's specific circumstances should allow government conservation officers to make suitable recommendations.

Fifth, further analysis should be performed on the factors that prevent landowners from complying with regulations. The government cannot subsidize a waste storage lagoon for every confined animal operation or no-till equipment for every crop operation. However, it may be possible to make changes in the system, once we fully understand why some landowners cannot adopt. For example, Extension offices might be able to help small landowners find timely scouting services.

Study Limitations

The study is first limited by the survey instrument. While the survey was partially constructed to test the hypotheses in this study, it also had to meet other research goals. Since there was a limited amount of time to question landowners over the phone (15 minutes, on average), every question needed to fully examine the adoption hypotheses was not asked. In turn, the logistic regression models are limited by the attempt to include every relevant variable. This effort results in a different model for almost every practice in each state. This amount of variability limits the ability to generalize across models.

The study is also bounded by the focused interview data collection. Unconscious bias in how the researcher asked questions probably affected responses by the interviewees. Some bias was eliminated by investigating conservation practices in each study area to become familiar with the practices before interviewing. This preliminary work allowed the researcher to wean out reported behavior that was not actually conservation oriented. Moreover, the researcher's inexperience potentially limited the relevance of the data gathered. The study is also limited by the lack of follow-up interviews to further explore interesting ideas. It is hoped future research can provide a more detailed examination of the themes brought out by the qualitative data.

Overall, the study is limited by its population of urban-edge agricultural landowners. This population is not representative of the total population of agricultural landowners. For example, only two large farm corporations are included in the focused interviews. These more industrial type farms may be dramatically different in their adoption of conservation measures than the family owned farms that are predominantly the subjects of this study.

Taken as a whole, the study opens many new research venues. Much of the evidence lends to the idea that previous models used to explain the adoption of agricultural conservation practices can be abandoned or modified in the search for models that offer greater explanatory power. Napier reached similar conclusions in his 2001 study. Initially, future research should revolve around qualitative data collection that allows the full array of relevant variables to be clarified. Once significant factors are identified, hypotheses can be formulated to test them through statistical modeling.

Areas of Future Study

Specific areas of future exploration have been identified in this study. First, study should be performed on industrial farm operations. These farms were not well represented in this study and merit investigation due to their magnitude.

Second, what aspects of the states cause variation in the models? Further statistical analysis on the available data did not provide a great deal of information on the differences between states that cause variation in the logistic regression models. However, both the statistical models and the focused interviews hint at state differences that might shape the adoption of conservation practices.

The third area of recommended future research is determining why educational efforts are effective. Certain populations may be more responsive to different types of educational efforts, or specific educational efforts may work better for some practices than others. Since information is so important to the adoption of conservation practices, improving its effectiveness may be one of the most fundamental and inexpensive ways to increase compliance with conservation policy. One aspect of improving information that may prove extremely effective is to focus on the ability of conservation measures to reduce operation expenses and increase productivity, instead of emphasizing their conservation value.

Fourth, investigation should be performed on the types of feedback from the land (such as types of erosion damage or pasture) that the landowner uses to determine the need for conservation practices. Feedback may be contingent on the type of operation or environmental damage. It may also be mitigated by other factors. The landowner's economic position may cause him to ignore signals from his land about the need for conservation practices.

Fifth, how does the landowner establish his ability to adopt conservation practices? A new measure of the ability to adopt conservation practices is needed, as the current measures of income and operation size do not seem to effectively identify the landowner's ability to use conservation practices. It is important to understand the limiting factors from the landowner's perspective.

Sixth, the question of how can government assistance be made the most successful should be answered from the landowner's perspective. Again, the landowner is the policy target. If the regulations do not meet the landowner's needs, they are not likely to be effective.

Seventh, future investigation needs to determine how the market impacts the landowner's ability to adopt conservation practices. Two organic producers mentioned the need to limit their production to the organic market's capacity to absorb it. Landowners who may want to move toward an organic operation may be limited by the market's ability to absorb their product.

As research further discredits previous models of conservation practice adoption, new avenues of investigation are opened. These specific research areas should further explain the conservation practice adoption process to the extent that new models of adoption can be formulated. This research provides valuable information for the policy implementers responsible for increasing agri-environmental policy compliance, as it points them to ways to make policy more effective.

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APPENDIX A

LIST OF VARIABLES

APPENDIX A. LIST OF VARIABLES

Fieldcrp. Field crops grown on land
Livestock. Livestock raised on land
Orchard. Has orchard or vineyard crops
Ornament. Has ornamental crops
Fruits. Has fruits or vegetables
Soil1. One or more practices applied to protect land from soil erosion
Flow1. One or more practices applied to minimize water pollution from agricultural chemicals
Waste. One or more practices applied to minimize water pollution from livestock waste
Protct1. Practice to protect or improve wildlife habitat
Wet1. Practice to protect or improve wetlands
Decide1. Respondent makes decisions for the land by self or with spouse
Infam. Decision making is in the family
Age. Age in years
Gender (1=male, 0=female)
Acrenumb. Total number of acres owned
Revenue. Gross revenue from agriculture either in 2000 or in a year that is more typical
Income. Revenue dichotomized as up to 100,000, and 100,000 and over
Educ. Years of formal education
Gov_pay2. In 2000 received government payments to offset low market prices for crops
Gov_pay1. In 2000 received government payments for weather damage to crops
Retired. Respondent is retired
Farmer. Respondent is a farmer or rancher
Othfarm. Not a farmer, but occupation is farming-related
Profess. Respondent has a professional occupation
Decide1. Owner is a farm or ranch operator
Farmbk. Now an operator or was one in the past
Absent. Is an absentee owner.
Future. Respondent believes that in five years all his/her land will be either farmed or lie fallow
Value. Owner has the objective of seeing dollar value of land increase over time
Lease. Has objective of earning land each year by leasing the land
Earn2. Has objective of earning money by operating land him/herself
Recre. Objective of self and family enjoying recreation on the land
Eros. Objective of protecting the land from soil erosion
Pollut. Objective of protecting bodies of water from agricultural pollution
Gener. Objective of having future family generations benefit from the land
Makemon. Making money from farming is one of the top two objectives
Steward. Stewardship is one of the top two objectives
Recrea. Recreation is one of top two objectives
Dollar. Increasing dollar value of land in one of top two objectives
Tax or taxcalf. Agricultural-value property tax assessment is very or moderately important to the owner
H2o. Government help with adequate supply of reasonably priced irrigation water is very or moderately important (use only for California and Texas)
Worker. Help with recruiting agricultural workers is very or moderately important
Damage. Help with insurance against weather-caused damage to crops is very or moderately important
Prices. Government payments to offset low market prices is very or moderately important
Chem. Help to minimize use of agricultural chemicals is very important
Pollute. Help to minimize water pollution from crop production is very important
Habitat. Help to protect or improve wildlife habitat is very important

Organic. Help to produce organically grown food is very important
Stinky. Help to minimize water and odor pollution from livestock is very important
Market. Help to market products directly to consumers is very important
Divers. Help to diversify mix of crops is very important
Tourist. Help with agro-tourism is very important
Conflct. Local government zoning to limit conflicts with non-farm neighbors by restricting the number of non-farm homes is very important
Expand. Local government zoning to permit livestock operations to expand to economical levels is very important

APPENDIX B
CONSERVATION PRACTICES

APPENDIX B. CONSERVATION PRACTICES

Cover crops. Cover crops are grown to protect the soil surface from erosion. They can be grown on fields between crop seasons or between orchard trees (Thurston, 1996).

Crop oil. A derivative of paraffin-based petroleum oil used to increase the penetration of a pesticide spray into a plant cuticle or the chitinous shell of insects. Crop oil should not harm beneficial insects (Petroff, 2003).

Crop rotation. Crops are alternated yearly according to a cropping plan. Crop rotation can reduce fertilizer needs, break disease, insect, and weed cycles, and reduce erosion (USDA/NRCS Iowa, 2003).

Integrated Pest Management (IPM). The use of manage strategies such as resistant plants, beneficial insects, natural enemies, and behavior disruption to control disease, insects, and weeds with a minimum of environmental harm (USDA/NRCS Iowa, 2003).

Manure storage. Manure is stored in a structure to prevent nutrient loss and water contamination. Storing manure prevents runoff from livestock feedlots, reduces fertilizer cost, and allows manure application under appropriate conditions (USDA/NRCS Iowa, 2003).

Micro-irrigation. Micro irrigation is the process of applying water on or below the soil surface. A low flow rate of water is applied directly to the root zone according to the level of plant consumption. Additionally chemical inputs can be applied directly to the plant through the irrigation system reducing the amount of chemicals used and the potential for them to flow off the soil (Haman and Izuno, 1989).

No-till. A planter is used to open a narrow slot in the soil with minimal disturbance of crop residue. No-till leaves the maximum amount of residue and reduces the amount of rain erosion. Over time soil structure is built including macro pore formation to allow for greater water infiltration (Shouse, 1990). Additionally, beneficial insect populations are maintained. Weeds are controlled by cover crops or herbicides. No-till, minimum till, and conservation tillage differ from each other in the amount of soil disruption prior to planting (Peet, 2001).

Ridge tillage. Crops are planted on the same ridges every year. Chemical fertilizer and pesticides can be reduced with ridge tillage (Reeder, Ozkan, Griffith, and Parsons, 2003). Ridge tillage allows soil to dry and warm more quickly than no-till (Dickey, Jasa,,Klein, Eisenhauer, Shelton, Dolesh,, and Smith, 1996).

Rotational grazing. Livestock are moved from one pasture to another to control grazing. In continuous grazing systems, animals selectively graze some areas allowing others to mature. In rotational grazing systems, forage is grazed more uniformly, allowing for more uniform paddock re-growth (Henning, Lacefield, Rasnake, Burris, Johns, Johnson, and Turner, 2003)

Soil testing. The process of testing the soil for nutrient levels to determine the level of nutrient application. Soil testing identifies soil nutrient or chemicals that limit plant growth, increases fertilizer efficiency, reduces over fertilization, and identified polluted soil (Oklahoma State University, Soil, Water, and Forage Analytical Lab, 2003).

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[1] Government Information Sharing Project, Oregon State University – Information Services, Census of Agriculture, 1987, 1992, 1997. http://govinfo.kerr.orst.edu/ag-statesis.html (April 4, 2002).

[2] This stipulation prevents small counties that while 10 percent of their land may be in farms or ranches, it is still only a trivial amount of land in farms or ranches (Esseks, et al., 2002).

[3] An index of "urban influence" has been developed by USDA's Economic Research Service (ERS). For each 1990 census block it measures its accessibility to the population in other blocks within a 50 mile radius. Urban influence is higher as the blocs within the radius have a larger number of people and those blocs are closer to the bloc under study. The measure is first used by the ERS to assign the counties in to two categories "totally rural" counties (there is no town or part of town within the tract that has at least 2,500 residents, and the primary commuting pattern is to sites in the tract. Counties not in the "totally rural" category are placed in the "urban influenced" category. The ERS uses the same measure to group urban influence counties into three equal categories of urban influence in ascending order 1. medium low, 2. medium high, and 3. high. Esseks et al. combine the percentage for areas with medium low, medium high, and high urban influence to find out which counties meet their condition of having at least 25 percent of their land subject to a degree of urban influence. Next, they decide which counties meet the fourth condition by adding together percentages of "medium" and "high urban influence" . Last, they needed to make sure the ten counties were varied on the fourth condition, so they divided the state group of counties into three categories, the lower third, the middle third, and the top third. They randomly chose three to four counties from each category to obtain the final sample of ten counties. Source: communication to Dr. Esseks, et al. and databases for the five states provided by ERS: October 2000 (Esseks, et al., 2002).

[4] Craig Gundersen et al., of USDA's Economic Research Service defined limited resource farms as "Any farm with . . . gross sales of less than $100,000. . . " (A Safety Net for Farm Households, Agricultural Economics Report No. 788, p. 5).

[5] "This year does any of the farmland you own have applied to it one or more methods that aim to minimize soil erosion?"

[6] A consensus does not exist as to the best measure for the percent of variance explained. Nagelkerke R Square should be considered a rough guide (Pampel, 2000).

[7] "This year does any of the farmland you own have applied to it one or more methods that aim to minimize the flow of chemical fertilizers or pesticides into surface water or groundwater?"

[8] "This year does any of the farmland you own have applied to it one or more methods that aim to minimize the flow of livestock waste into ground or surface water?"

[9] "This year does any of the farmland you own have applied to it one or more methods that aim to protect or improve wildlife habitats?"

[10] "This year does any of the farmland or ranchland you own have methods applied to it that aim to minimize overgrazing or other damage to pasture or rangeland?"

[11] See Tables 4, 8, 10, and 12 in Chapter 2.

[12] See Tables 4, 6, 8, and 12 in Chapter 2.

[13] See Tables 6, 10, and 12 in Chapter 2.

[14] See Tables 4, 6, 8, and 10 in Chapter 2.

[15] See Tables 6 and 10 in Chapter 2.

[16] See Table 4 in Chapter 2.

[17] See Tables 4, 6, 8, 10, and 12 in Chapter 2.

[18] See Tables 4, 6, and 12 in Chapter 2.

[19] See Tables 4, 6, 8, 10, and 12 in Chapter 2.