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AN ECONOMIC ANALYSIS
OF LANDOWNDERS' WILLINGNESS TO ENROLL FILTER STRIPS
IN A CONSERVATION PROGRAM:
A CASE STUDY IN NEWAYGO COUNTY, MICHIGAN

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Amy Kathleen Purvis

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Vernon L. Sorenson
Major professor

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AN ECONOMIC ANALYSIS OF LANDOWNERS' WILLINGNESS TO ENROLL FILTER STRIPS IN A CONSERVATION PROGRAM: A CASE STUDY IN NEWAYGO COUNTY, MICHIGAN

By

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ABSTRACT

Filter strips are an important recent addition to farm programs. In this thesis, the policy context for filter strips is reviewed. A conceptual framework for weighing the marginal benefits and marginal costs associated with different conservation policy alternatives is developed. Farmers' willingness to accept yearly payments to participate in a ten-year filter strip program is understood as a utility-maximization problem. Survey research conducted in Newaygo County, Michigan using contingent valuation methods is described. The survey data were analyzed using a two-limit Tobit model. The results indicated that yearly payment offers, opportunity costs, preferences, and expectations about the future have a significant impact on prospective participation.

Implications of these empirical findings for the design of future farm conservation programs to target water quality are discussed. Increasing yearly payments offers and allowing farmers to cut hay on acreage set aside as filter strips could improve program enrollments.

This thesis is dedicated to my parents,

Norma and George Purvis,

in appreciation of their friendship and support

every step of the way.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ASCS	Agricultural Stabilization and Conservation Service
CES	Cooperative Extension Service
CRP	Conservation Reserve Program
CV	Contingent Valuation
LR	Likelihood Ratio
SCS	Soil Conservation Service
TDM	Total Design Method
USDA	United States Department of Agriculture

INTRODUCTION

Filter strips are a potentially significant addition to today's farm conservation programs. Filter strips are bands of cropland adjacent to streams or drainage ditches which are retired from crop production and planted in a permanent vegetative cover. They act as a buffer to stop sediment from being washed downstream. Agronomists estimate that filter strips can reduce off-farm damages from sediment movement related to cropland erosion by between 25- and 50-percent (Walter, 1989; Clark, et.al., 1985). In February, 1988 the Secretary of Agriculture announced that farmers could enter ten-year contracts to set aside filter strips in the Conservation Reserve Program (CRP). The CRP is the first national conservation program to include as an explicit policy objective controlling non-point water pollution due to cropland erosion.

This thesis reports empirical research results describing farmers' willingness to accept yearly payments to set aside filter strips for ten years. An experimental design was developed for measuring the marginal costs associated with influencing farmers' willingness to supply conservation, especially to prevent off-farm erosion damages. Farmers' decision-making was understood in a utility-maximizing framework, where responsivenss to yearly payment offers was conditioned by economic factors.

Objectives

A case study was conducted in Newaygo County, Michigan to learn about farmers' willingness to accept yearly payments to set aside filter strips for ten years. The objectives of the research were three-fold:

1. To describe the conservation policy context for this analysis concerning participation in a filter strip program.

2. To assess farmers' responsiveness to yearly payments for setting aside filter strips for ten years by testing a set of economic hypotheses to identify characteristics of landowners and their farmer that are correlated with participation.

3. To develop a framework to measure the marginal costs of increasing participation in a filter strip program based on farmers' responsiveness to yearly payments as conditioned by economic factors.

Overview of the thesis

In Chapter I the context for this study about filter strips is discussed. An economic framework for weighing costs and benefits is developed for analyzing choices between conservation alternatives,

In Chapter II a conceptual framework for empirical research is developed. A set of hypotheses about farmers' willingness to set aside filter strips is presented: farmers make decisions about whether to accept or reject a yearly payment according to their preferences and values, subject to economic constraints including opportunity costs, transaction costs, and expectations about the future.

Chapter III is a description of contingent valuation methodology, the procedures followed in designing the mail questionnaire, and the

data collection process.

Chapter IV outlines the econometric model employed to analyze the empirical data collected in the mail survey and the results of hypothesis-testing.

Chapter V considers results from analysis of the empirical data in a qualitative context based on forty-two personal interviews with current CRP participants and a random sample of individuals who responded to the mail survey.

In Chapter VI, a summary of the thesis, policy implications, and directions for further research are presented.

THE POLICY CONTEXT

Filter strips represent a significant change in the design of farm conservation practices. In this chapter, the differences between conservation practices are described. The context for the policy change to include filter strips in the CRP is discussed. A conceptual framework for weighing the benefits and costs of conservation alternatives is developed. Finally, some preliminary questions are posed about increasing farmers' use of filter strips.

Conservation practices to control erosion

Cropland erosion has effects both on and off the farm. On the farm, soil movement by wind and water lowers soil productivity, immediately and over the long run. Off the farm, displaced sediment muddies streams, rivers and lakes which affects downstream water-users. Farmers use conservation practices to control soil erosion.[1] Farm conservation practices which cost-effectively reduce the quantity of displaced sediment entering streams and ditches on the farm are not necessarily the same as practices which lower erosion rates (Smith, et. al., 1979).

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[1]Although soil conservation is a broader concept than soil erosion control, the two terms are often used interchangeably. In this thesis, an attempt is made to take account of differences in their meanings. Erosion control implies keeping soil in place. Conservation also includes measures to maintain and improve soil productivity and fertility over the long run. Conservation practices do not always reduce erosion or sediment delivery (Ervin and Ervin, 1981).

In general, structural practices, such as terraces and grassed waterways, both control soil erosion and reduce the amount of sediment washed downstream. On the other hand, non-structural practices such as the use of vegetative cover crops and conservation tillage are effective in reducing erosion, but do not necessarily affect the amount of sediment movement off the fields where they are used. Designing a farm conservation plan to control erosion on the farm implies recommending different practices on different fields than a plan to achieve the most cost-effective possible reduction in sediment delivered off the farm. Whether applying conservation practices to control erosion will also affect sediment delivery ratios depends on the location of the practices within fields and the choice of fields where conservation is implemented. For most farmers, controlling erosion to save soil on the farm takes priority over reducing sediment delivery ratios, which benefits downstream water-users.

The context for today's conservation policy

Since the 1930's the United States Department of Agriculture (USDA) has supported farmers' decision-making about adopting conservation practices to control cropland erosion. The USDA has sponsored conservation programs offering technical assistance and cost-sharing. An important impetus driving public support for conservation is concern about maintaining enough productive soil to allow future generations to meet their demand for food and fiber. Once soil is lost, it's difficult, expensive, and sometimes impossible to restore. Public policy intervention in conservation is appropriate because markets send farmers imperfect signals about when to invest in soil

erosion control. Market mechanisms fail to convey society's interest in saving enough soil to provide for the needs of future generations to farmers.

When farmers think about soil erosion control as an input to production, they often decide not to use conservation practices because the pay-off is not immediate. An important motive behind a farmer's investments in conservation today is to prevent productivity losses which would otherwise occur several years or decades later. The right timing for investments in soil conservation is often difficult to pinpoint because serious erosion damages can occur gradually. Potential benefits from conservation may accrue in the future to someone other than investing farmers or their families.

Conservation programs have traditionally emphasized education, and have offered financial support to help farmers overcome constraints to the adoption of conservation practices. Beginning in the 1930's, cost-sharing funds were allocated with the objective of reaching as many farmers as possible, rather than according to the severity of cropland erosion problems (Batie, 1983). Along with controlling erosion, improving farm incomes and supporting agricultural expansion were important objectives achieved through early farm conservation programs.

An important trend for the 1980's is the changing role environmental quality objectives play in the design of conservation programs. Generally speaking, through the 1970's agricultural policies were formulated by asking how farmers' net incomes and production capacities were affected by resource quality and quantity and by

prices. Accordingly, the primary goal of conservation programs was to help farmers control erosion, in order to assure a continuing, dependable supply of food. In contrast, today increasingly policies are formulated by asking how farmers' practices impact resource quality and quantity. This change is fundamental (Batie, et. al., 1986).

Evidence of this change toward integrating environmental quality objectives in the design of conservation programs is reflected in the content of the conservation provisions of the 1985 Food Security Act. Environmental quality objectives are additions to a long list of priorities for conservation, rather than replacing other priorities. For example, the first two goals of the CRP are to reduce water and wind erosion and to protect our long-term capability to produce food and fiber. These are followed by three environmental objectives, to reduce sedimentation, to improve water quality, and to create better habitat for fish and wildlife through improved food and cover. In designing and implementing conservation programs with multiple objectives, trade-offs are inevitable. Farmers who enter contracts to set aside filter strips in the CRP are likely to contribute most to the environmental objectives of the program. For a program like the CRP, more emphasis on filter strips may mean less progress with other conservation priorities.

The objective of this research was to learn about farmers' willingness to set aside filter strips for ten years. Farmers' decision-making was described in the context of the trade-offs they consider in evaluating conservation alternatives. A conceptual

framework helps to identify the benefits and costs relevant to farmers' choices and to public policy decisions about conservation.

Supply and Demand for Cropland Erosion Control

The demand for erosion control on cropland is determined by the marginal benefits from using conservation practices. Benefits arise both on and off the farm. Adoption of a conservation practices depends upon its marginal benefits and marginal costs. Farmers are concerned with the benefits and costs of conservation as they are experienced on the farm. Public decisions consider both on farm and off farm benefits and costs. Since farmers and the public perceive different benefits from conservation, their levels of willingness to support soil erosion control efforts on the farm are different. The divergence between private and public conservation decisions can be shown graphically using marginal benefit and marginal cost curves (Figure 1.1).

Farmers invest in conservation practices to control soil erosion. When farmers increase their conservation spending, they can achieve higher levels of erosion control. Farmers who take land out of production for conservation purposes face higher opportunity costs as they set aside more acreage, and as they set aside more productive acreage. Farmers' willingness to supply land into conservation practices depends on an upward-sloping marginal cost function.

Demand for the use of conservation practices depends on the benefits associated with controlling cropland erosion, depicted graphically with a down-ward sloping marginal benefit function. On the farm, landowners themselves perceive the need to prevent cropland erosion in order to avoid productivity losses which could result in

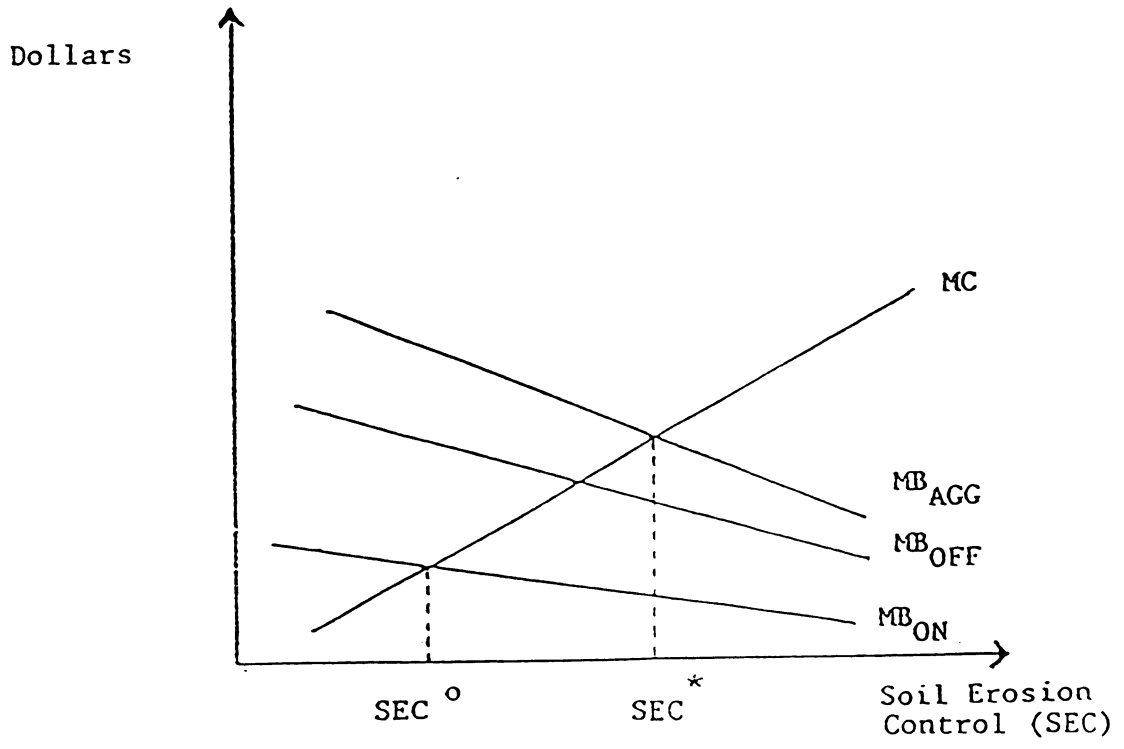

Figure 1.1: **Marginal costs and marginal benefits of conservation**

lower yields now and in the future. Off the farm, demand for conservation comes from downstream water-users who are concerned about sediment displaced by erosion entering streams, rivers and lakes.

From a farmer's perspective, the benefits from erosion control are largely from the prevention of productivity losses. Market mechanisms tend to reward farmers who use conservation and punish those who erode. Yield reductions lower production revenues and reduce the capacity of cropland to produce food and fiber. Eroded cropland commands a lower price in the land market. Commodity and land prices offer farmers incentives to control cropland erosion, with pay-offs in higher net farm incomes over time. At the same time, non-monetary benefits play an important role in determining farmers' willingness to conserve. Improved wildlife habitat, increased recreational uses of cropland, and the ethical satisfaction from good land stewardship have intrinsic value to farmers and make a difference in their decisions about investing in conservation practices.

To maximize the benefits from using a conservation practice, a farmer would try to achieve a level of soil erosion control, SEC^{O}, where the marginal on-farm benefits (MB_{ON}) equal the marginal costs (MC) of conservation. From a farmer's point of view, investing in higher levels of erosion control is inefficient--the costs are more than additional improvements are worth on the farm.

The on-farm decision regarding conservation tends to ignore benefits from controlling erosion that arise off the farm. Cropland erosion can cause sediment movement, which muddies streams, rivers and lakes. When farmers use conservation practices to control erosion,

these off-farm effects can be reduced and water quality is improved. Downstream water-users are the beneficiaries when off-farm erosion damages are reduced. Since direct incentives to farmers for preventing off-farm erosion damages are small, these considerations play a minor role in their decisions about using conservation practices.

From a public perspective, controlling cropland erosion has important potential benefits off the farm. Interest in the use of conservation practices arises because of benefits which result from curtailing several types of damages caused by displaced sediment. Reduced sedimentation may prevent flooding, reduce the costs of dredging inland waterways and drainage systems, and lower water prices for those who rely on surface water to supply residential or commercial water needs. Improved water quality also benefits boaters, swimmers, anglers, and other recreators. Graphically, the marginal off-farm benefits from erosion control are drawn separate from the on-farm benefits to acknowledge different beneficiaries and different motives for conservation on and off the farm.

The estimated dollar value of off-farm benefits is larger than the estimated on-farm benefits from erosion control. Clark and co-authors (1985) estimate the total benefits of eliminating the off-farm effects of cropland erosion to be approximately $2.2 billion per year. In contrast, Crosson (1986) estimates that the on-farm benefits from eliminating cropland erosion amount to approximately $500 to $600 million per year.

From a public perspective, both the on-farm and the off-farm benefits are important. Decisions about public support for

conservation represent both downstream water-users who are concerned about the off-farm effects of cropland erosion, and also the more general social goal of saving enough soil on farms to meet future generations' food production demands. To provide a level of erosion control to satisfy public demands for both on- and off-farm benefits, ideally farmers would choose to use conservation practices where the benefits from reducing damages both on and off the farm equal the marginal costs of erosion control. From the public's point of view, it would be desirable for farmers to use conservation toward the level SEC^*, to the extent that the aggregate marginal benefits (MB_{AGG}) exceed the marginal costs. However, bearing the costs of these higher levels of erosion control would be difficult for farmers to justify because the costs are greater than the benefits which accrue on the farm.

The discrepancy is significant between the on- and off-farm benefits from erosion control. The magnitude of potential benefits to off-farm water-users suggests a role for increasing farm conservation efforts to reduce sediment delivery to streams and ditches. Farmers themselves are motivated to use conservation practices in response to the on-farm benefits. Without policy interventions, farmers aim to invest in conservation to the extent that the on-farm benefits exceed the marginal costs. If farmers are offered financial incentives to use conservation practices, especially to counter the off-farm effects from cropland erosion, then they may be willing to provide more erosion control. Compensation encourages farmers to bear additional costs of using conservation practices.

Offering public support to farmers who conserve is a way to

narrow the divergence between farmers' and the public's desired levels of erosion control. Farmers' willingness to supply land into conservation uses is measured by the marginal costs of controlling erosion. Graphically, the size of the divergence between farmers' chosen levels of erosion control (SEC^0) and the socially desirable level of erosion control (SEC^*) depends on the slope of the marginal cost curve. An argument can be developed in favor of policy intervention, to offer funding to farmers to help offset the costs of controlling erosion and increase their investments in conservation above SEC^0 toward SEC^*.

Baseline estimates of the on- and off-farm benefits from conservation are available. Several researchers are working to assess the extent of the off-farm damages from cropland erosion (Ribaudo, 1986; Gianessi, et.al., 1986). On the other hand, empirical data required to begin estimating the marginal costs associated with increasing farmers' use of conservation practices is lacking. Without an idea of the marginal costs associated with increasing farmers' use of conservation, it is impossible to judge the size of the divergence between the level of conservation farmers would choose, and the level of conservation the public is prepared to support. If the marginal cost curve is elastic, then the expected difference would be relatively small between farmers' conservation decisions and the levels of erosion control desired by the public. A more inelastic marginal cost function would increase the importance of the role for incentives to farmers in order to encourage more use of conservation practices than they would otherwise choose.

The focus of this research was to learn more about the marginal costs associated with influencing farmers' willingness to supply conservation, especially to prevent off-farm erosion damages. Specifically, this thesis reports empirical research results describing farmers' willingness to accept yearly payments to set aside filter strips for ten years.

Filter strips

Offering financial incentives to farmers who voluntarily set aside filter strips is one among several alternatives discussed in comparative analyses of policy interventions for dealing with agricultural non-point water pollution (Uchtmann and Seitz, 1979; Shortle and Dunn, 1986). Two strategies have been proposed as public policy options to deal with the problem of the off-farm effects from cropland erosion, either to offer farmers positive incentives for conservation or to enforce legal regulations against water pollution. If there is an established relationship between the use of filter strips and prevention of water pollution, then, in principle, no legal barriers exist to passing laws requiring farmers to use filter strips on their farms (Uchtmann and Seitz, p. 601, 1979). However, there are practical and technical obstacles to using a regulatory approach to force farmers to set aside filter strips. Linking erosion on the farm with sedimentation problems downstream is difficult. Distinguishing the effects of cropland erosion from pollution caused by other sources is often impossible. Without a reliable method for tracing damaging sediment back to an eroding site, knowing who to regulate is difficult (Crosson, 1986).

Since matching agricultural non-point pollution problems with their sources is problematic, use of conservation practices, like filter strips, to intercept sediment and other erosion-related pollutants before they are washed downstream has been recommended. The advantage of promoting practices which intercept sediment is that they can be targeted close to sites where erosion-related damages occur. As a policy intervention, promoting voluntary use of filter strips has been proposed as a strategy likely to compare favorably with current conservation programs in terms of cost-effectiveness (Gianessi, et. al., 1986). Observing farmers' behavior in response to opportunities to enter ten-year CRP contracts is a chance to evaluate filter strips in use. The CRP has been proposed as an inexpensive testing ground, a chance to experiment with policy strategies for treating non-point pollution (Ogg, 1986). For many farmers, participation in the CRP is an economically feasible opportunity to try filter strips.

Farmers have less experience with conservation practices to prevent the off-farm effects of cropland erosion than with practices designed to control on-farm erosion. Farmers have received cost-sharing to install filter strips in a few local watershed-level programs. Evaluations of farmers' experiences with filter strips have yielded mixed results. In the Corn Belt, fifty farmers received a one-time payment to install filter strips in 1972. Nine years later, 92-percent of these farmers were still maintaining their filter strips (Walter, 1989). In contrast, in Virginia, 33 farmers received cost-sharing to establish filter strips in conjunction with a Chesapeake Bay Program in 1983. Three years later, 36-percent of the filter strips

were totally ineffective or no longer in existence. Based on their observations, Virginia researchers proposed that additional on-farm experimentation with filter strips is urgently needed to evaluate their long-term effectiveness and maintenance, and to provide technical guidelines for more widespread use of filter strips (Dillaha, et. al., 1986). Participation patterns in the CRP will provide farmers and conservationists opportunities for experience using filter strips in diverse locations to learn more about where they likely to be most effective.

In terms of informing policy design, observing participation patterns in the CRP provides only one dimension of information about offering farmers financial incentives to set aside filter strips for ten years. According to current CRP implementation procedures, farmers submit a bid indicating how much they are willing to accept as a yearly payment to enroll their eligible acreage in the program for ten years. After the first CRP sign-up in 1986 bid caps were established, setting a limit for the maximum accepted yearly payment in each county. For farmers who are informed about the option to set aside filter strips in the CRP, their decisions depend on whether or not they are willing to accept the yearly payment offered in their county.

To learn more about the role of financial incentives in determining farmers' willingness to set aside filter strips, this research examined the effect on participation of offering different yearly payments to farmers. Farmers' payment-responsiveness was explored in a survey setting using contingent valuation methods. Respondents were presented a scenario, describing an opportunity to

receive a yearly payment to set aside filter strips in a ten year program. Different yearly payments were offered to the respondents on a random basis. Their reactions to twelve yearly payments ranging from $20 per acre up to $550 provide data which was used to estimate a function describing how participation patterns change according to levels of financial incentives for setting aside filter strips. Rather than predicting participation in the CRP as it is currently being implemented, this results of this research simulate what might happen if financial incentives offered to farmers to participate in a filter strip program were varied.

Information about farmers' responsiveness financial incentives for setting aside filter strips is likely to be helpful in designing conservation programs for the 1990 farm bill. Senator Sam Nunn has proposed enlarging the CRP and including more water quality initiatives within the current CRP. Senator Robert Dole has introduced a bill to create another ten-year land reserve, the Environmental and Conservation Acreage Reduction Program (ECARP). In their critiques of the implementation of the CRP, economists have speculated about possible efficiency gains from allowing farmers to submit competitive bids for yearly payments when they enroll contracts in a ten-year cropland retirement program (Taff and Runge, 1988; Boggess and Reichelderfer, 1988). This research proposes a conceptual framework for measuring those efficiency gains.

A CONCEPTUAL FRAMEWORK FOR EMPIRICAL RESEARCH

This chapter outlines a conceptual framework for understanding farmers' decisions about whether to enter ten-year contracts to set aside filter strips.[1] Farmers' responsiveness to offers of yearly payments for participation in a filter strip program are likely to be directed by their preferences and values, conditioned by economic factors including opportunity costs, transaction costs, and future expectations.

The development of this conceptual framework draws on previous research about conservation behavior. Since farmers have had the option to set aside filter strips in the CRP only since February, 1988 observed CRP participation patterns offer limited information to guide empirical research about filter strips. Empirical findings from two early studies about farmers' decisions to enroll highly erodible land (HEL) in the CRP offer a basis for identifying some of the factors likely to be correlated with farmers decisions to participate in a ten-year land retirement program (Esseks and Kraft, 1987 and 1988).

An empirically-based literature regarding the adoption and diffusion of conservation practices provides the foundation for building an economic framework to explain farmers' willingness to set aside filter strips for ten years. Farmers' decisions about

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[1]The terms "farmer" and "landowner" are used interchangeably.

participation are recognized as fundamentally different from decisions about adopting conservation practices. After identifying the sources of the differences, a set of economic hypotheses is developed to test which factors are relevant in farmers' decisions about participation in a ten-year filter strip program.

Adoption of Conservation Practices

Although farmers weigh a unique set of criteria in decisions about participating in a ten-year filter strip program, understanding why farmers adopt conservation practices is a useful starting place for a conceptual framework to explain participation decisions.

Farmers adopt conservation practices to control cropland erosion. Using structural practices, such as grassed waterways and terraces, results in lower erosion rates and can stop sediment from being washed downstream from the farm. Non-structural practices, such as conservation tillage and rotations with permanent vegetative cover crops, enhance soil productivity and fertility as well as controlling erosion. Farmers' primary motive for integrating conservation techniques into their farm management schemes is to improve the capacity of their for producing high crop yields, both in the short run and over the long run. Farmers are most willing to adopt profitable conservation practices, such as conservation tillage, which have immediate pay-offs in higher net incomes from production (Lee and Stewart, 1983; Norris and Batie, 1987). Modifying tillage practices or rotations involves nominal adjustments in the way acreage is managed and maintained under an on-going cropping system. On the other hand, investing in structural practices may require trading off current

income to pay for preventative measures against erosion damages which, if allowed to occur, would endanger future crop production revenues.

Setting aside filter strips is different from adopting a conservation practice because it means taking acreage out of crop production. Entering a contract to participate in a ten-year land retirement program means exchanging revenues from crop production for a yearly payment. An acceptable yearly payment compensates for the opportunity costs of retiring cropland, the expected net revenues from production or from other economic uses of the acreage. The yearly payment includes a risk premium to account for the ten year commitment, and the transaction costs associated with making a change in farm operating procedures. Receiving a yearly payment to retire cropland is a way for some farmers to gradually disinvest in a farm operation by reducing the necessary flow of operating monies, lowering the costs of maintaining the capital stock, and streamlining human capital requirements on the farm.[2]

The primary purpose of filter strips is fundamentally different than the purposes of other structural and non-structural conservation practices. Normally, farmers adopt conservation practices to control on-farm erosion problems and to enhance the productivity and fertility of their soil. Filter strips are designed to stop sediment from being washed downstream. The on-farm, productivity-related benefits from using filter strips are limited. Farmers who participate in a ten-year

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[2]Participation in a ten-year land retirement program is a particularly important way to disinvest in a farm operation if a large proportion of the acreage on the farm is eligible. In most cases, only a small percentage of the cropland on a farm is eligible for filter strips.

land retirement program consider their filter strip acreage set aside from production on a long-term basis. In financial terms, a farmer's immediate motive to set aside filter strips is the yearly payment, rather than a desire to enhance soil productivity over the long run or to improve the profitability of the current cropping system.

Previous research on the adoption of conservation practices focuses on identifying the socio-economic characteristics of landowners and their farms that are correlated with decisions to set aside filter strips. In its recent review of the adoption literature for the second RCA appraisal, five categories of factors relevant to farmers' conservation decision-making are identified (USDA, 1987). Several other researchers have used similar categories to provide the framework for their literature reviews (Ervin and Ervin, 1982; Napier and Forester, 1982; Christensen and Norris, 1983; Nielsen, et.al., 1989).

The overall objective of studying conservation adoption is to discover why some farmers conserve and others do not conserve. First, the sociological characteristics of farmers including age, education, experience with farming, and off-farm employment are related to their decisions about conservation. Second, farmers' attitudes about their land stewardship responsibilities and about government involvement in agriculture, their risk orientations, and their profit motives affect their choices about conservation. Third, financial and economic factors including current and expected net farm income levels, the size of the farm operation, landownership, debt load, real interest rates, and access to credit or cost-sharing enter into farmers' conservation decision-making. Fourth, environmental conditions, including the

actual severity of erosion problems and the farmer's perception of erosion conditions, play a role in decisions about adopting conservation practices. Finally, institutional linkages make a difference in the adoption of conservation practices. Farmers who are currently receiving technical assistance for conservation or participating in farm programs are most likely to adopt conservation practices.

The objective of statistical analysis of empirical data on adoption behavior has been to identify the categories of factors and the individual explanatory variables correlated with the adoption of conservation practices. In performing statistical tests, researchers have encountered problems due to the large number of potentially important explanatory variables, the high likelihood of collinearity between these variables, and relatively small sample size (Nowak and Korsching, p. 360, 1983). In studies of conservation adoption, cross-sectional analysis has often failed to explain the majority of the variation in the dependent variable; total explanatory power of models is often low (Ervin and Ervin, p. 290, 1982). Ad hoc models have been employed, using econometric techniques such as stepwise regression to identify explanatory variables which explain behavior. Significant correlations may exist between important variables and those variables not present in final statistical models. Different sets of explanatory variables may be appropriate for analyzing sets of empirical data collected in diverse settings representing distinct groups of individuals.

Past empirical research has successfully identified guidelines to

indicate the categories of factors that make a difference in conservation decision-making. Yet after four decades of empirical research on the adoption and diffusion of conservation practices, social scientists still disagree about which characteristics of landowners and their farms play the most significant roles in decisions about conservation. Some literature reviews have highlighted institutional and sociological factors and concluded that for some farmers non-monetary incentives outweigh economic considerations (USDA, 1987). On the other hand, several empirical studies have shown that financial and economic factors are important in determining whether farmers will adopt conservation practices (Norris and Batie, 1987; Ervin and Ervin, 1982). Sociological and economic factors have not been viewed as mutually exclusive sets. Sociologists have explicitly acknowledged the importance of economic factors in choices about conservation (Napier and Forester, 1982) and economists have recognized the key role that sociological insights play in explaining farmers' conservation behavior (Batie, 1986; Lynne, et. al., 1988).

Progress in empirical research will require efforts to determine the relative importance of factors associated with conservation behavior (Nowak, 1982). More strongly stated, "we have not yet managed to state the problem in terms that are succinct and sensitive enough to give insights into causal relationships. Unless causal factors can be identified, we are at a loss in making (policy) recommendations" (Barkley, p. 190, 1982). To describe conservation decision-making in a more satisfactory manner will require a theoretically sound model for integrating economic and sociological explanations of behavior. A

comprehensive framework will both show how economic factors are mediated by non-economic factors and, at the same time, establish the economic, structural, and ecological context in which farmers' attitudes about conservation exist.

Two contributions from recent empirical studies signal progress along these lines, toward the development of a behavioral model to explain the adoption of conservation practices. One important innovation is improved precision in specifying the dependent variable (Norris and Batie, 1987; Ervin and Ervin, 1982). In previous research, the approach for measuring farmers' adoption of conservation practices was not consistent. Most frequently, a dichotomous dependent variable was used to indicate the simple distinction between farmers who use some conservation practices and those who use none. To inform the selection of more appropriate measurements for adoption, Ervin and Ervin performed statistical tests on their empirical data using two different dependent variables. They proved an important theoretical distinction: a farmer's decision to use many conservation practices is not conceptually an equivalent for soil conservation effort, measured using an objective evaluation of the difference between actual erosion conditions before and after conservation practices are used on the farm. In a further refinement, Norris and Batie measured the extent of farmers' adoption as the total amount spent on capital investments, operating expenses, and maintenance of conservation practices in one year.

Another important step toward the development of a theoretically sound behavioral model is the acknowledgment that a utility-

maximization approach is appropriate as the framework for explaining farmers' decisions about conservation practices (Norris and Batie, 1987; Lynne, et.al., 1988). Both groups of researchers pointed out that economic theory offers limited guidance for determining soil conservation decision variables. Norris and Batie suggested a utility maximization framework as the proper theoretical model, but stated that the arguments required to operationalize a utility-maximization problem are unknown.

Lynne and co-authors recognized that the lack of an economic paradigm for conducting analysis is a fundamental problem, explaining that although previous research has helped to identify some of the psychological processes that determine preferences, no cohesive framework exists for linking preferences with economic decisions. Empirical data about conservation behavior among farmers in northern Florida were analyzed using two different categories of variables, income and attitudes, to explain decisions to use conservation. A model with income as the only explanatory variable was not statistically significant. A model with only attitude variables was statistically significant, but the most powerful model included both income and attitudes. These research results showed that the combination of stronger attitudes toward conservation and higher incomes together provide the best explanation of behavior (Lynne and Rola, 1988). This study made an important contribution through improving specifications of variables representing farmers' preferences. However, the set of explanatory variables used to represent economic decision factors was not equally well developed.

To properly operationalize a utility-maximization framework would involve expressing farmers' decisions as attempts to maximize utility according to preferences and subject to economic constraints. Some of the economic constraints can be measured using market-determined values; others involve institutional linkages and goods without prices.

Farmers' Decisions about Setting Aside Filter Strips

A utility-maximization framework was selected for describing farmers' willingness to accept yearly payments to set aside filter strips for ten years. Farmers make decisions about participating in a filter strip program in order to maximize their utility, according to their preferences and subject to economic constraints. Farmers derive utility from setting aside filter strips for ten years because yearly payments add to their cash income. Farmers with a preference for environmental quality and for land stewardship also derive utility from using filter strips on their farms. Their efforts to maximize utility are constrained by the costs associated with setting aside filter strips, including opportunity costs, transaction costs, and a risk premium to account for expected and unpredictable changes over ten years. Opportunity costs are the revenues foregone from taking cropland out of production. Transaction costs are the actual and psychic costs associated with changes in the farm operation. Economic costs may be measured using both market and non-market values.

Yearly payments

The level of yearly payments offered for setting aside filter strips were considered likely to play a key role in farmers' decision-making. Financial incentives compensated for the opportunity costs of

taking acreage out of crop production. Empirical evidence indicates that historically financial considerations have made a difference in farmers' decisions about adopting conservation practices. Cash flow difficulties sometimes preclude adoption. "Farmers seemingly develop much more positive attitudes about the implementation of soil erosion control measures when there are financial incentives attached to them" (Napier and Forester, p. 142, 1982). In designing voluntary conservation programs, education and technical assistance have been considered necessary but not sufficient to promote adoption. Cost-sharing, offering farmers financial assistance to help them with investments in conservation, has been called an essential component of effective voluntary conservation programs (Christensen and Norris, 1983; Batie, 1986).

Statistical analysis of empirical data on adoption behavior has shown that the availability of cost-sharing is positively correlated with adoption (Ervin and Ervin, 1982; Nowak and Korsching, 1983; Norris and Batie, 1987). Cost-sharing has been identified as more important in determining how much effort a farmer puts into conservation than how many conservation practices are used on the farm. In models explaining adoption, the statistical significance of the variable representing cost-sharing is influenced by other explanatory variables. Perceived profitability, an economic factor related to cost-sharing, has been highlighted as an important criterion determining farmers' use of conservation practices (Ervin and Ervin, 1982).

For the case of participation in a filter strip program, farmers view the yearly payment as compensation for the opportunity costs and

transaction costs associated with taking cropland out of production. A risk premium is necessary to compensate for unforeseeable economic changes over the ten year contract period. Levels of yearly payments acceptable to farmers are likely to vary because each farm situation is characterized by a unique set of economic considerations. To make participation a financially viable option, different farmers will require different yearly payments.

Increased willingness to set aside filter strips is likely to be positively correlated with higher yearly payments. A study of farmers' attitudes about participation in the CRP suggested that financial incentives play an important role in landowners' decisions about enrolling in ten-year programs which requires landowners to take cropland out of production. According to results of a survey of landowners in the Midwest eligible to enroll highly erodible land in the CRP, increasing yearly payments by $10 per acre per year would recruit another 11- to 24-percent of the survey respondents. Raising yearly payments by $20 would augment participation by 29- to 50-percent (Esseks and Kraft, 1988).

For this research project, a comparative statics approach was employed to analyze farmers' willingness to accept yearly payments to set aside filter strips. The innovation in this experimental design was to use CV methods to look at potential changes in farmers' opportunity sets, namely yearly payment offers, that would be likely to affect their conservation behavior.

This study of participation in a conservation program recognized that varying financial incentives to farmers is a potentially important

way to influence their choices about conservation. Using comparative statics analysis offers an additional dimension of information to inform the dynamic process of designing conservation policy. Simulating the effects of modifying long-term land retirement programs by changing the levels of yearly payments offered was a way to inform evaluations concerning the relative effectiveness of policy alternatives.

To measure how differences in the economic characteristics of farmers and their operations affect responsiveness to yearly payments for setting aside filter strips, in a survey setting on a random basis respondents were offered a variety of yearly payments. Each respondent could either accept or reject a yearly payment offered. The objective was to collect baseline information on the cost of recruiting participation among a diverse group of farmers and to assess how farmers' willingness to participate in a filter strip program was influenced by changes in yearly payments offered.

Preferences and economic constraints

Four sets of economic factors were considered likely to influence decisions about whether the financial incentive offered is sufficient to make setting aside filter strips in a ten-year program a viable option. Farmers maximize their utility according to their preferences, subject to economic constraints including opportunity costs, transaction costs and future expectations.

Preferences direct economic decision-making. Values and attitudes are essential guidelines for maximizing utility. Farmers who are concerned about environmental quality and about conserving soil

on their farms are more likely to participate in a ten-year filter strip program than others with weaker conservation ethics who are less concerned about the environment.

Opportunity costs are the value of a resource (in this case, cropland eligible to be set aside as filter strips) in its next most productive use. A landowner compares the yearly payment offered with their average expected revenues from crop production on the eligible acreage. For a landowner to strongly consider participating in a ten-year program, the yearly payment ought to compensate for expected production revenues foregone.

Transaction costs involve the actual and psychic costs associated with changing current farm management practices in order to participate in a ten-year filter strip program. Setting aside filter strips requires planting permanent vegetative cover crop on acreage adjacent to a stream or a drainage ditch. Deciding which acreage is eligible for filter strips, understanding the rules for enrolling in a program for ten years, developing a conservation plan, and sorting out the bureaucratic procedures for signing a contract to participate all constitute transaction costs.

Future expectations impose costs, as risk and uncertainty have an impact on decisions about signing a ten year CRP contract. When a landowner makes a commitment to set aside filter strips for ten years, price forecasts are uncertain for farm products, both inputs and outputs. If price levels change, then the relevant opportunity costs of taking cropland out of production could be either higher or lower than those indicated by past experience. If inflation runs rampant, a

yearly payment which is adequate today might be much too low at the end of ten years. A landowner's perceptions about inflation and about agricultural price trends play an important role in determining their planning horizon and an acceptable yearly payment level.

To operationalize a utility-maximization framework for describing farmers' decisions about setting aside filter strips, characteristics of landowners and farm operations that determine their preferences, opportunity costs, transaction costs, and future expectations are identified. Instead of using single explanatory variables, sets of economic characteristics of landowners and their farms are designated which are relevant to decisions about participation in a ten-year filter strip program. These four sets of variables are used to structure hypothesis tests about what influences farmers' willingness to set aside filter strips.

Hypotheses

Farmers' decisions about whether to set aside filter strips for ten years are likely to be influenced by economic decision criteria. Five hypotheses bear empirical testing:

1. Farmers' willingness to set aside filter strips for ten years is positively correlated with increases in yearly payments. If offers of yearly payments are increased, then farmers will enroll a higher proportion of their eligible acreage into a filter strip program.

2. Farmers make economic choices according to their preferences. Farmers' concern about the environment and about conserving soil on the farm make a difference in their responsiveness to yearly payments.

3. Farmers who face higher opportunity costs from taking their

cropland out of production for ten years will require higher yearly payments to set aside filter strips than farmers whose opportunity costs are lower.

4. Farmers who face high transactions costs from taking their cropland out of production for ten years will require higher yearly payments to set aside filter strips than farmers whose transaction costs are lower.

5. Future expectations play a role in farmers' decisions about the levels of yearly payment that is acceptable for setting aside filter strips for ten years.

To empirically measure preferences, opportunity costs, transaction costs, and future expectations in order to operationalize hypothesis tests, sets of explanatory variables are identified as proxies for these economic decision criteria.

Preferences

Farmers' attitudes and values are the guidelines within which their decisions are made about setting aside filter strips for ten years. Preferences direct all economic choices. Developing interpersonally valid measures of individuals' preferences is a task most economists consider impossible (Johnson, 1986). Observed behavior is more predictable and easier to measure than attitudes. Yet often behavior and attitudes vary considerably (Lovejoy and Napier, 1986). In the adoption literature, variables representing attitudes are often highlighted as important in explaining farmers' decisions about conservation. However, the measures of preferences used are neither consistent nor part of a coherent behavior model.

The work of Lynne and his fellow researchers was a serious attempt to develop a more comprehensive approach to measuring farmers' attitudes as they relate to conservation behavior (Lynne, et.al., 1988; Lynne and Rola, 1988). They drew on the social psychology literature for guidelines to assess the relationship between farmers' values and their actions. Their empirical research design covered a broad range of criteria likely to be relevant to farmers' decision-making, including their beliefs, their priorities, and the context in which their farm operation exists.

To measure the extent to which preferences make a difference when farmers decide whether or not to participate in a ten-year filter strip program, two simple considerations were considered likely to be pertinent. "Concern about the environment" and "concern about conserving soil on my farm" are likely to be reasons farmers might consider in their decisions about whether to set aside filter strips. Those who are concerned about the environment or about soil conservation on their farms are likely to accept a lower yearly payment to set aside filter strips than those who are not concerned about either the environment or soil conservation.

Opportunity costs

Opportunity costs are the potential revenues from crop production or other income-generating activities which a landowner gives up in order to set aside filter strips for ten years. Farmers who have high opportunity costs associated with changing the current uses of their cropland in order to set aside filter strips for ten years are likely to expect higher yearly payments than farmers whose opportunity costs

are lower. Four variables were used to represent opportunity costs: the projected average crop yields on acreage eligible for filter strips, the estimated cash rental rate for cropland on the farm, household income level, and the percentage of household income from farming. An alternative set of opportunity cost variables was developed using differences in farm types as a general indicator of expected revenues from production.

Crop yields: A landowner's expected revenues from crop production are a function of both crop yields and commodity prices. An acceptable yearly payment for setting aside filter strips must be sufficient to compensate for production revenues foregone. According to empirical findings, crop yields make a difference in decisions about participation among landowners who are likely to be eligible to enroll highly erodible land (HEL) in the CRP (Esseks and Kraft, 1988). Among those farmers who would not be interested in bidding to enter the CRP, 35 to 52-percent believed that they could earn more by producing annual crops. Many of these respondents reported that their corn yields on HEL eligible for the CRP were at or above the upper bound on top state average corn yields.

Cash rental rates: Landowners who wish to reduce their active involvement with crop production could potentially generate some revenue from their cropland by entering a rental agreement with a tenant. When yearly CRP payments were established in 1986, average cash rental rates for each county were used as a proxy for the opportunity cost of land retiring cropland for ten years (Dicks, 1988). A study of landowners' attitudes about conservation easement programs,

where participants would agree to set aside cropland over a horizon longer than ten years, researchers found that "cash rental rates tend to predict bid prices quite well" (Ervin et.al., 1987). Farmers' perceptions of the going cash rental rate for their land are considered a good indicator of the productive capacity of cropland on a farm, even if they are not currently renting out land on the farm.

Household income levels: Farmers' opportunity costs of participating in a ten-year filter strip program are influenced by their household income. A decision to set aside filter strips implies trade-offs. A yearly payment is a steady, predictable source of income for ten years. In contrast, cash flows from crop production are likely to fluctuate according to changes in yields and farm prices. When farmers decide to set aside filter strips, several uncertain factors outside their control affect whether the yearly payment will be more or less than what they can earn using the land for crop production or in the land rental market. The decision to make a change in farm management which might result in lowering net returns from cropland is inherently risky. In general, economic theory suggests that as individuals' incomes increase, they become more willing and able to bear risk.

Participating in a ten-year land retirement program is risky because of three sets of factors outside landowners' control (Boggess, 1986). First, stochastic variables, such as yields, interest rates, and farm prices are a source of risk regardless of whether farmers participate in land retirement programs. Second, uncertainties about how the USDA will administer long-term conservation programs influences

farmers' decisions. Agency officials may know what bids for yearly payments are acceptable, but landowners have limited information and are uncertain submitting bids for yearly payments. Finally, unknown factors about program rules also contribute to risk. The rules for participating might change over time; a farmer who waits to enroll might receive higher yearly payments. Those with higher incomes have more discretionary income. If they gamble and lose, then they can absorb the loss more easily. In general, farmers with lower incomes are more risk averse.

Empirical evidence has shown that farmers' off-farm income (their net after-tax income) is positively correlated with decisions to adopt conservation practices (Lynne and Rola, 1988; Ervin and Ervin, 1981). Farmers with higher incomes have been considered more likely to set aside filter strips than those with lower household incomes.[3]

Percentage of income from farming: Whether a household relies on revenues from farming for a major share of the family's income plays a role in their decisions about setting aside filter strips. Families

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[3]Although the conventional economic interpretation of the role of income in determining opportunity costs was considered most relevant in a conceptual framework to explain farmers' decisions about filter strips, other approaches have been suggested.

Nowak and Wagener (1981) applied Cancian's thesis to analyze empirical data, in order to assess whether household income levels play an important role in farmers' decisions about adopting conservation practices. Cancian's thesis states the problem in terms of how economic rank and status affects choices about agricultural innovations. Individuals with high incomes have been considered less likely to adopt because they protect their status by avoiding the risk associated with adopting a new innovation. Individuals in the lower middle income have been considered most likely to adopt because they have less to lose and more to gain in status if they adopt a successful practice (Cancian, 1979).

who rely on net farm income for a major share or all of their household incomes weigh a different set of trade-offs than rural families where one or two family members have full-time employment off the farm. A yearly payment provides a dependable source of cash flow. However, that dependable yearly payment may be more or less than what would otherwise be earned from farming. Labor requirements to establish and maintain permanent vegetative cover on filter strips are generally less than for crop production activities. However, managing filter strips requires more effort than renting out cropland to another farm operator.

Empirical evidence on farmers' decision-making has suggested that high farm incomes are positively correlated with the adoption of conservation practices (Norris and Batie, 1987; Nielsen, et.al., 1989). In contrast, an empirical study about enrollment of HEL into the CRP suggested that farmers with high incomes from farming are less likely to retire cropland for ten years than those with lower farm incomes (Esseks and Kraft, 1988). This comparison of empirical findings offers tentative evidence to suggest that the proportion of income from farming may play a different role in decisions about adopting conservation practices than in decisions about participating in ten-year land retirement programs. To explain farmers' decisions about setting aside filter strips, farmers who earn the majority of their incomes from farming were considered likely to expect higher yearly payments than those whose off-farm incomes are more significant.

Farm types: Farms with different enterprise mixes face different opportunity costs associated with setting aside acreage as filter

strips. For example, crop yields and cash rental rates for acreage on a dairy farm where cropland is used for hay and forage production are different from yields and rents for acreage used to grow carrots and onions. A high degree of correlation is likely between variables representing the important income-generating activities on a farm and variables representing yield, rent, and income levels. Variables distinguishing farm types were analyzed as an alternative group of opportunity cost variables to determine whether differences in farm enterprise mixes are likely to play a role in determining participation patterns in a ten-year filter strip program.

In the adoption literature, evidence exists that farm enterprise mix has been studied as a factor which may influence farmers' conservation behavior. In their empirical research findings Ervin and Ervin (1981) showed that cash grain farmers are less likely to use conservation practices than other farmers. The relationship is statistically significant, and the authors suggested that more detailed study of cash grain operators would be useful to explain their decisions. Although the effect of differences in farm types have not been studied systematically, in general empirical evidence has indicated that farmers who operate livestock enterprises are more likely to use conservation practices than others (Christensen and Norris, 1983).

In a survey of farmers eligible to set aside HEL in the CRP, the percentage of the previous year's farm income derived from annual crops was statistically significant in explaining whether or not respondents were likely to bid to enter the ten-year land retirement program

(Esseks and Kraft, 1988). This phenomenon was explained as a reaction to the income benefit from participating in the program. Cash crop farmers who earn a large share of their income as revenues from cropland stand to gain most from setting aside land. Since only acreage with a cropping history is eligible, cash crop farmers are likely to own a high proportion of the cropland eligible for the program, and therefore to participate. On farms where dairy and livestock enterprises are important, cropland used to produce hay and forage may not have been harvested two of the five years between 1981 and 1985, a criterion for CRP eligibility. Among respondents in a county where dairy enterprises are important, there was a statistically significant difference between participation among dairy operators and other farmers. Dairy operators showed less interest in participating because they need to keep all their cropland in production to maintain the viability of their operations.

In Newaygo County, cash crop farm operators were considered more likely to set aside filter strips than farmers with dairy and livestock operations. Cash crop, dairy, and livestock operators were considered likely to be willing to participate in a ten-year program for a lower yearly payment than farmers who produce annual vegetables and orchard crops according to their respective levels of production revenues foregone.

Transaction costs

Change is neither automatic nor costless. Transaction costs are the expenditures and the costs of adjustments associated with changing the way land is currently used in order to participate in a land

retirement program. Farmers who have high transaction costs associated with changing the current uses of their cropland in order to set aside filter strips for ten years are likely to expect higher yearly payments than farmers whose transaction costs are lower. Four variables were used to represent transaction costs: recent contact with the Soil Conservation Service (SCS), recent contact with the Agricultural Stabilization and Conservation Service (ASCS), the land tenure situation on the farm, and the proportion of acreage on the farm eligible for filter strips.

Contact with SCS: The SCS offers technical assistance and conservation planning information to landowners who seek answers to questions about farm management and land use. Participation in SCS programs is voluntary. An individual who has recently sought and received technical assistance from SCS is likely to be aware of potential erosion problems and of the need for conservation on their farm. Strong empirical evidence has shown that perception of the need for conservation is a necessary pre-requisite to the decision to adopt conservation practices (Batie, 1986). Farmers who have worked with SCS in the past are more likely to have developed a conservation plan for their farm. They are likely to have more experience trying out conservation practices than non-SCS clients.

Contact with ASCS: Landowners who receive farm program benefits from the USDA are integrated into an institutional network. They are likely to know how farm programs are administered from experience. They are more likely to feel more comfortable entering a ten year contract with USDA than someone unfamiliar with the system. Because

they visit the local ASCS office to follow up on participation in other USDA programs, the likelihood is increased that current ASCS clients will learn about new conservation programs and consider participating.

To explain decisions about enrollment in the CRP, Esseks and Kraft (1988) have found a statistically significant relationship between recent contact with either SCS or ASCS and participation. "There was something about recent contacts with conservation agencies (or about the landowners who sought such contacts) that tended to give the clients an advantage in receiving or taking notice of information about the CRP" (p. 254). Recent ASCS and SCS clients receive newsletters informing them about new conservation programs and deadlines for enrollment. For them, the search costs are minimal for information about new programs and about changes in existing programs.

Farmers who have had dealings with either ASCS or SCS in the past three years were considered more likely to set aside filter strips for ten years than those who have not had contact with these agencies.

Land tenure: Economic logic would suggest that individuals who own their land would be the most likely to adopt conservation practices because the benefits would accrue to them or their children. In contrast, tenants' incentives are to maximize profits over the short run. However, in the adoption literature, "research findings amply portray the ambiguity surrounding the influence of tenancy on soil erosion control" (Ervin, 1986).

When a landowner's tenure situation is viewed as an indicator of transaction costs associated with participation in the CRP, the expected effect is straightforward. Making agreements with a landlord

and adjusting the terms of a leasing agreement clearly constitute transaction costs. To participate in a ten-year land retirement program, farm operators who are renters or have tenure arrangements instead of owning the land themselves will face higher transaction costs than those who can act as their own agents. Tenants accustomed to a year-to-year leasing agreement must be willing to commit to a ten year CRP contract, and must convince their landlord that participating in the CRP is a good idea. New leasing arrangements must be agreed upon and drafted. Transaction costs are higher for individuals who do not own their cropland than for those who do. Therefore, individuals who rent more than 50-percent of the land they farm were considered less likely to participate in the CRP than landowners who own the majority of the land they farm.

Proportion of acreage eligible: If a large proportion of the total cropland on a farm is eligible for a ten-year land retirement program, then a landowner may be more likely to participate than if only a few acres on the farm are eligible. Relatively speaking, the transaction costs are lower for farmers who can enroll a large contract in the CRP than for those who enroll only a few acres in the program. The transaction costs of collecting information on CRP participation, making the decision, and signing the contract are the same whether a CRP contract involves two acres or forty. Calculated on a per acre basis, the net benefits from participation become more significant as the size of the contract increases. Farmers with large proportions of the cropland on their farm eligible for filter strips were considered more likely to participate than those with less acreage eligible.

Future expectations

Participation in a long-term land retirement program requires a willingness to enter a ten year contract. Signing a CRP contract, an individual agrees to receive a fixed yearly payment regardless of what happens to prices and inflation over a ten year contract period.

Length of contract: In farming, most decisions are flexible from year to year; production and tillage changes can be made each planting season. A ten year commitment imposes a longer planning horizon than landowners normally encounter. Among some farmers, the ten-year contract period was considered likely to be an obstacle to participation in a program to set aside filter strips.

Price expectations: Accepting a fixed yearly payment is risky because of the uncertainty of agricultural markets. For example, demand for grain could go up and commodity prices would skyrocket. In that case, the landowner could earn more from net income from returning retired acreage to crop production than they would receive in yearly payments. On the other hand, uncertain market forces could swing agricultural prices in the other direction: energy prices might increase dramatically, raising the cost of producing crops. If this scenario takes place, the landowner would be glad to receive a yearly payment agreed upon before prices went up.

For a landowner making decisions about participation in the CRP, expectations about commodity prices over the next ten years play an important role in determining whether or not a yearly CRP payment is enough. A farmer who believes that prices will rise slower than inflation over the next ten years was considered more likely to set

aside filter strips than someone who thinks that prices may rise more rapidly or at the same rate as inflation.

Multiple category variables

Three characteristics of landowners and their farms were analyzed which may make a difference in decisions about setting aside filter strips, although they fail to fall neatly into a single grouping of economic factors for hypothesis-testing purposes. Farmers' age and education levels and the size of their farm operations were considered likely to influence conservation behavior.

Education: The decision to participate in the CRP involves weighing trade-offs. Landowners with more formal education are likely to be better equipped to deal with abstract ideas, and therefore are more capable of determining the feasibility of their alternative conservation and land use options (Nowak and Korsching, 1983). A decision about setting aside filter strips for ten years requires considering expectations about the future in order to determine what kind of risk premium would be included in an acceptable yearly payment. More schooling is likely to help farmers feel at ease weighing the long-term benefits and costs of participation.

Several studies have shown that decisions to adopt conservation practices are correlated positively with higher levels of education (Norris and Batie, 1987). More education may help landowners develop the necessary skills to find their way through the labyrinth of rules and regulations for participating in long-term land retirement programs. For the CRP, eligibility requirements changed with each sign-up period in 1986 and 1987. To make a participation decision

farmers must collect and understand information about eligibility criteria and program rules. Making a bid and signing a CRP contract assumes an ability to follow bureaucratic procedures. For farmers with more formal education, the transaction costs associated with a participation decision were likely to be lower than for those with less schooling.

Age: Several empirical studies show that the age of landowners plays a role in decisions about conservation. In general, younger farmers appear more likely to perceive erosion problems on their land, to accept the financial risk associated with adoption, and to acknowledge that conservation practices may be profitable (Nowak and Korsching, 1983). However, empirical evidence has suggested that older farmers may be more likely to actually adopt soil conservation practices (Christensen and Norris, 1983). In general, the evidence about whether younger or older farmers are more likely to adopt conservation practices is not conclusive. Analysis of one set of empirical data where farm operators are grouped into four age categories showed little difference among the groups with respect to average annual soil losses on their farms (Nowak and Korsching, 1983).

A farmer's age is likely to influence their expectations about the future. Farmers approaching retirement may be uncertain about their plans for future ownership of the farm. Considering a ten year contract to set aside filter strips is likely to be increasingly difficult for older farmers.

Considered as an indicator of the opportunity cost of time, the role of age is ambiguous in predicting participation in a ten-year land

retirement program. In general, when acreage is set aside in filter strips, after a permanent vegetative cover has been established, management requirements will be minimal for the next ten years. The opportunity cost of time may be high among both older and younger landowners. Older farmers may be looking toward retirement, and other farmers may have full-time off-farm employment. For farmers at different stages of their lives who are looking for ways to reduce their workload on the farm and to increase their leisure time, the opportunity cost of time may be an important consideration in the participation decision.

Farm size: Empirical evidence indicates a positive relationship between farm size and conservation behavior. Landowners operating large farms are more likely to adopt conservation practices because of greater flexibility in decision-making, more access to discretionary financial resources, greater freedom to experiment, and a better capacity to absorb the risk associated with adopting new practices (Nowak and Korsching, 1983).

In analyzing empirical data, it may lead to confusing results to use explanatory variables representing both farm size and net farm income. In analyzing one set of empirical data, significant correlation was identified between the total cropland on the farm and net farm income levels, which interfered with evaluating the statistical significance of the two variables independently (Nowak and Korsching, 1983). In contrast, Ervin and Ervin (1982) used a farm size variable as a proxy for net farm income. They deemed these two variables imperfect substitutes because the farm size variable did not

have the expected level of statistical significance in the model.

Farm size may be an indicator of both opportunity costs and transaction costs relevant to farmers' decisions about setting aside filter strips for ten years. Empirical evidence suggests that in terms of opportunity costs farm size and farm income levels may be correlated. In terms of transaction costs, the proportion of cropland on the farm eligible for filter strips was considered likely to be more important in farmers' decisions about setting aside filter strips than the overall farm size.

Structuring hypothesis tests

The conceptual framework categorizes 22 explanatory variables into groupings of economic characteristics of landowners and their farms likely to be relevant in decisions about setting aside filter strips for ten years (Table 2.1).

To represent opportunity costs, crop yields, cash rental rates, household income levels, and the proportion of family income from farming are designated important. An alternative set of opportunity cost variables are identified representing differences in farm enterprise mixes.

Transaction costs are described using variables to indicate whether farmers have had recent contact with SCS and ASCS, the land tenure situation on the farm, and the proportion of acreage eligible for filter strips.

Future expectations are represented by variables indicating the importance of the length of the contract and farmers' expectations about prices relative to inflation over ten years.

Table 2.1: Explanatory variables and expected relationships

Categories and variables	Expected relationship
PAYMENT	+
Opportunity costs:	
Yield	-
Rent on most productive cropland	-
Household income	+
Farm income	-
Transaction costs:	
Recent contact with ASCS	+
Recent contact with SCS	+
Land tenure situation	-
Proportion of cropland eligible for filter strips	+
Future expectations:	
Length of contract	-
Price expectations	+
Preferences:	
Concern about the environment	+
Concern about conserving soil	+
Farm type (alternative opportunity costs):	
Dairy operation	-
Livestock operation	-
Corn enterprise	+
Hay enterprise	-
Annual vegetable crops	-
Orchards	-
Multiple-category variables:	
Age	+/-
Education	+/-
Farm size	+/-

As indicators of farmers' preferences, concern about the environment and about conserving soil are considered important.

Three variables which are likely to influence decisions about filter strips fall under more than one category: age, education level, and farm size.

These sets of economic factors are used to structure hypothesis tests to determine what influences farmers' willingness to accept yearly payments to set aside filter strips for ten years.

In Chapter III methods for empirically measuring these economic characteristics of landowners and their farms are described.

In Chapter IV these sets of economic variables are used to operationalize hypothesis tests and to perform statistical analysis about farmers' responsiveness to yearly payments and to identify participation patterns in a filter strip program.

METHODS FOR DATA COLLECTION

Contingent valuation methods were employed to collect empirical data among a random sample of 600 individuals who own cropland in Newaygo County, Michigan. A mail survey and follow-up personal interviews were conducted to assess farmers' willingness to set aside filter strips and to identify the economic facctors which condition their responsiveness to yearly payments for participating in a ten-year conservation program.

The survey instrument was designed to measure farmers' willingness to accept (WTA) yearly payments to enter a ten-year filter strip program. This chapter begins with a general description of the CV methodology. The specific application of CV methods to learn about farmers' willingness to accept yearly payments to participate in a ten-year filter strip program is discussed.

Newaygo County, Michigan, the site for the case study, is described. Criteria used for selecting the yearly payment offers to respondents in the CV context are outlined. Procedures followed in designing the questionnaire and implementing the mail survey are discussed. A format is presented for a series of personal interviews conducted with 30 of the mail survey respondents and 12 current CRP participants.

Contingent valuation methods

The contingent valuation methodology is a set of survey research techniques used to assess the value of goods without prices.[1] To evaluate alternative policies, economic analysis provides a framework for weighing relative benefits and costs and for understanding the distributional consequences of policy changes. Conventional benefit-cost techniques rely on identifying and assigning observed market prices to the benefits and costs associated with a proposed policy change. Often both monetary and non-monetary considerations are relevant in determining the economic value of public goods and environmental goods. When the value of a public good or an environmental good is determined outside a smoothly functioning market, then no ordinary market prices exist to reflect its economic value.

To impute the value of unpriced goods using CV methods, in a survey setting respondents are asked how much they would be willing to pay (WTP) to help bring about specified improvements in the good being valued. (Or, conversely, how much they would be willing to accept (WTA) as compensation for a lower level of the good being valued.) This empirical data collected using a CV survey instrument is analyzed and used to estimate the value of the amenity. Valuations from CV data can be used to quantify the value of goods in a benefit-cost framework for policy analysis.

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[1]For a comprehensive overview of the CV methodology, Mithcell and Carson (1986) review its theorietical underpinnings and empirical progress applying CV methods. The introductory chapters in the state of the art assessment by Cummings and co-authors (1986) develop a historical context for understanding the use of CV methods. Hoehn and Krieger (1988) provide a helpful discussion of the major theoretical and empirical issues confronting CV practicioners.

A 1986 state of the art assessment of the CV method (Cummings, et. al., 1986) is introduced with a succinct yet comprehensive description of CV survey research techniques.

> CV devices involve asking individuals, in survey or experimental settings, to reveal their personal valuations of increments (or decrements) in unpriced goods by using contingent markets. These markets define the good or amenity of interest, the status quo level of provision and the offered increment or decrement therein, the institutional structure under which the good is to be provided, the method of payment and (implicitly or explicitly) the decision rule which determines whether to implement the offered program. Contingent markets are highly structured to confront respondents with a well-defined situation and to elicit a circumstantial choice contingent upon the occurence of the posited situation. Contingent markets elicit contingent choices (Randall, et. al., 1983).

Interpretation of CV data offers a different type of information about a prospective policy change than the results of more conventional survey research, such as opinion polls. To the extent that individuals' attitudes and opinions deviate from their actual behavior, results of opinion polls may be unreliable as the basis for policy evaluation. In a CV context, respondents are asked to react to a hypothetical situation, with the objective of measuring behavior rather than attitudes.

Contingent valuation methods have been lauded as the most promising approach yet developed for determining the economic value of goods without prices (Mitchell and Carson, 1986). Choices about environmental quality and levels of provision of public goods are among today's most critical policy issues, yet efforts to measure the policy effects of policy changes in these areas using market-based techniques fall short, particularly on the benefit side. Development of CV

methods to evaluate social benefits and conduct policy assessments is a demand-driven process.

To value unpriced goods, economists have found three sets of techniques most useful, the travel cost method, hedonic pricing, and CV methods.[2] The travel cost method is used to assign values to natural resource amenities associated with recreation-based activities, where the cost of travelling to a recreation site can be used as a proxy to indicate the value individuals associate with access to the site. Hedonic pricing is useful where variations in market values which indicate one portion of the value related to a good or service can be measured and attributed to the multiple characteristics of a resource. The flexibility of the CV methodology makes it useful for diverse problem-solving applications. In terms of accuracy, CV methods compare well with other available techniques for valuing non-market goods. Contingent valuation methods can be adapted to address a variety of valuation problems for which other methods are inadequate (Randall, et. al. 1983).

Although the acceptability of CV methods is widely recognized and growing, its support is far from unqualified. Economists are accustomed to using prices and consumer behavior as the basis for conventional economic analysis; they are ambivalent about using survey data to impute economic values. Values associated with public goods and environmental goods must be accounted for in economic analysis, even though market-based information is not available to indicate how

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[2]Hoehn and Krieger (1988) offer a concise descriptive analysis of these three techniques for survey research on nonmarket values.

much these goods are worth. Some economists are uneasy about CV methods because the idea of using WTP as a conceptual substitute for demand (or WTA as a conceptual substitute for supply) is unfamiliar and abstract. Among other economists, objections to CV methods are more fundamental: they consider valuation in the absence of real market data a task beyond the realm of economic analysis (Cummings, et. al., 1983).

Skepticism about the accuracy and reliability of data elicited in a hypothetical market is the gist of criticisms about CV methods. Critics ask whether respondents are motivated to thoroughly search their preferences and make honest, accurate valuations in a survey setting. The operative incentives for respondents to offer well-thought-out answers are limited. Especially if respondents are persuaded by the realism of a hypothetical situation presented in a CV survey, then they are likely to behave strategically. If respondents believe that selfish behavior will pay off by skewing the CV results to reflect their preferences, then they are likely to downplay their willingness to pay and inflate their WTA valuations in a survey situation.

To address these challenges to the validity of CV methods, extensive theoretical and experimental research has been conducted concerning on respondents' incentives to behave strategically. Strong empirical and theoretical evidence suggests that strategic bias in CV data does not threaten to undermine its usefulness.[3] Techniques have been developed and tested to mitigate against strategic behavior among

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[3]Mitchell and Carson (1986) provide a thorough and thoughtful review of theoretical and empirical literature on resolving the problem of strategic behavior among CV survey respondents.

CV survey respondents. For example, empirical evidence suggests that as situations portrayed in a CV survey become more hypothetical, incentives for strategic decision-making are diminished. Enhancing the hypothetical nature of survey scenarios and questions is a way to avoid strategic bias in CV results (Cummings, et. al., 1986). Experience suggests that in well-designed CV surveys, strategic behavior is minimal.

Theoretical and empirical evidence suggests that a discrete choice take-it-or-leave-it format is incentive compatible and minimizes strategic behavior (Hoehn and Randall, 1985). The use of discrete choice formats has been of interest in recent work with the CV methodology (Boyle and Bishop, 1988; Boyle, et. al., 1988; Hanemann, 1984; Sellar, et. al., 1985). If a respondent is offered the opportunity to either accept or reject a payment in a WTA situation, then the best decision they can make is to accept if the proposed offer is sufficient or more than sufficient. (In a WTP situation, a respondent can do no better than to accept a payment obligation if it's equal to or less than their actual willingness to pay for the good.) By using a dichotomous choice format to elicit valuations, respondents have no mechanism for bidding up a payment to a higher level, which effectively eliminates strategic bias. Rigorous empirical and theoretical work by CV researchers has successfully "blunted traditional fears that strategic responses would inevitably dominate data sets of stated personal valuations" (Randall, et. al., 1983).

Applying CV methods

To inform the design of today's soil conservation programs it is

important to know how much farmers are willing to accept in financial incentives in order to change their cropland management practices, especially when conservation requires taking acreage out of crop production. A CV format was applied to the problem of learning about farmers' responsiveness to yearly payments for setting aside filter strips for ten years.

Elements of a CV format

A mail questionnaire was developed using CV methods to elicit valuations from individuals who own cropland and who are potential participants for a filter strip program. The CV format has five elements: 1) a presentation medium, 2) a description of policy impacts, 3) a method of provision, 4) a method of payment, and 5) the bid elicitation procedure (Hoehn and Krieger, p. 92, 1988). These elements determine how effectively CV data will represent respondents' willingness to participate in a conservation program. To collect policy-relevant CV data, this survey instrument was developed with attention to minimizing inconsistencies between the scenario presented to respondents and actual policy choices.

Presentation medium

Either face-to-face interviews, telephone surveys, or a mail questionnaire could be used to elicit respondents' reactions to a filter strip program. Researchers conducting CV surveys have most often chosen personal interviews. When an interviewer presents a CV scenario to a respondent in person, the respondent has opportunities to ask questions. The interviewer can engage respondents in "bidding games" to pinpoint exactly how much they are WTP or WTA in response to

a proposed policy change. On the other hand, in a personal interview situation, a respondent may have insufficient time to ponder all the relevant aspects of a newly-proposed opportunity. The search process may be constrained and incomplete (Hoehn and Krieger, 1988).

For this CV format, a mail questionnaire was used to collect information about farmers' responses to an opportunity to enroll filter strips in the CRP.[4] It's a complex problem to decide whether a yearly payment adequately compensates for retiring acreage from crop production to install filter strips. Respondents were asked to think through how routine tasks and expenses associated with the farm operation would be affected by their participation decision. When respondents receive a mail survey, they had the option to take as much time as they needed to think through the opportunity to participate in a conservation program for a stated yearly payment. Respondents could read through the questionnaire and reflect on whether the payment seemed sufficient, considering their preferences, opportunity costs, transaction costs and expectations about the future. Some respondents took advantage of the opportunity to seek more information by discussing the questionnaire with family members or other landowners, or by placing a telephone call to the CV researcher. The mail survey instrument was chosen in order to mitigate against "the problem of communicating complex information subject to the time constraints of the CV format and the assimilative capabilities of the respondent" (Hoehn and Krieger, p. 100, 1988). In responding to a mail questionnaire, respondents were considered likely to make fewer errors

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[4]A copy of the mail questionnaire is included in Appendix A.

in perception and comprehension than in a personal interview or a telephone interview.

A mail survey is a cost-effective technique for collecting CV data. Econometric analysis of CV data requires large numbers of observations. For this case, the accuracy of the estimates generated using CV data to indicate the appropriate levels of financial incentives for participation in a filter strip program could be improved by increasing the number of farmers surveyed. In the 1970's, CV researchers avoided mail surveys because of notoriously low response rates; however, today, researchers who follow Dillman's total design method expect average response rates of 70-percent for surveys of the general public (Dillman, 1978).

Description of policy impacts

Filter strips are a relatively new conservation practice. They became an eligible practice for the CRP in February, 1988 only six months before this CV survey was conducted. According to feedback during personal interviews and in written comments on the questionnaire, several respondents heard about filter strips for the first time through the information provided in the mail questionnaire. To maximize the plausibility of the scenario outlined in the CV format, actual rules for participation in the CRP, a real-life conservation program, were outlined, including eligibility requirements and procedures for entering a ten year CRP contract. However, the participation offered was described as "the filter strip program" to avoid possible confusion about the level of yearly payments actually available to those who enroll in the CRP.

Method of provision

Presenting actual rules for CRP participation in the CV format provides respondents a realistic framework for considering how they would receive the proposed payment for enrolling filter strips in the CRP. Many landowners participate in USDA farm programs, and the minority who do not participate are familiar with programs.[5] This CV format explicitly describes a method of provision in order to learn about landowners' willingness to accept yearly payments to set aside filter strips in a ten-year land retirement program and to assess how changing yearly payments would be likely to affect participation patterns. The question is posed in the context of an existing program, the CRP, in an attempt to make the scenario believable and to enhance the accuracy of respondents' valuations.

Method of payment

The most fundamental challenge in designing a CV format was to combine a hypothetical scenario with a realistic payment vehicle. When CV survey respondents are asked to consider the economic value of environmental amenities such as clean air or water quality, they have no direct market experience to use in formulating their WTP or WTA for a change in environmental quality. To help respondents develop meaningful valuations under the time constraints in a survey setting, CV researchers develop a market-related frame of references for respondents to use in their WTP or WTA decisions.

In the design of this CV questionnaire, using the existing CRP

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[5]The sampling frame comprised of 925 Newaygo County landowners includes approximately 600 who are currently participating in some USDA farm program and 325 who are not.

program as a framework for building a scenario about enrolling filter strips in a ten year contract was intended to enhance the plausibility of participation for respondents. For most landowners, the possibility of receiving yearly payments to participate in a USDA farm program was familiar. Respondents' decision criteria about retiring cropland to set aside filter strips were related to market choices about managing their farms.

The bid elicitation process

This CV survey elicits respondents' willingness to accept yearly payments to participate in a filter strip program. When applying CV methods, the risk of strategic behavior is a more serious concern for measuring whether respondents are WTA yearly payments than for assessing whether respondents are WTP for a given policy change. In this case, in principle, if the CV scenario about the filter strip program was believable and respondents were persuaded that their decision about whether they are WTA a yearly payment would make a difference in the design of future conservation programs, then they would be inclined to behave strategically. Given the opportunity, they might reject an acceptable offer in the hypothetical survey context, in order to try to bid up the level of yearly payments the filter strip program would offer, if it were actually implemented.

In this CV survey, respondents have no avenue to demand a higher yearly payment than the amount they would actually be WTA. The valuation question was posed as a dichotomous choice, to accept or reject the offer of a yearly payment. If the payment offered was actually too low, then rejecting the payment is the reflexive response.

On the other hand, if the financial incentive offered would make participation an attractive alternative for a respondent, then it was in their best interest to respond positively to the yearly payment offer. Falsely rejecting a payment which the respondent might actually like to have the opportunity to receive would send the wrong signal about the appeal of the proposed program.

To operationalize this dichotomous choice framework to collect CV data describing respondents' willingness to accept yearly payments to set aside filter strips, a range of reasonable yearly payment offers was designated to anticipate respondents' actual valuations. In CV surveys which use bidding games to elicit respondents' WTA or WTP valuations, in reacting to the questionnaire respondents themselves offer bids which define the range of payments they consider acceptable. The quality of the CV data collected using dichotomous choice valuation questions depends upon how well the range and distribution of the payments offered in the survey setting reflect the actual preferences of the population being surveyed. "In general, the more a priori information one has on the distribution of values prior to selecting offers, the better the resulting estimates of the value will be" (Boyle and Bishop, p. 26, 1988).

Choosing a site for the case study

An important criterion for selecting a sample population was the availability of data to estimate, with some precision, an appropriate range for acceptable yearly payment offers to participate in a ten-year filter strip program. The extent of the diversity within a group of respondents and their farm operations determines the range and

distribution of the yearly payments they would be likely to accept.

An attempt to develop a range of yearly payments to represent the likely response nationwide to opportunities to participate in a long-term land retirement program would be subject to more error than a CV study designed to focus on one state. Even within one state, there exists considerable variability in the opportunity costs associated with retiring cropland from production. For example, for implementing the CRP in 1986 the state of Michigan was divided into three bidding pools, each with different bid caps, which designate the maximum yearly payments offered to CRP participants (Kovan, et. al., 1987). In the upper peninsula and upper half of the lower peninsula, landowners received up to $40 per acre for participating in the CRP. In the southwestern lower peninsula, the bid cap was set at $65. In the thumb region and the southern tier of counties, the bid cap was $85. Within each of these three bidding pools, there is considerable variance in land values, cash rental rates, and current crop yields on eligible acreage.

This CV study focused on one Michigan county, Newaygo County. There is considerable diversity in the agricultural activities in the county. At the same time, since these activities are within a relatively small geographic area, information about the range of land values and the proportion of acreage used for different farm enterprises was available. This descriptive data was used to develop a relatively accurate range of yearly payments respondents would be WTA to set aside filter strips. A related practical consideration is that confining the study to one county simplifies the problem of developing

a comprehensive sampling frame.

A profile of Newaygo County

Three criteria were relevant to the selection of Newaygo County as the site for a case study about a filter strip program: the prevalence of surface water, the presence of erodible cropland in the county which would indicate the possibility for non-point water pollution associated with cropland erosion, and the diversity of agriculture in the county.

Newaygo County has more surface water than many Michigan counties: there are four major watersheds within the county's boundaries, the White River, the Muskegon River, the Pere Marquette River, and the Rogue River. Newaygo County has 356 miles of streams and 234 lakes.[6] High water quality is an important recreational resource. In addition, most farms in the county use tiled drainage systems with open ditches bordering their fields.

A significant proportion of the cropland in the county is highly erodible. The 1982 National Resource Inventory (NRI) classifies 104,900 acres as cropland in Newaygo County, with 24,500 (23-percent) eligible for the CRP.[7] During 1987 and 1988, SCS personnel in Newaygo County made HEL determinations for 50,012 acres of cropland and classified 5400 acres (11-percent) as highly erodible.[8]

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[6]Brochure entitled "Nature's Playground," from Western Michigan Community Growth Alliance, Big Rapids, Michigan.

[7]Unpublished analyses of Michigan NRI data, Jim Reisen, SCS, East Lansing, Michigan, April, 1987.

[8]Personal communication, Glenn Lamberg, SCS district conservationist, Newaygo County, Michigan, August, 1988.

Many of Michigan's principal agricultural activities are represented in Newaygo County's agricultural economy.[9] The largest proportion of the farmland in the county is used for dairy and livestock operations. Approximately 40-percent of the cropland in the county is in hay or forage crops. Landowners plant corn on approximately 35-percent of the county's cropland. Small grains, including wheat and oats, occupy another six percent of the acreage. Cropland planted to soybeans has increased in recent years.[10] High-value annual vegetables and orchard crops are especially important to western Michigan's agricultural economy. Approximately eight percent of Newaygo County's cropland is in annual vegetables, and another four percent is in orchards.

Demographically, both large and small farm operations are present in Newaygo County.[11] In 1982, the Michigan Census of Agriculture reported 736 farms harvesting cropland. Small farms, under 100 acres, predominate: 537 farms harvested an estimated 18,213 acres of cropland, averaging 34 acres per farm. 344 of the farms in the county had over $10,000 in sales. The proportion of full time farm operators in Newaygo County was above the state average. Newaygo County farmers' participation in set-aside programs and other USDA farm programs was comparable with participation in other counties.

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[9]Proportions are calculated using statistics from the 1982 Michigan Census of Agriculture. See Table 4.2 for more detailed information on the data.

[10]Personal communication, Norm Myers, agricultural agent for the Cooperative Extension Service in Newaygo County.

[11]1982 Michigan Census of Agriculture

Newaygo County is predominately rural. Fremont, the county's largest town, has approximately 5000 residents; the county's total population is 38,000. The county is growing: it had Michigan's eighth largest population increase between 1980 and 1986. Newaygo County is both rich and poor. Fremont is the international headquarters for Gerber Products Company, a large corporation with net sales of approximately $1 billion in 1988. Yet the county has an unemployment rate of 11.5 percent (the state average is 8.9 percent). 4200 Newaygo County residents receive some kind of welfare payments.[12]

Developing the sampling frame

To develop a sampling frame representing all Newaygo County residents who own cropland and would potentially be eligible for a filter strip program, cooperation from the personnel at the county level in the Cooperative Extension Service (CES), the Agricultural Stabilization and Conservation Service (ASCS), and especially the (Soil Conservation Service (SCS) offices was a prerequisite. During the summer of 1988, in several Michigan counties, agency personnel were understaffed and overburdened with responsibilities for implementing the 1985 Food Security Act, including making HEL determinations, planning CRP contracts, and enforcing the sodbuster and swampbuster provisions. In these counties, conducting a CV survey was out of the question in 1988.[13] Although the workload is significant in Newaygo County, personnel in all three agencies welcomed the CV study and

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[12]Fremont Rotary Club newsletter, July 1988.

[13]Personal communication, Bill Hartman, SCS, East Lansing, March, 1988.

offered their full support.

In 1988, the level of computerization of records in Newaygo County's SCS field office was exceptional. A computerized file of all the clients of the conservation district was available in the Computer Assisted Management and Planning System (CAMPS).[14] Using a sorting feature in CAMPS, it was possible to separate the famers who own cropland form rural landowners with woodlots and acreage used for recreational purposes. At the SCS field office during June, 1988, over sixty hours of staff time was devoted to checking the accuracy of the mailing list. A final list was developed representing 709 SCS clients who own cropland in Newaygo County. Among these 709, approximately 600 are ASCS clients who currently participate in USDA farm programs. The CES provided their mailing list, which was cross-referenced with the combined ASCS and SCS lists. The final sampling frame numbers 925 landowners who own cropland in Newaygo County and might be eligible to participate in a filter strip program.

A special effort was made to assure the comprehensiveness of the sampling frame to include landowners who are not currently participating in USDA farm programs. Many landowners who own and manage cropland do not currently participate in USDA farm programs. The results of recent research about USDA farm program participants indicated that half to three-quarters of the nation's highly erodible cropland is operated by landowners who do not participate in USDA farm programs (Reichelderfer, 1985).

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[14]Many of the SCS field offices are just installing computerized record systems. Newaygo County is among the most advance in the state, according to Vicki Siems, SCS, Lansing.

Two recent studies of participation in conservation programs used the mailing lists supplied by the local ASCS offices as sampling frames (Ervin, et.al., 1987; Esseks and Kraft, 1988). In most counties, the ASCS mailing list covers only those farmers who are currently participating in USDA farm programs or who have participated recently. If survey respondents were selected from a sampling frame which does not include non-participants in USDA programs, then it would be impossible to determine whether contact with ASCS and SCS makes a difference in farmers' participation decisions.

An objective of the CV survey about the filter strip program was to assess whether participation patterns among non-participants are different from participation patterns among landowners who are currently enrolled in USDA farm programs. An effort was made to develop a sampling frame for Newaygo County representing all those who own cropland and who might be eligible to set aside filter strips.

Selecting the range of yearly payment offers

In this CV survey, a randomly selected sample of respondents were presented with a dichotomous choice, whether to accept or reject a proposed yearly payment to set aside filter strips for ten years. In technical terms, to structure the range of yearly payments to offer survey respondents required

> an optimal sampling procedure for obtaining the best estimate of the cumulative distribution function over its entire range....The use of the empirical distribution employs prior information about the distribution of values to set the range and distribution of the closed-ended offers. This process insures that the selected observations are balanced between the tails of the distributions and clusters the majority of offers around the median. (Boyle et.al., 1985, p. 97)

Simply stated, the range of yearly payments offered to respondents was designed to reflect the best possible prior estimate of the range and distribution of payments they would be WTA to set aside filter strips for ten years. To choose these values required empirical data to predict the financial incentives necessary to recruit participation among eligible landowners, acknowledging the economic factors which condition their responsiveness to yearly payments.

For many of the public goods evaluated using CV methods, little or no empirical data exists on how much respondents would be WTA or WTP with regard to changes in policy. Pre-testing is recommended to determine the range of relevant payments to offer in the CV survey setting. A group of potential respondents reply to open-ended questions about how much they would be WTA or WTP for a proposed policy change. This range of payments articulated by respondents during the pre-test becomes the basis for determining the choice options to use in an actual CV format.

For this CV study on willingness to accept a yearly payment to set aside filter strips, pre-testing was not necessary to establish the appropriate range for dichotomous choice offers. Relevant empirical data existed to structure an appropriate range and distribution of yearly payment offers, based on the criteria for administering the CRP and on farmers' observed behavior in response to opportunities to participate in the CRP. To implement the CRP, criteria were established in 1986 to designate maximum acceptable rental rates (MARR) for each county. These "bid caps" are related to the yearly payments farmers are willing to accept to participate in the CRP. The basis for

the range and distribution of yearly payments offered to Newaygo County farmers in the CV survey setting was two types of empirical data: the opportunity costs associated with retiring cropland in the county and bidding behavior for the first CRP sign-up in 1986.

Criteria used to set bid caps for yearly CRP payments

Implementation of the CRP began soon after the 1985 farm bill was signed. In February, 1986 landowners had their first opportunity to enroll HEL in the program. To decide which of the submitted bids to accept, the USDA appointed state-level committees to designate bidding pools, groups of counties where the same maximum levels for yearly CRP payments would be appropriate. The criteria provided by USDA for these committees to use in developing bidding pools included land values, cash rental rates, soil types, and agro-climatic conditions. In Michigan, land values and cash rents figured most importantly into decisions about where the lines are drawn to form Michigan's three bidding pools.[15]

When the bidding pools were actually determined for Michigan, the committee relied on an annual report developed by each ASCS county executive director as the primary source of information about land values and cash rents. According the 1988 report for Newaygo County, the county-wide average market value of non-irrigated cropland is $337 and the county-wide average cash rent for non-irrigated cropland is $20 per acre.[16] Newaygo County was part of the CRP bidding pool which

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[15]Personal communication, Bob Payne, ASCS state conservation program specialist, East Lansing, Michigan.

[16]ASCS Notice AFIDA-15, Newaygo County's Land Value Survey Questionnaire, January 14, 1988.

includes Michigan's upper peninsula and the northern third of the lower peninsula. In Newaygo County, over the first seven sign-ups from 1986 through 1988, the USDA accepted bids for participation in the CRP from landowners who ask for yearly payments of $40 or less. In two of the counties bordering Newaygo County to the south, the CRP bid cap is $65.

Land values: An important source of empirical data on recent land values in Newaygo County was a record of 38 actual sales of cropland conducted between January, 1985 and March, 1987 (Harvey, et.al., 1987). The land sales reported for Newaygo County range from $397 per acre to $2567 per acre (Table 3.1). The average value of the land sold was $985.90 per acre, the median value was $796.50.

It's convention for agricultural economists to estimate cash rental values as a function of the market value of the land. In Michigan in 1987, cash rent was approximately six-percent of the market value of cropland (USDA, p. 15, 1987). Using calculations based on this function for the 38 land sales reported in Newaygo County between 1985 and 1987, reasonable cash rents in the county would range from $23.82 to $154.02 for the land which was bought and sold on the market. An estimated average cash rental rate for the county based on this data is $59.15, and the median cash rent was $47.79.

These figures were consistent with informal estimates of the "going rate" for cash rental of cropland in 1988.[17] Cash rents for land used for hay and alfalfa production were $45 to $65 per acre. During the summer of 1988, a serious drought inflated perceived and

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[17]Personal communication, Glenn Lamberg, SCS district conservationist and Norm Myers, CES agricultural agent in Newaygo County, Michigan.

Table 3.1: Newaygo County land values and estimated cash rental rates[a]

Acres Sold	Land Sale Value (per acre)	Estimated Cash Rent[b]
35.5	$397.00	$23.82
36.5	409.00	24.54
115.9	413.00	24.78
36.0	417.00	25.02
39.0	436.00	26.16
65.1	464.00	27.84
69.0	478.00	28.68
29.5	508.00	30.48
19.0	550.00	33.00
46.1	558.00	33.48
25.2	589.00	35.34
178.8	590.00	35.40
35.0	600.00	36.00
19.6	606.00	36.36
41.5	661.00	39.66
34.2	681.00	40.86
24.5	710.00	42.60
9.8	728.00	43.68
40.7	795.00	47.70
14.4	798.00	47.88
58.0	801.00	48.06
55.3	802.00	48.12
71.2	883.00	52.98
18.0	944.00	56.64
15.2	966.00	57.96
61.8	981.00	58.86
18.0	989.00	59.34
6.4	1073.00	64.38
18.5	1081.00	64.86
58.9	1094.00	65.64
17.0	1165.00	69.90
38.0	1199.00	71.94
17.1	1996.00	119.76
93.6	2304.00	138.24
45.0	2373.00	142.38
52.0	2375.00	142.50
30.0	2483.00	148.98
11.6	2567.00	154.02
1600.9 TOTAL		

[a]Harvey, et.al., 1987. Data represents 38 land sales in Newaygo County between January, 1985 and March, 1987.

[b]Cash rents are estimated as six-percent of land sale values.

real values for cash rental rates for hay acreage. Cash rental rates for corn acreage ranged from for $15 to $45 per acre. Most of the cropland in corn production operated by renters is highly productive, and rents for over $35 per acre. For orchards, leasing arrangements varied according to agreements about who sprays the trees and whose equipment will be used for harvesting. Typical leasing arrangement started at $100 per acre. The market value for orchard acreage was approximately $1000 per acre, with considerable variation according to the age and productivity of the fruit trees.

The value of muck cropland was more difficult to estimate. Organic muck soils are highly productive and are used to grow high value crops such as carrots, onions, celery and spearmint. In four recorded market transactions between 1985 and 1987 involving muck cropland, prices ranged from $944 per acre up to $2567 per acre. Estimated cash rents as a function of these sale values would be between $56.64 and $154.02 per acre. In the 1988 rental market for muck cropland, rents ranged between $100 and $300 per acre. The real and perceived values of some of Newaygo County's best muck land was not reflected in this range, and would be somewhat higher. Some of the muck land would sell for as much as $5000 per acre on the current land market (or at least some people think that it would).[18] Property taxes for muck cropland are the highest in the county. To be acceptable, cash rental rates were expected to be high enough so that landowners could meet their tax obligations. Moreover, the opportunity costs of

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[18]Personal communication, Glenn Lamberg, district conservationist in Newaygo County.

taking muck cropland out of production were high: on the best muck soils, a grower can earn an estimated $500 profit per acre in a good year.[19]

Informal estimates of current cash rental rates and data describing land sales together werre used to develop a summary of the range and distribution of the opportunity costs associated with taking cropland out of production for landowners in Newaygo County. Land uses and estimated cash rental rates are summarized in Table 3.2 and Table 3.3. These estimates were the basis for cumulative distribution of estimated cash rental rates for Newaygo County (Table 3.4).

Historical bidding data: Landowner' actual behavior when faced with an economic choice to enter the CRP is an important source of information. When submitting bids to participate in the CRP Newaygo County landowners expected a yearly CRP payment higher than the amount they would receive in an annual cash rental agreement. In February, 1986 twenty-four landowners in Newaygo County offered CRP bids. The average CRP bid submitted by these landowners during the first CRP sign-up, before the $40 bid cap had been established, was $98.13. The average cash rent during that period was $59.15. It appears that those landowners who bid to enter the CRP in 1986 expected a yearly CRP almost double the going cash rental rate to enroll HEL in the CRP.

Historical bidding data from the first sign-up in 1986 was analyzed in three separate categories: for the 24 bids the USDA received from Newaygo County landowners, for 77 bids received from

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[19]Personal interview with a carrot and onion grower in Grant, Michigan in August, 1988.

Table 3.2: Breakdown of land uses for Newaygo County[a]

Crop	Acres	Percentage
Hay/alfalfa	31,870	40%
Corn	27,530	35
Annual vegetables and spearmint	5,397	7
Small grains	4,964	6
Orchards	2,079	2
Irrigated cropland (not muck)	1,653	1
Upland vegetables	1,109	1
Expansion factor[b]	4,981	6
TOTAL	79.583	100%

[a]Source: 1982 Michigan Census of Agriculture

[b]Acreage which is not accounted for when the statistics from the Census data are summed.

Table 3.3: Estimated cash rental rates for 1988[a]

Crop	Percentage of total acreage	Rents
Hay/alfalfa	35%	$45-65
Corn	31%	$15-45
Muck vegetables and mint	7%	$55-300
Small grains	6%	$50
Orchards	2%	$100 and higher
Irrigated cropland (not muck)	2%	$100
Upland vegetables	1%	$65
Expansion factor	6%	$65
	100%	

[a]Estimates based on informal estimates and from calculations of cash rental rates as a function of recorded land sales.

Table 3.4: Estimated cash rental rates, Newaygo County[a]

Crop	Rent	Percentage	Cumulative Percentage
Corn	$15	7.5%	17.5%
Corn	$30	7.5%	25%
Corn	$45	15%	40%
Hay	$45	15%	55%
Small Grain	$50	5%	60%
Hay	$55	10%	70%
Low value muck	$55	2%	72%
Hay	$65	10%	82%
Expansion factor	$65	10%	92%
Irrigated	$100	2%	94%
Orchards	$100	2%	96%
Muck	$150	2%	98%
Muck	$300	2%	100%
		100%	

[a]Land Use Proportions estimated based on statistics from the Michigan Census of Agriculture. Estimated cash rental rates from statistics from Table 3.1 and from informal estimates.

landowners in Newaygo County and the eight counties which share the county's borders, and for 526 CRP bids received for the entire state of Michigan. The range and distribution of CRP bids submitted in Newaygo County was similar to the bids submitted in the rest of the state (Table 3.5).

Bidding behavior observed in February, 1986 reflected the amount landowners were WTA to enroll highly erodible cropland in the CRP. These CRP bids were formulated in the face of genuine uncertainty about what yearly payment levels would be accepted by the USDA.[20] The record of this bidding behavior was particularly useful for formulating a range and distribution of yearly payment offers for participation in a filter strip program which will be offered to a random sample of survey respondents. It represented the actual perceptions and behavior of a group of potential CRP participants concerning the opportunity costs of taking cropland out of production for ten years.

The basis for selecting yearly payments to present to respondents in a dichotomous choice context in the CV survey about participation in a filter strip program were two cumulative distribution functions (CDF) comprised of data estimating cash rental rates in Newaygo County and describing CRP bidding behavior in 1986. The CDF representing cash rental rates doubled and the CDF describing historical CRP bidding behavior are close to the same shape (Figure 3.1). Based on these two empirically-based sets of data, a range of yearly payments to offer survey respondents were developed.

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[20]The majority of the bids offered were rejected by the USDA because they were higher than the $40 MARR. Many landowners submitted lower bids in later sign-ups in order to enroll in the CRP.

Table 3.5 Historical bidding data: first CRP sign-up, February, 1986

	Newaygo County	Eight Counties[a]	State of Michigan	Summary Value[b]
Number of Bids	24	77	526	*
Acres Bid	563.8	3151.0	25,044.5	*
Proportion of Acres				
10-percent	$45	$40	$50	$45
20-percent	$60	$58.90	$60	$60
30-percent	$65	$68	$68.50	$65
40-percent	$75	$75	$75	$75
50-percent	$79	$85.50	$84.50	$85
60-percent	$94	$100	$94	$95
70-percent	$110	$100	$100	$105
80-percent	$130	$124	$125	$125
90-percent	$149	$167	$165	$160
100-percent	$234.50	$249	$900	$600
Average Bid	$98.13	$91.11	$95.51	
Median Bid	$80.00	$75.00	$80.00	

[a]Represents eight counties bordering Newaygo County: Kent, Lake, Mecosta, Montcalm, Muskegon, Oceana, Osceola, Ottawa, and Newaygo Counties.

[b]Average of the three figures.

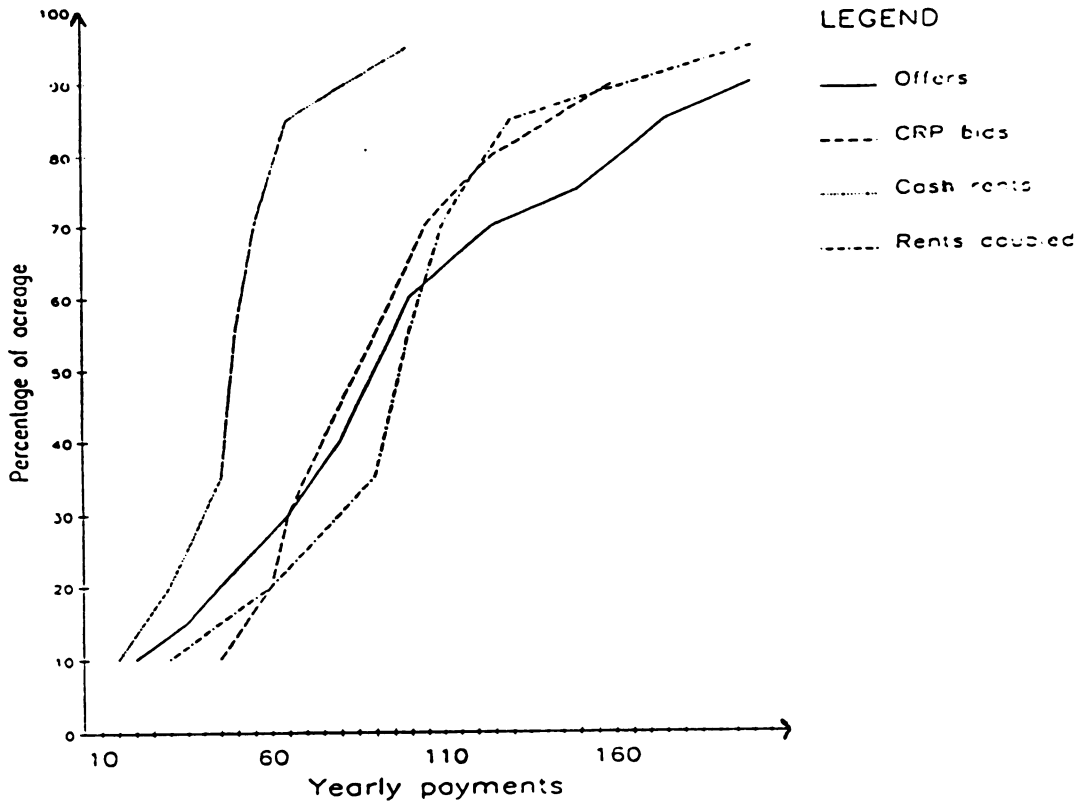

Figure 3.1: Empirical cumulative distributions for setting offer prices

Boyle and Bishop (1988) indicated that to assure the quality of estimates calculated based on CV data, it is essential to offer dichotomous choices covering the entire range of respondents' possible WTP or WTA levels. Toward this end, to assess landowners' willingness to accept yearly payments to set aside filter strips, the CDF showing the range of yearly payment offers to CV survey respondents was extended at the upper and lower tails, compared with the values indicated by cash rental rates and historical CRP bidding behavior. Instead of offering only ten yearly payments at 10-percent intervals on the CDF, twelve yearly payments were offered to CV respondents in order to concentrate the number of observations at the lower and upper tails. The twelve yearly payment offers were set at 10-percent levels with the exception of two extra offers around the 20-percent and the 80-percent levels of the empirically based CDF, at the 15- and 25-percent and the 75- and 85-percent levels respectively (Table 3.6).

Designing the mail questionnaire

The mail questionnaire to survey Newaygo County farmers about their willingness to participate in a filter strip program was designed following the total design method (TDM) (Dillman, 1978). The TDM provided guidelines for writing questions, organizing questions on the page, and developing a format to present a large amount of information in a small amount of space.

Dillman (1978) emphasized the importance of pre-testing a mail questionnaire (p. 155-159). To pre-test this survey instrument, a first round of opinions were sought from a dozen colleagues in the Department of Agricultural Economics at Michigan State University,

Table 3.6: Yearly payment offers to CV survey respondents

Proportion	Yearly Payment
10%	$20
15%	$35
25%	$45
30%	$65
40%	$80
50%	$90
60%	$100
70%	$125
75%	$150
85%	$175
90%	$200
100%	$550

including graduate students and faculty members. Farm management specialists offered helpful suggestions about word choices and phraseology and about how to elicit the most precise possible information about farm characteristics such as farm income and land tenure. Experienced survey researchers who have worked in developing countries pointed out ways to clarify questions and to strengthen the relationship between the information sought from the respondent and the exact statistical variable to be analyzed.

An early version of the questionnaire asked respondents to consider enrolling either filter strips or highly erodible land (HEL) into the CRP. Colleagues observed that respondents might confuse these two separate decision problems. They expressed concern about analyzing the responses to determine differences between respondents' considerations about setting aside filter strips versus the option to retire HEL. These observations motivated further pre-testing with farmers to compare respondents' performances when asked to consider both options against reactions to a questionnaire focusing on only filter strips. This pre-testing made it clear that to collect information concerning participation patterns for both HEL and filter strips would imply a serious trade-off in the quality of responses.

Reviews from another dozen conservation professionals helped to fine tune word choices and the content of the questionnaire. District conservationists at the county level, state-level conservation program specialists, and individuals involved in environmental education all provided useful feedback. Their most helpful contributions were opinions about what types of information matter the most in decisions

about the design and implementation of conservation policy, and, therefore, ought to take priority in the design of the questionnaire.

Suggestions about how to explain the rules for enrolling in a filter strip program improved the tone and the flow of the CV scenario. For example, 1988 eligibility criteriafor CRP participation required that cropland was harvested two of the five years between 1981 and 1985, not necessarily during the past two years. As a result of the conservation professionals' comments, this distinction was made more explicit than in earlier drafts of the questionnaire. Feedback about word choices was important. For example, referring to participation in the CRP as "setting aside" cropland might be confusing, as there are other farm programs called "set aside" programs. The term "retiring cropland" was recommended instead. Another suggestion helped to improve the terminology for describing the use of filter strips to straighten the edges of fields. In colloquial terms, farmers talk about "squaring up" their fields.

The final round of pre-testing was conducted in two stages. First, at Michigan State University's annual Ag Expo, a three day information and demonstration fair held in July, 1988, over thirty farmers responded to sample copies of the questionnaire. Most often, individuals were approached one at a time. In a few cases, three or four farmers discussed the questionnaire together. The amount of time respondents required to read and answer questions was recorded and compared between different versions of the questionnaire. Farmers offered opinions about the tone of the questionnaire and the nature of the questions asked. Some farmers responded to questionnaires covering

both HEL and filter strips. Others considered a version which covered only filter strips. The process made it clear that a survey instrument focusing just on filter strips would elicit the best quality data.

Limited pre-testing was done in Fremont, Michigan. Three members of the Newaygo County Soil Conservation District's board of directors reviewed the final draft of the questionnaire. They offered helpful suggestions to clarify the descriptions of drainage ditches in the CV scenario.

No less than twelve major modifications of the mail questionnaire were discussed and refined between May 13, 1988 and July 26, 1988 before a final version was printed at the end of July. The pre-testing process continued until the marginal costs of spending more time on survey design seemed to exceed the marginal benefits of another person's opinions about the survey format. Over sixty individuals offered thoughtful feedback during the pre-testing process and in each case they made at least one suggestion which contributed to a better final product.

Implementing the mail survey

The TDM guidelines were followed for disseminating the mail questionnaire. The first cover letter and questionnaires were mailed to 600 randomly selected landowners in Newaygo County on August 2, 1988.[21] Each cover letter opened with a personal salutation. Each cover letter was hand-signed. The cover letter included a local telephone number where respondents could call with questions about the

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[21]A copy of the mail questionnaire and three versions of letters to respondents used in successive mailings are included in Appendix A.

purpose of the survey or for help filling out the questionnaire.

Twelve versions of the questionnaire were mailed, offering twelve different yearly payments to groups of fifty respondents for each offer. The questionnaires were coded in order to match returned questionnaires with names on the mailing list to coordinate the follow-up mailings. The codes identified which respondents were offered the twelve different yearly payments.

Dillman (1978) strongly urged follow-up mailings. He estimated that survey response rates can be doubled by using the TDM technique of sending another questionnaire and a follow-up letter to those individuals who fail to respond to the survey (Dillman, p. 180, 1978). The follow-up sequence involved first sending a postcard to thank those who have already sent in their questionnaires and to gently prod those who have not. This postcard was mailed to all 600 respondents on August 9, 1988. A second mailing went out three weeks after the initial distribution of the survey, on August 23, 1988, to approximately 350 respondents. This reminder included a new cover letter informing respondents that their questionnaire had not yet been received, and another copy of the questionnaire. A third and final follow-up was mailed on September 23, seven weeks after the first mailing. This mailing was not sent by registered mail, although Dillman recommended the technique in order to convey a sense of urgency to respondents who have failed to reply to the two other mailings and a postcard.

On November 1, 1988, twelve weeks after the first mailing, 71.6-percent (411/576) of the mail surveys had been returned. Of the 600

respondents who received the first mailing, the postal service could not deliver questionnaires to 26 individuals (4.3-percent of the sample). For these 26 respondents, forwarding addresses had expired or the names themselves were unknown. Half of the responses were received soon after the first mailing; 35.1-percent were received before August 19, 1988. By September 19, between the second and the third follow-up mailings, another 62.2-percent of the responses were received. The final response rate was tabulated at the end of twelve weeks (Table 3.7).

The format for personal interviews

A survey instrument was designed for personal interviews to probe respondents' choices about their willingness to accept yearly payments to set aside filter strips and to learn about the criteria they weighed in making the decision.[22] The objective of the series of personal interviews was to verify the data collected in the mail questionnaire and to learn more about the factors significant in farmers' decisions about participating in a ten-year cropland retirement program.

During August, 1988 thirty individuals who had responded to the mail survey were interviewed. Their opinions about filter strips were solicited. Those who had responded to an option to set aside filter strips in the mail survey were also asked to consider whether they had HEL on their farms and whether they would consider retiring their HEL from crop production for ten years. Twelve individuals were interviewed who have already enrolled HEL in the CRP. They were asked to respond to an opportunity to set aside filter strips.

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[22]A copy of the survey instrument is displayed in Appendix B.

Table 3.7: Response rate

Timing	Date	Responses	Not Delivered	Ratio	Response Rate
After the first follow-up	8/19/88	205	4	205/586	35.1%
After the second follow-up	9/2/88	288	23	288/577	49.9%
Immediately preceding the third follow-up	9/19/88	359	23	359/577	62.2%
After the third follow-up	10/7/88	403	26	403/574	70.2%
After twelve weeks	11/1/88	411	26	411/574	71.6%

The survey instrument used to conduct personal interviews was comprised of three sections. First, landowners were engaged in a bidding game to find out whether they would be willing to accept more or less than the amount they were offered in the mail questionnaire to enroll in a filter strip program. The respondents were asked also to identify whether there is highly erodible acreage on their farms, and whether they would be interested in enrolling any HEL in a ten-year cropland retirement program.

In the second section, respondents were asked to consider the specific costs and benefits associated with participating in the CRP. Costs of entering the CRP would include establishing and maintaining permanent vegetative cover crops on the enrolled acreage. Possible savings from entering the CRP would include net changes in farm equipment costs, net changes in operating expenses, net changes in farm labor required for the farm operation, and net changes in farm program payments. In the interview setting, the respondents were prompted to break down their actual estimated costs of participation. After working step by step through this budgeting exercise, respondents were asked whether or not a lower or higher yearly CRP payment would be acceptable.

In the final section, miscellaneous information about how farmers would manage filter strips and retired HEL was collected. Respondents were invited to express their attitudes about planting trees on acreage set aside as filter strips or using filter strips as wildlife habitat.

The thirty mail survey respondents who were interviewed received mail questionnaires offering them either $65.00 or $80.00 yearly

payments. They were among the first respondents to return their questionnaires, since the interviews were conducted during August, the third, fourth, and fifth weeks after the survey was mailed out. Some of the individuals interviewed had acreage eligible for filter strips. Others indicated in their mail survey responses that they had no acreage eligible for filter strips. A sub-group of the respondents surveyed had HEL which would be eligible for the CRP. In addition, twelve of sixteen current CRP participants from Newaygo County were interviewed. Through the sixth sign-up (February, 1988) approximately 500 acres of HEL were enrolled in the CRP in Newaygo County. The average CRP contract enrolled in Newaygo County is 22.4 acres.

Summary

A mail questionnaire and personal interviews were used to learn more about Newaygo County landowners' responsiveness to yearly payments for setting aside filter strips. The empirical data collected in the mail survey is analyzed using a two-limit Tobit model. Statistical analysis and hypothesis testing are described in Chapter IV. An interpretation of the empirical results, discussed in a qualitative context using information from the personal interviews, is presented in Chapter V.

ANALYSIS OF CV DATA FROM THE MAIL SURVEY

Econometric techniques were used to analyze CV data collected through a mail survey. Farmers' decisions about whether to accept or reject a yearly payment to set aside filter strips were analyzed using an economic conceptual framework. The level of the yearly payment offered to respondents was expected to be the most important factor determining their willingness to set aside filter strips in a ten-year program. A series of hypotheses was tested to identify the economic characteristics of respondents and their farms which make a difference in conditioning their responsiveness to yearly payments.

In this chapter, the two-limit Tobit model used to analyze the empirical data is described. The procedures followed to test hypotheses and to identify economic factors which are significant in farmers' participation decisions are outlined. The interpretation of the results is discussed.

The two-limit Tobit model

The CV data from the mail survey were analyzed to estimate the proportion of their eligible acreage respondents would be willing to set aside as filter strips. This dependent variable was limited in its range: farmers could choose to enroll all, none, or some fraction of their eligible acreage in filter strips.

A maximum likelihood (ML) statistical technique, the two-limit

Tobit model, was applied to the problem of estimating the relationship between participation (proportion of eligible acreage enrolled) in response to yearly payment offers, conditioned by economic factors. Estimation of ML models is based on the principle that there exists one particular set of possible values for the parameters being estimated which the sample being analyzed is more likely to have been drawn from than any other set of parameter values. The ML estimate is a particular vector of coefficients which gives the greatest probability of drawing the sample actually observed (Kennedy, p. 18, 1986).

The ML estimation procedure involves maximizing the likelihood function or, equivalently, maximizing the log-likelihood function. The constrained maximum of a log-likelihood function is a single value, the log-likelihood value, which is used in statistical tests to compare results from estimated ML equations.

Tobit analysis was introduced by James Tobin (1958). The Tobit model is a hybrid of probit and multiple regression techniques. Standard Tobit analysis applies in the special situation where several observations cluster at one limit of the range of the dependent variable. Its first applications were to analyze household consumption data, where several low-income households have zero purchases of a given good, while the demand from middle- and high-income households is positive and continuous over a range. The Tobit model is useful for analyzing labor data, where some workers are unemployed and hours worked vary among others in the labor force (McDonald and Moffitt, 1980). Norris and Batie (1987) applied Tobit methods to the problem of estimating farmers' expenditures for adopting conservation practices

for a sample population including several farms where conservation practices are not used.

The two-limit Tobit model was introduced by Rossett and Nelson (1975). This estimation technique applies in cases where the dependent variable takes on limit values for a significant number of observations at both ends of its limited range, yet the dependent variable is continuous between its limits. The two-limit Tobit model was appropriate to analyze participation in a filter strip program among Newaygo County farmers, where some are willing to set all their eligible acres as filter strips, others are interested in enrolling some proportion of their eligible acreage, and the rest would not consider retiring any acreage into filter strips. The likelihood function which was maximized to estimate a vector of Tobit coefficients for the explanatory variables in the model was specified by Madalla (p. 161, 1983). This two-limit Tobit model was estimated using LIMDEP computer software (Greene, p. 188, 1988).

To specify the Tobit equation to estimate the relationship between participation and the economic factors conditioning farmers' decisions about filter strips, a semi-logged functional form was used.[1] In choosing the functional form for this equation, quadratic and linear functional forms were also considered. Estimates of intercepts and elasticities were very similar for the semi-logged and quadratic forms

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[1]Semi-logged functional form means using the natural logarithm of all continuous explanatory variables in the data set and the linear form of the dependent variable.

In specifying the variables to estimate the two-limit Tobit model, the names of logged continuous variables are prefaced by and "L". For example, when the variable PAYMENT is logged, it is labeled LPAYMENT.

of the equation. This phenomenon suggested that the function being estimated is not sensitive to differences between these two non-linear functional forms.[2]

Hypothesis-testing

Hypothesis tests were conducted identify the economic characteristics of landowners and their farms which condition their responsiveness to yearly payments for setting aside filter strips. Hypothesis tests were structured to test whether yearly payment offers, preferences, opportunity costs, transaction costs, and expectations about the future make a difference in farmers' willingness to participate in a ten-year filter strip program. Sets of explanatory variables were designated in order to identify the economic factors likely to make a difference in farmers' decisions about whether to accept a yearly payment to set aside filter strips (Table 4.1). A single variable, PAYMENT, and six sets of explanatory variables were specified.[3]

A farmer's decision to set aside filter strips was considered likely to be influenced by the yearly payment level offer (PAYMENT), economic factors (OC, FT, TC, FE, PREF) and non-categorized (NC)

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[2]To estimate the two-limit Tobit model, the semi-logged form was selected over the quadratic form to simplify the interpretation of the results when several continuous explanatory variables are present in the estimated equation. When quadratic functional form is used, significant collinearity exists between the squared and nominal terms in the equation, which makes the interpretation of coefficients ambiguous.

[3]The hypotheses are developed in Chapter II. Lists of the data used to estimate the Tobit equations. The data were collected using the mail survey instrument displayed in Appendix A. Descriptions of procedures followed to specify the explanatory variables are provided in Appendix C.

Table 4.1: Groups of variables for hypothesis-testing

Categories and variables	Conceptual descriptions	Expected relationship
PAYMENT	Yearly payment for participating	+
Opportunity costs:		
YIELD	Average yield on filter strip acreage	-
RENT	Cash rent on most productive acreage	-
INCOME	Household income	+
FINCOME	Percentage of income from farming	-
Transaction costs:		
ASCS	Contact with ASCS in the past 3 years	+
SCS	Contact with SCS in the past 3 years	+
TENURE	Over 50-percent of cropland is rented	-
PROPELG	Proportion of cropland on the farm eligible for filter strips	+
Future expectations:		
TOOLONG	Ten year contract is too long	-
PEXPECT	Price expectations for the next 10 years	+
Preferences:		
SCETHIC	Concern about conserving soil on the farm	+
ENVETHIC	Concern about the environment	+
Farm type:		
DAIRY	Dairy is an important farm enterprise.	-
LIVESTCK	Livestock is an important farm enterprise.	-
HAY	Hay is an important farm enterprise.	-
CORN	Corn is an important farm enterprise.	+
ORCHARDS	Orchards are an important farm enterprise.	-
VEG	Vegetables are an important farm enterprise.	-
Non-categorized variables:		
AGE	Respondent's age	+/-
EDUCATE	Respondent's schooling	+/-
TOT	Total acres of cropland on the farm	+/-

variables. To identify which explanatory variables were statistically significant in farmers' decisions about participating in a filter strip program, a Tobit equation describing participation was estimated. The full Tobit equation included PAYMENT and six groups of economic variables which condition farmers' responsiveness to yearly payments.

PARTICIPATION = f(PAYMENT, PREF, OC, FT, TC, FE, NC)

Hypotheses about which economic decision criteria and characteristics of landowners and their farms were important in decisions about filter strips were tested by examining the significance of groups comprised of 21 individual variables plus PAYMENT.

PREF = f(SCETHIC, ENVETHIC)

OC = f(YIELD, RENT, FINCOME, INCOME)

FT = f(DAIRY, LIVESTCK, CORN, HAY, ORCHARDS, VEG)

TC = f(SCS, ASCS, TENURE, PROPELG)

FE = f(PEXPECT, TOOLONG)

NC = f(AGE, EDUCATE, TOT)

Empirical data

Among 412 respondents to the mail survey, 167 individuals (40.5-percent) identified acreage on their farms which would be eligible for filter strips. Responses from 164 of these completed questionnaires were analyzed (Table 4.2).[3] Several categories of data have missing variables across numerous observations. For example, in many cases

[3]The original design of the study involved testing landowners' responses to twelve different payments. However, because of a clerical error involving the respondents who received questionnaires offering $20.00 payments, only three questionnaires from this category were returned. To avoid bias from this error in the administration of the mail survey, responses are analyzed resulting from offering respondents eleven different payments, ranging from $35.00 to $550.00.

Table 4.2: Responses to the mail survey

Payment Offer	Number of Responses	Percentage of total
$35.00	16	9.8%
$45.00	12	7.3%
$65.00	16	9.8%
$80.00	19	11.6%
$90.00	19	11.6%
$100.00	20	12.2%
$125.00	13	7.9%
$150.00	14	8.5%
$175.00	7	4.3%
$200.00	14	8.5%
$550.00	14	8.5%
TOTAL	164	100.0%

respondents did not supply an estimate of the yield for their acreage eligible for filter strips (42/164 or 25 percent). Many respondents were unable to estimate what kind of a cash rent they could get for the cropland on their farm. Only observations which included responses to each question on the questionnaire were used for statistical analysis. To perform hypothesis tests to determine the statistical significance of the 22 variables listed above, 93 observations were used to estimate Tobit equations.

Operationalizing the hypothesis tests

The objective of hypothesis testing was to determine whether economic factors (PAYMENT, PREF, OC, FT, TC, FE, NC) make a statistically significant difference in farmers' decisions about participation in a filter strip program. Hypothesis tests were performed using a likelihood ratio (LR) test (Madalla, p. 43-44, 1977).

The purpose of the LR testing was to compare the relative significance of the combination of variables which comprise one equation with those combined to form another equation. To perform a LR tests comparing two equations, a ratio was calculated using the two log-likelihood values (the constrained maximum of their respective likelihood functions). One equation was unrestricted; it contained a full set of independent variables. The other equation was restricted, comprised of only a partial complement of the variables present in the unrestricted equation. For example, an unrestricted equation (U) might include three independent variables:

$$Y = a + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \epsilon$$

The restricted equation (R) has zero coefficients for at least one of

the variables included in the unrestricted equation.

$$Y = a + \beta_1 x_1 + 0x_2 + 0x_3 + \epsilon$$

To compare two equations using a LR test, a ratio (λ) of the log-likelihood values was calculated, expressed as the log-likelihood value for the restricted equation (L^R) over the log-likelihood value for the unrestricted equation (L^U).

$$\lambda = L^R / L^U$$

The ratio, λ, was used to calculate a test statistic, $-2\log_e\lambda$, which has a chi-square distribution with a designated number of degrees of freedom according to the number of independent variables in the unrestricted equation. For this example, there are three degrees of freedom. By comparing the test statistic with the corresponding critical value from a chi-square distribution, it was possible to test the hypothesis that the unrestricted equation, with a full complement of explanatory variables, better described the actual distribution of the data than the restricted equation, which had fewer variables. The LR test is unbiased and consistent (Madalla, 1977).

To perform hypothesis tests about the significance of different groups of variables in a Tobit equation, theory suggests that two different approaches to applying the LR test are equally appropriate. One approach is to begin with an unrestricted equation which includes all the six groups of variables hypothesized to be important in explaining decisions about setting aside filter strips. The structure of the test is to remove one set of variables to show whether taking away those variables diminishes the explanatory power of the equation in a statistically important way. The other equally valid approach

begins with a restricted equation which contains only the variable LPAYMENT. A group of explanatory variables (either PREF, OC, FT, TC, FE, or NC) is added to test whether the set of variables improves the statistical significance of the equation.

Theoretically, both forms of the LR test evaluate whether or not a set of variables adds a statistically important amount of explanatory power to an equation. However, the first form of the LR test, which involves removing one set of variables from an unrestricted equation including all six sets of potential explanatory variables, is a more difficult statistical test to pass than the second form of the LR test. The LR test which involves adding one group of variables to a restricted equation with LPAYMENT as the only explanatory variable requires fewer degrees of freedom than a test using an unrestricted equation with six groups of variables. The two forms of the LR test are discussed below as the "add-to" and the "take-away" LR tests.

Likelihood ratio tests: the take-away approach

The first set of hypothesis tests followed the take-away approach. A full equation was estimated which includes the yearly payment offer plus six groups of variables hypothesized to be important in explaining farmers' willingness to participate in a filter strip program.

PARTICIPATION = f(LPAYMENT, PREF, OC, FT, TC, FE, NC)

The full unrestricted equation was comprised of 22 variables. The log-likelihood value for the equation was -128.47. Seven variables in the estimated equation were statistically significant within either a 90- or 95-percent confidence interval. (Table 4.3).

Table 4.3: Estimated Tobit Coefficients: An unrestricted equation

	Variables	Coefficient	Standard Error
	LPAYMENT	128.116**	48.741
	INTERCEPT	-713.072	1167.900
Preferences:			
	SCETHIC	29.417	78.834
	ENVETHIC	129.696**	71.456
Opportunity Costs:			
	LYIELD	-289.270**	157.637
	LRENT	-37.843	67.845
	LINCOME	129.677**	77.003
	LFINCOME	-19.073	17.723
Farm type:			
	CORN	-4.330	67.364
	HAY	104.465*	74.947
	DAIRY	-7.068	88.563
	LIVESTCK	-35.830	67.997
	VEG	60.550	115.272
	ORCHARDS	-169.943*	114.911
Transaction Costs:			
	ASCS	66.165	83.714
	SCS	52.541	58.797
	TENURE	-27.594	76.248
	LPROPELG	2.521	35.719
Future Expectations:			
	TOOLONG	-96.768*	71.685
	PEXPECT	69.089	63.479
Non-categorized:			
	LAGE	117.483	116.337
	LEDUCATE	-131.750	163.278
	LTOT	23.722	45.773

**Double asterisk shows significance at a 95-percent confidence level.
* Single asterisk shows significance at a 90-percent confidence level.

Caution was appropriate in interpreting the significance of individual variables in the context of this large equation. Collinearity was likely. Comparing the significance of individual variables in the large equation with results from estimating more limited equations indicated that significance levels of single variables were highly sensitive to the combination of other variables which accompany them in the equation.

In a correlation matrix with these 22 variables, no important collinearity was identified between any two variables (Appendix D, Table 1). A correlation coefficient with an absolute value of .80 is considered high (Kennedy, p. 150, 1986). Only two correlation coefficients above .50 were observed. The correlation coefficient between the proportion of household income from farming and total acres farmed was .501. The correlation coefficient between total acres farmed and the proportion of cropland on the farm eligible for filter strips was -.659. To mitigate against collinearity problems, the variable representing total acres farmed was analyzed in a set of non-categorized variables.

To test the statistical importance of each of the six groups of variables in the full, unrestricted equation using the take-away approach, six restricted Tobit equations were estimated. Variables were removed one group at a time from the unrestricted equation to form six restricted equations. Six likelihood ratio tests were performed to test hypotheses about whether each of six groups of variables (OC, TC, FE, PREF, NC, and FT) contributed to the explanatory power of the full, unrestricted equation in a statistically important way.

For example, to test whether the group of OC variables played a statistically important role in the unrestricted equation, a restricted equation was estimated, with the OC variables removed (R^{OC}).

$$R^{OC} = f(LPAYMENT, TC, FE, PREF, NC, FT)$$

The LR test was performed by comparing the log-likelihood value for the restricted equation with the log-likelihood value for the unrestricted equation to test a null hypothesis.

> H_0: An unrestricted equation which includes a group of variables representing OC explains landowners' decisions about whether to set aside filter strips with the same degree of statistical significance as the equation without OC variables.

When a LR test using the take-away method was performed to test the result of removing the set of OC variables from the unrestricted equation, the statistical test failed to reject the null hypothesis. The same approach was applied to conduct five more LR tests to evaluate whether sets of PREF, TC, FE, NC, and FT variables made a statistically important contribution to the estimated equation.

Results from performing a series of six LR tests using the take-away approach to evaluate each of the groups of variables considered important in explaining participation indicated that any one of these sets of variables could be removed from the unrestricted equation without reducing its significance in a statistically important way (Appendix D, Table 1). However, when all six groups of variables were removed simultaneously from the unrestricted equation, leaving LPAYMENT as the only explanatory variable, then the null hypothesis was rejected. This finding was significant within a 95-percent confidence interval. The result of a take-away test where all six sets of

variables were removed at one time suggested that there may be some groups of variables in combination which would contribute to the explanatory power of the unrestricted equation. However, the strength of these groups of variables one at a time was not sufficient to identify which groups of variables are statistically important using LR tests following the take-away approach.

Likelihood ratio tests: the add-to approach

A series of hypothesis tests was performed following to the add-to approach to identify which groups of variables, independently, contribute a statistically important degree of explanatory power to a Tobit equation explaining decisions about setting aside filter strips. The format of the add-to LR tests involved comparing a restricted equation with only one explanatory variable, LPAYMENT, with six different unrestricted equations. Each of the unrestricted equations was comprised of LPAYMENT along with a one group of variables hypothesized to be important in explaining decisions about filter strips, either OC, TC, FE, PREF, NC, or FT.

For example, a LR test was performed to show whether the statistical significance of an equation was improved by adding a set of variables to an equation with only one explanatory variable, LPAYMENT. As a basis for comparison with this restricted equation with LPAYMENT as the only explanatory variable, an unrestricted equation was estimated with OC variables plus LPAYMENT (U^{OC}).

$$U^{OC} = f(\text{LPAYMENT, OC})$$

The LR test was performed by comparing the log-likelihood value for the restricted equation with the log-likelihood value for the unrestricted

equation to test a null hypothesis.

> H_0: An unrestricted equation which includes a group of variables representing OC describes landowners' decisions about whether to set aside filter strips with the same degree of statistical significance as a restricted equation with only the variable LPAYMENT.

The number of variables in the unrestricted equation being tested determined the degrees of freedom used in comparing the test statistic with the chi-square distribution. Six unrestricted equations were estimated to perform LR tests using the add-to method. The statistical tests reject the null hypothesis for three of the groups of variables tested and fail to reject the null hypothesis for the other three of the groups of variables (Appendix D, Table 3).

Results of a series of six add-to LR tests suggested that the three groups of variables representing PREF, OC, and FE contributed to the explanatory power of an estimated Tobit equation in a statistically important way. Among the landowners whose decisions were described by these data, the yearly payment offered, opportunity costs, expectations about the future, and preferences are important factors in decisions about whether to set aside filter strips for ten years. The other three sets of variables tested, TC, NC and FT, did not change the statistical significance of the estimated Tobit equations. For this sample, the group of variables representing transaction costs, an alternative set of variables representing opportunity costs by farm types, and a set of three non-categorized variables do not influence decision-making about filter strips in a statistically important way.

The conclusion from the results of this series of add-to LR tests was that the variable LPAYMENT along with the eight individual

variables which comprise the groups of variables OC, FE, and PREF were candidates to be included in a Tobit equation to describe landowners' decisions about setting aside filter strips. Because they were not statistically important as groups, the sets of variables TC, NC and FT were not candidates to be included in the equation describing responsiveness to yearly payments for setting aside filter strips. In principle, the nine explanatory variables in an estimated Tobit equation captured the most relevant economic factors in farmers' decisions about participating in a filter strip program.

Interpretation of the Participation Index

An estimated Tobit equation with LPAYMENT and three sets of explanatory variables representing preferences, opportunity costs and expectations about the future comprised an index to show farmers' willingness to accept a yearly payment to set aside filter strips for ten years. The dependent variable, participation, showed the proportion of eligible acreage enrolled in the filter strip program. Five of nine explanatory variables appear statistically significant (Table 4.4).

In estimating the proportion of eligible acreage landowners would set aside as filter strips, the most important explanatory variable was the yearly payment offered to respondents in the CV context. The level of the yearly payment offer was statistically significant and positively correlated with participation. In addition, three sets of economic factors were important in explaining the relationship between yearly payments offers and participation.

Table 4.4: Estimated Participation Index

	Variables	Coefficient	Standard Error
	LPAYMENT	123.785**	47.59
	INTERCEPT	-399.401	810.79
Opportunity Costs:			
	LYIELD	-188.318*	131.80
	LRENT	-47.917	55.73
	LINCOME	87.437*	62.46
	LFINCOME	-11.499	14.07
Future Expectations:			
	TOOLONG	-124.585**	71.82
	PEXPECT	60.580	59.97
Preferences:			
	SCETHIC	52.041	76.97
	ENVETHIC	102.152*	67.12

**Double asterisk shows significance at the 95-percent confidence level
* Single asterisk shows significance at the 90-percent confidence level

Important sets of explanatory variables

The first statistically important set of variables is economic characteristics of landowners and their farms used to represent the opportunity costs faced in setting aside filter strips. In the equation, both YIELD and INCOME were statistically significant at the a 90-percent confidence level. A negative coefficient on the yield variable indicated that farmers who with highly productive cropland were less likely to set aside filter strips than those with less productive acreage. The positive coefficient on the variable representing household income showed that well-to-do farmers were more likely to set aside filter strips than low income farmers.

Although they do not add to the explanatory power of the estimated Tobit equation in a statistically important way, both the FINCOME and the RENT variables had the expected signs. Farmers who earn larger proportions of their household income from farming were less likely to set aside filter strips than those with more significant off-farm incomes. Landowners who could earn high cash rents in the cropland rental market were less likely to enroll in a filter strip program than those whose acreage is worth less in the cash rental market. A Pearson correlation matrix (Appendix D, Table 4) indicated that there was no important level of correlation between the explanatory variables used as proxies for opportunity costs. No significant correlation was present between any of the nine explanatory variables in the final estimated Tobit equation; all of the correlation coefficients were below an absolute value of .50.

The second group, comprised of two variables representing

respondents' expectations about the future, played a statistically important role in explaining decisions about participation in the proposed conservation program. Anxiety about a ten year commitment (TOOLONG) was shown to be an obstacle to considering filter strips, an explanatory variable significant at the 95-percent confidence level. A positive coefficient on the variable representing landowners' price expectations (PEXPECT) indicated that those who believe that farm prices will rise slower than inflation over the next ten years were more likely to participate in a ten year program than those who think prices will rise more rapidly or at the same rate as inflation.

The third group of variables included in the equation explaining participation represented individuals' preferences, variables which indicate how respondents weigh benefits and order priorities. Values and attitudes underlie decisions between economic alternatives. Landowners who expressed concern about environmental quality (ENVETHIC) and about conserving soil on their farms (SCETHIC) were shown to be more likely to set aside filter strips than those who did not cite these as reasons for setting aside filter strips. Concern about environmental quality was positively correlated with participation and significant at the 90-percent confidence level.

Sets of variables which are not included in the participation index

Transaction costs, represented by a set of four explanatory variables, were not included in the participation index because they did not contribute to the statistical importance of an equation explaining decisions about setting aside filter strips. Farmers who have had recent experience dealing with SCS or ASCS were not

necessarily more likely to accept yearly payments to set aside filter strips than non-clients. Farmers with a large proportion of the cropland on their farm eligible for filter strips were not necessarily more likely to participate in the program. Farmers who rent over 50-percent of the cropland they farm were not necessarily more likely to set aside filter strips than those who own their cropland.

For Newaygo County landowners, this set of variables selected to represent transaction costs did not appear important in explaining decisions about setting aside filter strips. This result contradicts other empirical research results which have suggested that recent contact with SCS and ASCS was likely to be highly correlated with participation in the CRP (Esseks and Kraft, 1988). Among Newaygo County landowners, 24-percent of those who identified acreage eligible for filter strips have not had contact with SCS or ASCS in the past three years.

The finding that the four explanatory variables used to represent transaction costs were not statistically important in describing farmers' participation behavior was not sufficient evidence to prove that transaction costs were unimportant in their decision-making. Rather, this finding suggests that in further studies about conservation decision-making other explanatory variables should be specified and measured in order to discover which transaction costs are relevant to choices about participating in a filter strip program.

The set of farm type variables, an alternate group of explanatory variables used to represent opportunity costs, failed to contribute to the a statistically important degree of explanatory power to the

estimated Tobit equation. This finding indicated that differences between income-generating activities on farms were not sufficient to predict participation patterns for a filter strip program, even though farm type variables may be important indicators of opportunity costs.

The set of three non-categorized variables (age, education, and farm size) did not contribute to the participation index in a statistically significant way. Although these explanatory variables have been correlated with the decision to adopt conservation practices in the analysis of data from previous studies about the conservation behavior, they were not clearly designated in this utility-maximization framework as either OC, TC, FE, or PREF. In this estimated Tobit equation, they did not appear to be important in explaining farmers' responsiveness to yearly payments for participating in a filter strip program.

Responsiveness to changes in yearly payment offers

The estimated Tobit equation was used to show how farmers' willingness to participate in a ten-year filter strip program is influenced by changes in yearly payment offers.

Farmers' participation (the proportion of their eligible acreage they are willing to set aside as filter strips for ten years) was positively correlated with increases in yearly payments and was conditioned by economic factors. The Tobit estimation procedure integrated observations describing respondents' reactions to yearly payment offers along with data describing economic factors which condition their decision-making. The estimated Tobit equation summarized respondents' willingness to accept yearly payments and

accounted for differences in their preferences, their opportunity costs, and their expectations about the future (Figure 4.1).

A plot of the raw data shows the total proportion of their eligible acreage which groups of respondents who were offered each of twelve yearly payments would enroll in a filter strip program. As yearly payments offered to respondents were increased, in general they were willing to set aside higher proportions of their eligible acreage as filter strips. The function showing farmers' responsiveness to yearly payments based on the estimated Tobit equation shows what proportion of their eligible acreage a group comprised of <u>average</u> farmers would be likely to set aside as filter strips in response to incremental increases in yearly payments.

The estimated function depicting the participation-payment response represents a group of average farmers' predicted behavior To calculate this function, the normalized coefficient (β) for each explanatory variable in the estimated equation was multiplied by the mean value which summarizes all the responses in the data set for the eight explanatory variables representing preferences, opportunity costs, and expectations about the future. Only the explanatory variable showing changes in yearly payment offers was varied. The coefficient for the yearly payment offer was multiplied by a vector of values representing payments ranging from \$10 per acre per year up to \$200 per acre per year at \$10 increments.

$$E(Y) = \beta_1 x_1 + \beta_2 \bar{x}_2 + \beta_3 \bar{x}_3 + \beta_4 \bar{x}_4 + \beta_5 \bar{x}_5 + \beta_6 \bar{x}_6 + \beta_7 \bar{x}_7 + \beta_8 \bar{x}_8 + \beta_9 \bar{x}_9 + \epsilon$$

The variable x_1 was replaced by a vector representing a range of yearly

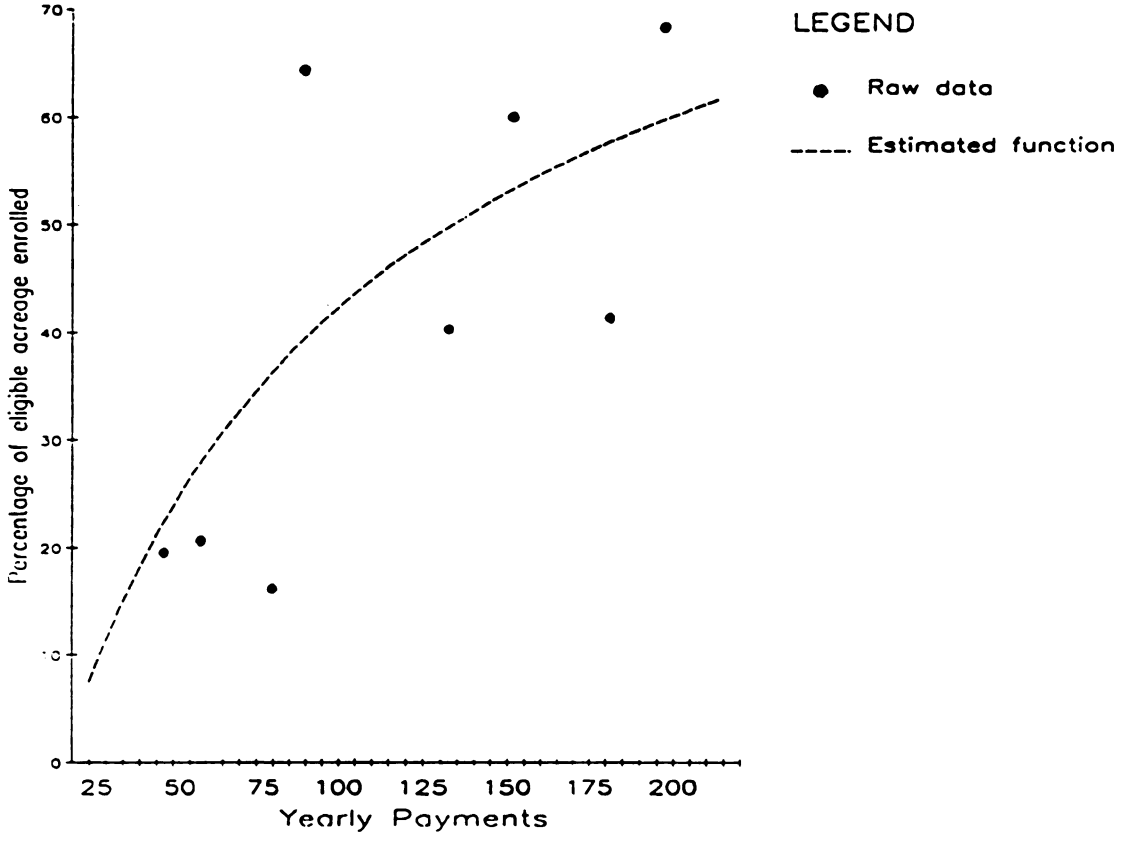

Figure 4.1: Plot of raw data: Responsiveness to yearly payments

payment offers. The other eight explanatory variables were held constant at their means.

Before the normalized coefficients were used to develop the payment-participation function, the coefficients were adjusted to account for censoring in the error term. This Tobit equation described participation using a limited dependent variable: the expected values concerning participation, specified as the proportion of eligible acreage enrolled as filter strips, were observed over the continuous range from zero up to 100. Farmers could set aside all (100-percent), none (0-percent) or some proportion of their eligible acreage as filter strips. Possible observations of the dependent variable fall within this limited range. Therefore, the estimation process took place within a censored range, rather than drawing possible observations from a normal distribution ranging from negative to positive infinity.

The stochastic model underlying the estimated Tobit equation expressed the limited dependent variable as a function of X, a vector of regressor variables; β, a vector of Tobit coefficients; and $\in$, a vector of independent and identically distributed error terms assumed to have a zero mean and a constant variance. The product $X\beta$ is labeled "I" which stands for index function. The index function is a product of a vector of regressor variables and Tobit coefficients before they are adjusted to account for censoring. For the two-limit Tobit model with a dependent variable ranging between a lower limit of zero and an upper limit of 100:

$$I = X\beta \text{ if } X\beta + \in > 0 \text{ and } X\beta + \in < 100$$

$$I = 0 \text{ if } X\beta + \in \leq 0 \text{ or } I = 100 \text{ if } X\beta + \in \geq 100$$

The estimated Tobit model (the index) was adjusted for censoring. McDonald and Moffitt (1980) developed statistical procedures to adjust for censoring in the error term in order to correctly interpret estimated Tobit coefficients for the standard single-limit model.[4] Adjustment for censoring is necessary because of the limited nature of the dependent variable. For the standard Tobit model, observations for the dependent variable are assumed normally distributed in the range above (or below) a designated limit value, but no observations exist below (or above) the designated limit. To describe the range within which observations for the dependent variable occur, the vector $X\beta$ is multiplied by F(z), the cumulative standard normal density function. To further account for censoring, since the error term is assumed normally distributed, σ, the standard deviation for the vector $X\beta$, is multiplied by f(z), the standard normal density function.

$$E(Y) = X\beta\, F(Z) + \sigma\, f(z) \qquad (1)$$

To account for censoring in the two-limit Tobit model, the principle is the same as for the standard Tobit model. The vector $X\beta$ (or I) was multiplied by F(z) and the error term was multiplied by f(z). Actual observations fall at or between the designated limits; it's conceptually possible that the underlying variable (I) could fall above or below the limits. The adjustment for censoring accounts for the fact that actual observations for the dependent variable may occur only at or between the upper or lower limits.

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[4]Norris and Batie (1987) present a helpful discussion of their application of these methods in interpreting a standard Tobit model.

$$E(Y) = L\,[F(L - Y/\sigma)] + U\,[1 - F(U - Y/\sigma)] + Y\,[F(U - Y/\sigma) - F(L - Y/\sigma)] + \sigma\,[f(L - Y/\sigma) - f(U - Y/\sigma)] \quad (2)$$

The first two terms in Equation 2 account for the probability that observations may occur at the upper and lower limits of the dependent variable. The first term multiplies the value at the lower limit by the probability of falling at the lower limit. The second term multiplies the value at the upper limit, in this case 100, by the probability of falling at that limit. The standard deviation in the denominator of these probability terms is a weighting term to adjust for the actual distribution of the empirical data being used to estimate the model.

The last two terms in Equation 2 account for censoring which affects the index. The third term accounts for the systematic portion of the estimated Tobit equation, $X\beta$ (or I), which is expressed in terms of F(z). To adjust $X\beta$, it's multiplied by the probability of observations occurring within the designated bounds, weighted by the standard deviation of the empirical data. The fourth term accounts for the random portion of the estimated equation, the error term (ϵ). The standard deviation is multiplied by f(z), the probability of observations occurring within the upper and lower limits, weighted by the standard deviation of the empirical data.

The size of the standard deviation determines the magnitude of the effect of adjusting the index function, $X\beta + \epsilon$, to account for censoring. Each term in the equation (2) used to derive the adjusted function, E(Y), has σ in its denominator. In data sets where the

variance of the index is small, the effect of adjusting for censoring will be relatively minor because there is a high probability that observations are concentrated between the upper and lower bounds. Where the variance associated with the index is relatively large, adjustment for censoring will result in a more significant difference between values associated with the index and the adjusted functions.

Interpreting the payment-participation response function

The estimated Tobit equation E(Y), adjusted for censoring and solved at 20 different yearly payment offers, shows projected changes in the proportion of eligible acreage that an average group of landowners would enroll in a filter strip program according to increases in financial incentives for participation.

The group of 93 Newaygo County farmers surveyed would be willing to set aside 26-percent of their eligible acreage in filter strips for a yearly payment of $40 per acre. If the yearly payment were doubled to $80 per acre, then these respondents would enroll 41-percent of their eligible acreage into the proposed program. As the level of yearly payments is increased, the payment-participation function becomes more inelastic (Figure 4.2).[5]

In Newaygo County in 1988 the maximum acceptable rental rate for yearly CRP payments was $40 per acre. Filter strips were eligible for the CRP during two sign-up periods before the mail questionnaire was distributed, but during 1988 no CRP contracts for filter strips were set up in the county.

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[5]Elasticities calculated at $10 increments between $10 and $200 are reported in Appendix D, Table 5.

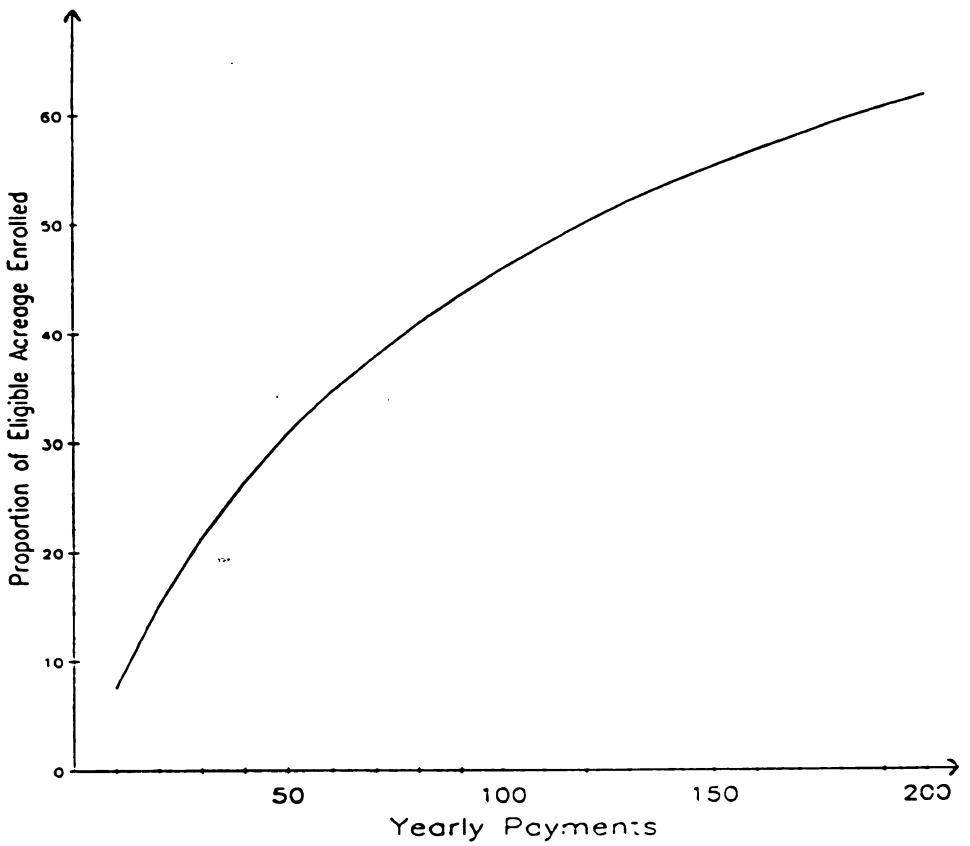

Figure 4.2: Landowners' responsiveness to yearly payment offers

The difference between actual CRP participation and respondents' willingness to set aside filter strips expressed in the mail questionnaire was due to a lack of information about filter strips reaching farmers. Respondents' written comments and feedback during the personal interviews indicated that many farmers learned about filter strips for the first time through the mail survey. The survey results suggest that the concise yet descriptive scenario provided in the mail questionnaire was a helpful framework to guide farmers in thinking through a decision about participating in a filter strip program. Efforts to improve the effectiveness of campaigns to promote new conservation programs would be likely to pay off in significant increases in participation.

Comparison between the estimated and index functions

To further evaluate farmers' responsiveness to yearly payments, an interesting insight was gleaned from a comparison between the estimated function E(Y), which is adjusted for censoring, and the index function. A plot of two payment-participation response functions using both the adjusted equation and the index showed a difference in their orientations (shapes and positions). The discrepancy was a function of the size of the estimated variance inherent in the empirical data used to describe farmers' willingness to enroll in a filter strip program. As depicted in Figure 4.3, the index is more elastic than the adjusted function.[6] If the estimated variance were reduced by 50-percent, then the index function and the adjusted function would move together. If it were possible to reduce the estimated variance to zero, then the

[6]Elasticities are given in Appendix D, Table 6.

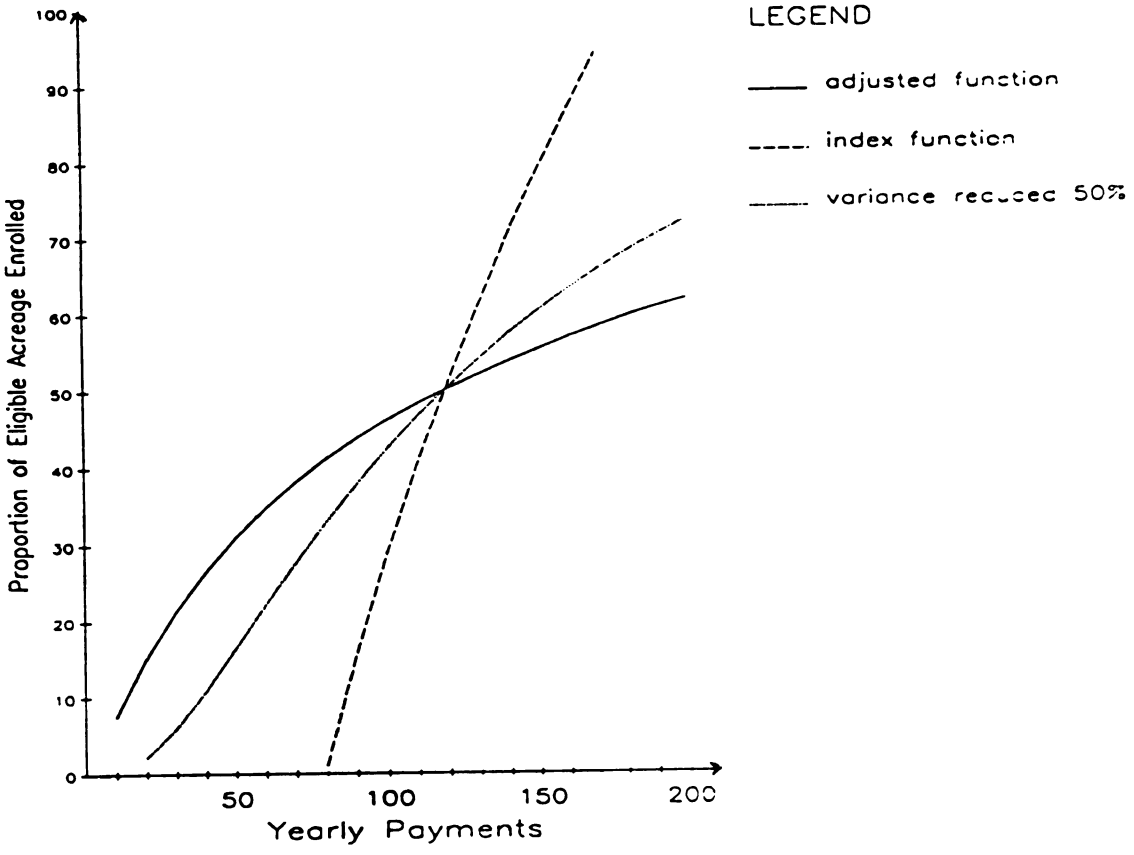

Figure 4.3: **Comparison between the** estimated and index functions

payment-participation response function would lie somewhere between the current index and adjusted functions.

The magnitude of the discrepancy between the estimated and index functions showed the effect of the estimated variance in farmers' participation-payment responses. This discrepancy was an indication of the level of uncertainty inherent in the estimated equation. There were two important and distinct sources of this uncertainty.

The first source of uncertainty was farmers' general ignorance about filter strips and their willingness to participate in a ten-year filter strip program. According to written comments and feedback during personal interviews, many of the farmers surveyed learned about filter strips for the first time from the mail questionnaire. The vast majority of farmers had never seen a filter strip installed on a neighbor's farm. Farmers were unsure about how a ten-year commitment to filter strips would fit into the management plan for their farms. Given more time and experience and, most importantly, improved information to help weigh the economic trade-offs associated with using filter strips, variability would be expected to decline among a group of farmers' responses to offers to participate in a filter strip program.

The second component of estimated variance reflected real differences in the economic characteristics of farmers which influenced their decision-making behavior. This source of uncertainty in the estimation process would tend to decline as researchers' understanding improves regarding the characteristics of farmers that make a difference in participation decisions. For example, if it were

possible to specify a set of explanatory variables to capture the transaction costs farmers consider in their participation decisions, then the estimated variance inherent in this estimated Tobit equation would be reduced.

Both sources of estimated variance are always present to some extent in empirical data. They can be reduced but not eliminated. The two sources of uncertainty cannot be separated.

For this estimated Tobit equation, the graphical representation of the index and the adjusted functions provided an indication of the level of uncertainty reflected in Newaygo County farmers' decisions about participation in a filter strip program. This estimated Tobit equation offers a baseline for evaluating variability in farmers' payment- participation responses: it would be useful to compare the discrepancy between the index and the adjusted function for these data with analysis of other empirical observations about participation decisions.

Other CV experiments could be conducted to provide farmers with different types of information about a new conservation program, like the filter strip program. Farmers' uncertainty about participation would be expected to decline to the extent that their use of decision support tools improves their ability to evaluate the trade-offs associated with participation. Comparative analyses of CV data offers a framework for evaluating the relative effectiveness of decision support tools. Effective decision support tools would reduce uncertainty and, therefore, reduce the variability in data describing a group of farmers' participation decisions. Comparisons of the

discrepancies between index and adjusted functions for different sets of empirical data would provide a basis for evaluating farmers' relative levels of uncertainty when offered with alternative types of decision support tools to help guide their decision-making.

To provide effective decision support tools to help reduce the uncertainty farmers face in their choices about participating in conservation programs, an important starting place is to identify the factors that make a difference in their decision-making processes. For the Newaygo County survey data, the estimated Tobit equation showed that opportunity costs, expectations about the future, and preferences make a difference in farmers' participation behavior. Sensitivity analysis was conducted to identify the relative importance of various economic factors in conservation decision-making. Further interpretation of the estimated equation showed how differences between farmers' preferences affect their willingness to accept yearly payments to set aside filter strips.

The role of concern about the environment

For example, to show the effect of differences among farmers regarding concern about the environment, the estimated Tobit equation was solved three different ways (Figure 4.4). One function showed the payment-participation response for a group comprised of average farmers. To calculate this function, the normalized coefficient (β) for each explanatory variable was multiplied by the mean value for each vector of regressor variables, incorporating adjustments for censoring. The yearly payment level was evaluated at $10 increments (see Figure 4.2). For a yearly payment of $40, an average group of Newaygo County

farmers would enroll an estimated 26-percent of their eligible acreage in a filter strip program.

To show the effect on participation resulting from differences in respondents' preferences about environmental quality, the estimated Tobit equation was calculated under two other assumptions. One payment-participation response function showed estimated willingness to set aside filter strips among a group of farmers who are <u>not</u> concerned about the environment. Another showed estimated participation among a group of average farmers who were <u>all</u> concerned about the environment. These were plotted on a graph with the baseline payment-participation function which uses the mean value for ENVETHIC (Figure 4.4).

To calculate these functions, the estimated Tobit equation was modified to account for these differences.

$$E(Y) = \beta_1 x_1 + \beta_2 x_2 + \beta_3 \bar{x}_3 + \beta_4 \bar{x}_4 + \beta_5 \bar{x}_5 + \beta_6 \bar{x}_6 + \beta_7 \bar{x}_7 + \beta_8 \bar{x}_8 + \beta_9 \bar{x}_9 + \epsilon$$

The term $\beta_1 x_1$ represented the yearly payment offers for participating in a filter strip program. A vector representing yearly payment offers was used for the x_1 variable. The term $\beta_2 x_2$ was a dummy variable representing whether farmers' concern about the environment entered their decisions about setting aside filter strips. To estimate the payment-participation response for the case where a group of average farmers were not concerned about the environment, a zero was used for x_2. To show the opposite case, where a group of average farmers were all concerned about the environment, a one was used for x_2.

A group of farmers who do not consider concern about the environment an important reason for setting aside filter strips would

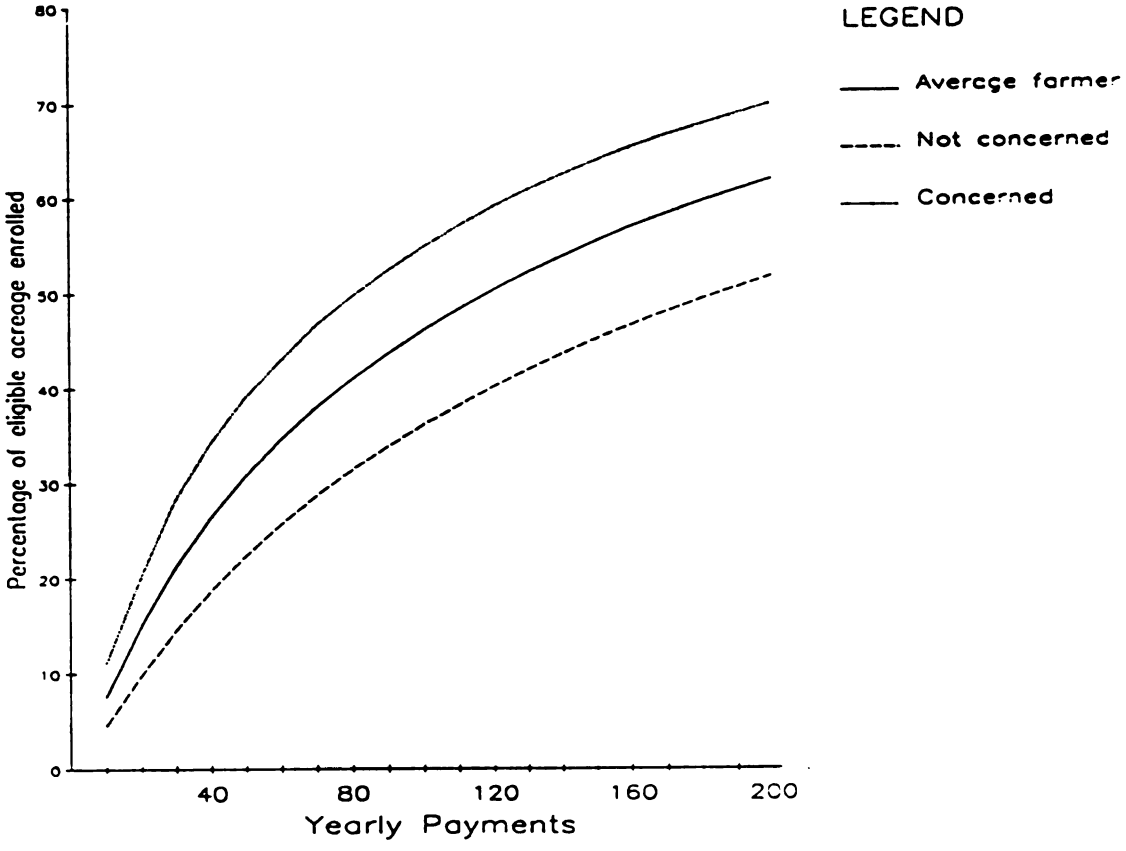

Figure 4.4: Differences in farmers' concern about the environment

enroll only 19-percent of their eligible acreage in a filter strip program for a yearly payment of $40 per acre. In contrast, among farmers who express concern about the environment as an important reason to set aside filter strips, expected participation in a filter strip program for a $40 yearly payment would be an estimated 34-percent of the eligible acreage.

Farmers who are concerned about the environment were willing to participate in a filter strip program for a yearly payment $35 lower than would be acceptable to those who do not consider concern about the environment in their participation decisions. To enroll 26-percent of their eligible acreage, a group of average farmers who are concerned about the environment would expect a $27 yearly payment to participate in a filter strip program. In contrast, farmers who are not concerned about the environment would expect a $62 yearly payment.

These results suggest that concern about the environment made an important difference in farmers' decision-making about filter strips. This information may be useful to make decisions about the appropriate targets for campaigns to recruit participation in a filter strip program. If promotion efforts focus on farmers who already consider environmental quality important when they make decisions about participating in conservation programs, then enrollment is likely to be higher than from recruitment efforts among farmers who are less concerned about the environment.

On the other hand, if decision support tools were developed to influence farmers' preferences about the environment and if these tools were successful in changing farmers' preferences and behavior, then the

potential impact of information campaigns targeting farmers who are less concerned about the environment could be significant as well. A decision support tool might provide a meaningful framework for farmers to weigh choices about participation and, at the same time, introduce concern about the environment as a decision criterion for those who had not considered environmental quality in previous decisions. The results from the estimated equation suggest that if all farmers were to consider concern for the environment an important criterion for their participation decisions, then enrollment in a filter strip program could be increased from 19-percent of eligible acreage up to 34-percent participation at the $40 yearly payment level.

The Payment-Participation Response with Haying Allowed

In the mail questionnaire, respondents indicated how many of their acres eligible for filter strips they would set aside if haying were allowed on acreage enrolled in a filter strip program. The rules for the filter strip program outlined in the mail questionnaire indicated that haying on filter strip acreage is not allowed except in cases of severe drought. Overall, 93 respondents were willing to accept the yearly payment they were offered in their mail questionnaire to enroll 74-percent of their eligible acreage as filter strips if the rules were changed to allow haying, compared with 49-percent enrollment under the current rules.

To analyze how farmers' willingness to accept yearly payments to set aside filter strips would change if rules prohibiting haying were relaxed, a revised Tobit equation was estimated. Respondents' participation was considered likely to be conditioned by yearly payment

offers, preferences, opportunity costs, and expectations about the future. Nine explanatory variables were included in the estimated equation. A dummy variable, RULES, was used to indicate whether the participation decision was based on having the option to cut hay on filter strips (RULES = 1) or on farmers' enrollment with haying prohibited (RULES = 0).

The results of the estimated equation (Table 4.5) were based on 186 observations (93 respondents, with each expressing their willingness to participate in a filter strip both with and without haying allowed). The dummy variable, RULES, had a high level of statistical importance. The level of significance of the LPAYMENT variable was higher than in the simple estimated Tobit equation for participation with haying prohibited. This was partly due to the effect of doubling the number of observations being analyzed. The signs on the coefficients on the explanatory variables representing preferences, opportunity costs, and expectations about the future were the same as in the simple equation predicting participation with haying prohibited, although the levels of significance varied somewhat between the two equations. The explanatory variables representing household income and the length of the contract were both significant in the equation without RULES, but failed to show a statistically important level of significance in the equation where the option of haying is considered. The variable representing concern about conserving soil (SCETHIC), was not statistically significant in the estimated Tobit equation without RULES but was significant in the larger equation.

The estimated Tobit equation was adjusted for censoring and used

Table 4.5: Estimated Participation with Haying Allowed

	Variables	Coefficients	Standard Error
	LPAYMENT	79.0931**	28.911
	ONE	27.7310	574.327
	RULES	181.799**	49.016
Opportunity Costs:			
	LYIELD	-168.334*	95.027
	LRENT	-50.541	38.121
	LINCOME	46.409	41.693
	LFINCOME	.110	9.567
Future Expectations:			
	TOOLONG	-44.785	45.273
	PEXPECT	42.349	41.582
Preferences:			
	SCETHIC	76.758*	52.906
	ENVETHIC	93.756**	46.805

**Double asterisk shows significance at the 95-percent confidence level
* Single asterisk shows significance at the 90-percent confidence level

to estimate a payment-participation response function to describe farmers' willingness to enroll in a filter strip program with haying allowed (Figure 4.5). For a $10 yearly payment, an average group of farmers would be willing to set aside 47-percent of their eligible acreage as filter strips with haying allowed. To achieve a similar level of participation under a filter strip program where haying is prohibited, a $100 yearly payment would be required.

Maintaining the option to cut hay on filter strips may have been a more important consideration for the sample population surveyed during the summer of 1988 than in normal years due to a severe drought. For Michigan, the drought was the most severe the state had experienced in more than sixty years.[7] Hay was scarce because between April and July, 1988 in Newaygo County rainfall failed to keep pace with evapotranspiration.[8] Farmers were fortunate if they had one cutting of hay.

In normal years as in 1988, farmers' participation decisions would be likely to be influenced by the real or perceived potential revenues from haying (the opportunity cost of foregone hay production). In Newaygo County during the summer of 1988, hay was scarce and accordingly prices were high. When the mail survey was conducted in August, hay was selling for $80 to $160 per ton, approximately double the market price in a normal year.[9] Market conditions may have

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[7]J.D. Carlson, extension agricultural meteorologist, in "Coping With Drought in Michigan: Summer, 1988," Michigan State University, Cooperative Extension Service.

[8]"Alert: Crop Advisory Report," Michigan State University, Cooperative Extension Service, July 13, 1988.

[9]Personal communication, Norm Myers, agricultural agent, Cooperative Extension Service, Newaygo County, Michigan.

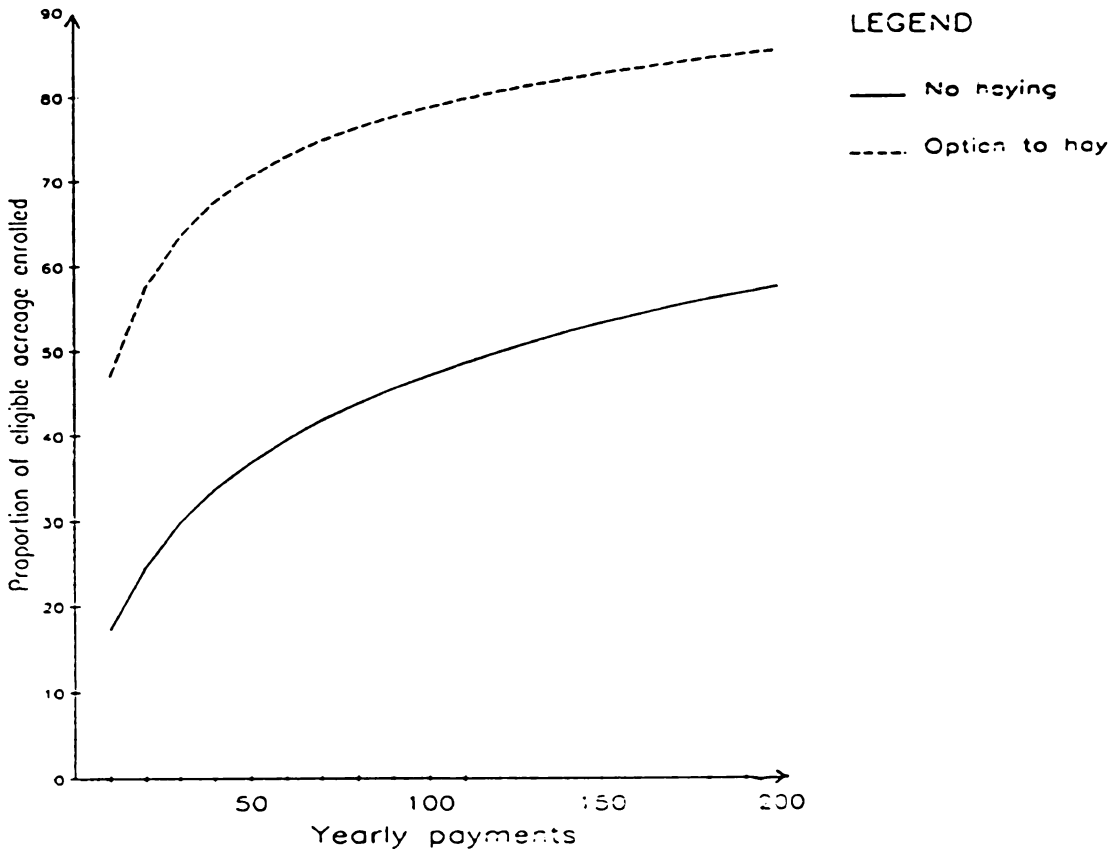

Figure 4.5: Payment-participation response function with haying allowed

influenced farmers' attitudes about the opportunity costs associated with losing the option to cut hay if they were to participate in a filter program. However, when asked directly about the drought, 75-percent of the mail survey respondents indicated that the unusual weather conditions had no effect on their decision about setting aside filter strips.

Even in a normal year, Newaygo County farmers would be likely to place a premium on the option to cut hay on filter strips if they were making a decision about participating in a land retirement program. In Newaygo County and the neighboring counties, demand for hay generally exceeds the supply.[10] Under normal rainfall and market conditions, the price of hay is $50 to $80 per ton during the growing season. For an intensive system (three cuttings per season), approximately three tons per acre is average production. Farmers might expect to earn $150 to $240 per acre per year in gross revenues from hay.

The average cost of establishing clear-seeded alfalfa is $166.50 per acre in the year the crop is planted (Nott, et. al., p. 9, 1988).[11] Once established, a good stand of hay and alfalfa normally lasts four to five years before re-seeding is necessary. If the fixed

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[10]Norm Myers, agricultural agent, Newaygo County.

[11]Seed costs vary depending on the quantity and quality of the seed used. Farmers planning to harvest a hay crop would be likely to use a good hay/alfalfa mix. As a permanent vegetative cover crop, a mixture of clover, timothy grass, and orchard grass would be less costly.

The soil fertility conditions determine whether liming is necessary. The average cost of a lime treatment is $60 per acre.

In personal interviews, Newagyo County farmers estimated the cost of establishing an acre of hay at between $20 and $400 per acre.

establishment costs are allocated over five years, then annual costs amount to approximately $33 per year. Subtracting these establishment costs, a farmer's expected revenues from a hay crop amount to approximately $117 to $207 per acre before accounting for the variable costs associated with harvesting and transport.

The estimated average variable costs of harvesting hay are $120 per acre (Nott, et. al., p. 11, 1988).[12] Based on average hay production of three tons per acre, in a normal year farmers earning less than $50 per ton selling hay will not break even. Depending on variable costs, net profits from hay sold at $80 per ton would be approximately $87 per acre per year.

For farmers with storage capacity who are willing to transport bales of hay to market, prices for hay often double during the winter months. Transport costs vary according to the distance to market and the quantities transported. If a farmer were to store hay and transport it to market during the winter, then net profits would range from $147 to $327 per acre per year less transportation and storage costs.

In August, 1988, due to the severe drought, farmers could reasonably expect to earn net profits of $87 to $347 per acre from hay production,[13] selling at the summer market price of $80 to $160 per ton. These potential profits explain Newaygo County farmers'

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[12]This estimate is based on a $5.00 hourly wage for family and hired labor.

[13]This figure assumes normal yields and no transport or storage costs. Only farmers with irrigation had normal yields in the summer of 1988.

willingness to accept lower yearly payments and to enroll higher proportions of their eligible acreage with haying allowed on filter strips.

In a normal year, potential profits from hay production range from breaking even up to $347 per acre. For an average situation, selling hay during the summer at $65 per ton would yield net profits of approximately $42 per acre from hay production.[14] To set aside filter strips, an average Newagyo County farmer would be willing to accept a yearly payment approximately $42 lower if haying were allowed than with haying prohibited.

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[14]This estimate assumes a yield of three tons per acre ($195 gross revenues), estimated establishment costs of $33 per acre per year, estimated variable costs of $120 per acre, and no storage or transport costs.

A QUALITATIVE CONTEXT FOR INTERPRETING THE SURVEY RESULTS

In written comments on the mail questionnaire and in discussions during personal interviews, Newaygo County farmers offered opinions about filter strips and participation in a filter strip program which add a useful dimension to the statistical results discussed in Chapter IV. This qualitative information reinforces the finding that yearly payment offers, preferences, opportunity costs, transaction costs, and expectations about the future make a difference in farmers' participation decisions. Farmers' responses to the mail questionnaire indicate that they would be likely to set aside a larger proportion of their eligible acreage as filter strips if the rules were changed to allow haying on enrolled acreage.

During the series of personal interviews, 30 respondents to the mail questionnaire and twelve landowners who are currently participating in the CRP discussed their decision-making about whether to accept a yearly payment offer to set aside filter strips for ten years. Some major findings from these personal interviews are presented.

Mail survey data was verified during personal interviews and some misunderstandings as well as possible weaknesses in the mail questionnaire were identified. Some farmers may have failed to identify acreage on their farms which would be eligible for filter

strips; others may have miscalculated how much acreage on their farm would qualify for the filter strip program. Respondents to the mail questionnaire may have misunderstood questions about farm size and income levels. Suggestions for clarifying the design of selected questions and improving the mail survey instrument are outlined.

In the final section demographic information is presented describing the 167 Newaygo County landowners who identified acreage eligible for filter strips.

Opinions expressed by mail survey respondents

Almost half of the mail survey respondents (79 individuals or 47-percent of those who identified acreage eligible for filter strips) wrote comments on the questionnaire, expressing their opinions and concerns about the filter strip program. During August, 1988 sixty-four respondents (over ten percent of the population of Newaygo County farmers sampled) placed telephone calls asking for more information about the mail survey or about their eligibility for the filter strip program. In these telephone conversations, many respondents expressed their opinions about the filter strip program.

The opinions expressed in written comments reinforce the statistical finding that the yearly payment offered makes an important difference in farmers' willingness to set aside filter strips for ten years. The level of the yearly payment offer was mentioned explicitly by ten respondents in written comments. One respondent said that participation would be contingent on the financial incentive offered.

> Good idea--it would help stop erosion. Farmers would need a substantial payment because it would be a lot of bother. The size of the payment would be the determining factor.

Respondents' comments offer evidence that opportunity costs, transaction costs, expectations about the future, and preferences condition their responsiveness to yearly payments.

For some respondents, opportunity costs were the primary consideration in participation decisions. One livestock operator was concerned about not having enough pasture land and about wildlife damages to his crops, and expresses ambivalence about a decision to enroll filter strips in the CRP. Ultimately, in response to a $125 yearly payment offer, filter strips merit consideration because

> These filter strips will help environmentally and financially ...(even though) apparently they cannot be pastured. Economically though, I must consider them.

The trade-off between retiring filter strips and renting out cropland was the major decision criterion for another respondent.

> If I were to put in filter strips I would have to stop renting out most of my land so it would have to bring in more money than renting the 55 acres.

Transaction costs entered into one respondent's decision about whether a yearly payment would be sufficient to compensate for foregone rental revenues from a tenant.

> The people renting my farmland haven't got time to mess around maintaining ONE acre of filter strip land. If you're willing to pay me $90.00 a year for ten years just to leave that acre alone, fine! That amount is more, by far, than the amount I'm getting for that acre now.

For another respondent, the issue of transaction costs on a societal level was a consideration.

> The people involved in the administration of this type of program would be the only ones who came out ahead. Our farm benefits in cash payments would be very small, we all know this. But the bureaucratic load on our social order would add to our already heavy load of taxes. I feel that farmers should be encouraged to do this, but let them use it as a tax deduction or write-off.

For certain respondents, expectations about the future played an important role in a decision about setting aside filter strips. One respondent was unwilling to accept a $175 yearly payment to enter a contract to enroll in a filter strip program because of the ten year obligation. "Five years would be long enough for such a program." According to another respondent,

> We need every acre to stay in production or corn supply will be short. $65.00 an acre for farm land is cheap, ten years from now.

Farmers' preferences clearly conditioned their responsiveness to yearly payments for setting aside filter strips. Some respondents discuss their land stewardship values and concern about the environment and view filter strips as a worthwhile conservation strategy.

> We don't want our good soil going down the river and we work to see that doesn't happen. This green belt thing may be necessary some places but it doesn't fit into our operation.
>
> I think it's a good idea--keep those rivers clean.
>
> We are looking into ways to make our farm more attractive to wildlife of all kinds with the idea of possibly charging a fee for people to hunt on our property. This (filter strip program) would fit right in with our plans. I hope it can be done.
>
> Farmers have to become involved in anti-pollution programs and not hold the notion that this is someone else's problem.

Some respondents' preferences about land stewardship and environmental quality were influenced by the issue of property rights.

> We feel very good about the way we are farming. Late years it has become increasingly ridiculous to continue the way we are, because others are nearly doubling their incomes by farming their mailbox. I continue to hope that these opportunities will diminish or cease so that the market will again directly pay our costs and profits. We really can produce at low cost and preserve the environment as well. We don't need tax supported subsidies that dictate how we should farm.

> We have used filter strips along our creek for 25 years. The area left into grass can be cut as hay. No pasture. It's a good idea--each farmer should do it on his own. It's your farm and you should keep it up on your own.

Another respondent explained that it would be best if farmers could take land out of production for conservation purposes without a government-sponsored program. He rejected a $200 yearly payment to set aside filter strips. However, he recognized that there is a role for government intervention to offer farmers financial incentives for participation in conservation programs.

> Our ground is highly erodible. The reason we would not participate is that we already work to conserve the soil on our farm. We're doing pretty well, too. ...I think some of these ideas should be environmental law. However, until the economics of farm prices allow this kind of luxury, the USDA would likely need to support it with dollars.

For several respondents, a strong dislike for government involvement in the agricultural economy completely overshadowed their willingness to consider the merits of a filter strip program.

> 1) Get government out of agriculture. 2) Let supply and demand control prices. 3) Eliminate government bureaucracy. 4) Let farmers manage the conservation of the natural resources which is their livelihood and main concern. 5) Farmers are more knowledgeable about feeding the people than politicians or bureaucrats. 6) (Filter strips) are not in the best interest of the economy, or the health, safety and welfare of the people of our USA.

> I am afraid I am the wrong person to fill out this questionnaire. I see so many set aside acres on good land that farmers are getting good money for not planting. And when you get paid for not doing something that's not right. You drive through the country and see farms that used to support a family. Now they are in some government program, or part of it is. (And who is the government?) I'm retired now, but when I farmed I pastured land like you are talking about. We rent out our ground and get $25.00 or $30.00 an acre for good ground. I think that filter strip program will go over big. A lot of people are looking for a handout. I think supply and demand is the way.

Other landowners were critical of filter strips, but offer alternative conservation strategies. Only one respondent commented about the width of filter strips: "I would rather put in one field than filter strips that narrow." Two respondents mentioned that proper mowing is necessary to maintain the effectiveness of filter strips.

> The idea of filter strips sounds like a way for the drain commission to get out of mowing the ditches. Instead of filter strips, maybe they ought to pay the owners of the land to keep it mowed for so much an acre.
>
> Ditches in this area are generally filled with vegetation already. How would the ASC office enforce the mowing rules? Better than the PIK program?

Two respondents suggested financial support for tiled drainage systems rather than filter strips.

> Filter strips are not practical. Tiling is a more practical way of draining to make better water quality and soil conservation. Open ditches all need maintenance periodically as they fill in. Every hill gets lower and every hole gets shallower as time goes by. If money is available, pay farmers to tile. Filter strips are not the answer to soil conservation as every circumstance is different with soil type and topography.
>
> My biggest runoff of topsoil is broken field tile in fields which I cannot repair anymore because I need a permit to repair them. Fix tiles before filter strips.

Modifications in filter strip program rules to allow haying

Under the rules for the filter strip program outlined in the mail questionnaire, haying is not allowed on acreage enrolled as filter strips. If the rules for participation were changed to allow haying, then the respondents surveyed indicated that they would enroll 74-percent of their eligible acreage as filter strips for the yearly

payments they were offered.[1] In addition, five respondents indicated that maintaining the option to cut hay on acreage set aside as filter strips is an important decision consideration. One respondent with a dairy operation indicated that "the ability to cut hay off the filter strip would be a major concern" in his choice about whether to accept a $125 yearly payment for filter strips. All the respondents who wrote comments about haying are livestock or dairy operators.

According to feedback during the personal interviews, for some farmers, especially annual vegetable growers, the option to cut hay more than once per season would be important from a management standpoint. Weeds spreading from filter strips into adjacent fields planted in carrots and onions would be a big problem. Other farmers simply disliked the idea of a strip of tall grass bordering their tidy fields for aesthetic reasons.

In personal interviews, ten farmers[2] discussed their motive for wanting to maintain the right to cut hay on filter strips in economic terms. They would like to be able to use or sell hay from filter strip acreage. It was difficult for those interviewed to be explicit about how much less they would be willing to accept as a yearly payment for participating in a filter strip program if haying were allowed on a enrolled acreage.

During the summer of 1988, severe drought conditions may have

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[1]Mail survey respondents indicated that they would set aside 49-percent of their eligible acreage as filter strips in a program where the rules for participation forbid haying on the enrolled acreage.

[2]Approximately 25-percent of those farmers interviewed during August, 1988.

influenced farmers' attitudes about the value of hay on the market. However, the mail survey data shows that the majority of respondents did not view the drought as an important consideration in their participation decision. Three-quarters of the respondents indicated that the drought had no impact on their decision about setting aside filter strips. Thirteen-percent of respondents were more likely to set aside filter strips because of the drought and 12-percent were less likely to participate in a filter strip program.

Farmers' Decision-making about Participation

In a series of personal interviews conducted during August, 1988 42 Newaygo County landowners expressed their opinions about the filter strip program, their attitudes about the rule prohibiting haying on filter strip acreage, and discussed their participation decision criteria. Personal interviews were conducted with 30 randomly selected respondents to the mail survey who had received questionnaires asking them to consider either a $65 or $80 yearly payment to set aside filter strips for ten years and with twelve landowners who enrolled highly erodible acreage in the CRP in 1986 or 1987.

The personal interview sessions started with a discussion about the respondents' willingness to accept the yearly payment they were offered in the mail questionnaire. Sixty-percent of those interviewed had responded positively to the yearly payment offered to them in the mail questionnaire, agreeing to set aside some proportion of their eligible acreage as filter strips. A simple bidding game was introduced. Those interviewed were asked whether they would be willing to participate for a higher yearly payment (if they had rejected the

original offer) or whether they would consider a lower yearly payment (if they had agreed to consider enrolling some proportion of their eligible acreage already).

To encourage landowners to consider lower yearly payments than the amounts they had been offered in the mail questionnaire, they were told that the maximum acceptable bid paid to those who participate in the current CRP in Newaygo County is $40. For the majority of respondents, $40 was not a sufficient payment to enroll acreage in a filter strip program. Only six farmers (15-percent of those interviewed) were willing to consider a $40 yearly payment to set aside filter strips for ten years. For those who had agreed to participate for the yearly payment offered to them in the mail survey (either $65 or $80) it was difficult to decide whether they would accept a payment between $40 and $65 (or $80). Most responses were vague: "it depends."

Among those landowners with highly erodible acreage enrolled in the CRP, five (42-percent) have acreage eligible for filter strips which they would consider setting aside for ten years for a $40 yearly payment. Only one of the current CRP participants interviewed was aware that filter strips had been an eligible practice for the CRP since February, 1988. The other eleven had not heard about filter strips.

During personal interviews, landowners were asked whether they thought program participants should earn the same payments for setting aside an acre of filter strips as for an acre of highly erodible land, or whether the yearly payment for filter strips ought to be more (or less). The majority of those who offered an opinion felt that the

payment for retiring highly erodible land and filter strips ought to be equal (64-percent, or 14 of 22 respondents). Five landowners (23-percent) felt that a landowner should earn a higher yearly payment for setting aside filter strips than for highly erodible land.

The third component of the personal interviews was a budget exercise designed to identify the decision criteria which are relevant when farmers weigh the trade-offs associated with a choice about accepting a yearly payment to set aside filter strips for ten years. The format for the budgeting routine asked farmers to make estimates of the costs of entering a ten-year land retirement program, including crop production revenues foregone as well as the establishment and maintenance of a permanent vegetative cover crop. They were asked to weigh these costs against possible savings from entering a ten-year land retirement program, such as the net changes in farm equipment costs, farm operating expenses, farm labor requirements, and farm program payments.

This budgeting exercise was difficult for the majority of the farmers interviewed, and impossible for some. Difficult cost estimates, such as the opportunity cost of farm labor, were passed over quickly. More straightforward cost estimates required considerable head-scratching and back-of-the-envelope calculations. Coming up with an estimate of the cost of establishing one acre in a permanent vegetative cover crop was impossible for 36-percent of those interviewed (15 of 42 landowners). For the others, cost estimates ranged from $20 to over $400 per acre for establishing a cover crop.

The exercise of weighing trade-offs between the costs and

benefits associated with participating in a ten-year land retirement program was an arduous task. The framework for decision-making proposed in the budgeting routine was unfamiliar. Nowak reported similar findings in interview situations with landowners in three different midwestern states.[3] In survey research conducted to measure landowners' estimates of the costs of installing conservation practices and their perceptions about how much cost-sharing for conservation is available, farmers sampled consistently report cost estimates with wide variances.

In evaluating these empirical results, at first Nowak and his colleagues attributed the unsatisfactory findings to problems with survey instruments. More recently, after similar experiences with numerous landowners and several different survey formats, Nowak is convinced that what we are picking up is an accurate description of landowners' general ignorance about the costs of alternative conservation practices. Two studies conducted in Wisconsin provide strong empirical evidence that "a majority of farmers are ignorant of the costs of common conservation practices. And of those who do have estimates, there is a tendency to overestimate the costs of conservation practices" (Nowak, p. 57, 1987).

In the final section of the personal interviews, landowners were given opportunities to offer feedback about a diverse set of considerations for the design of a long-term land retirement program. Several interesting attitudes were expressed.

The length of the contract was mentioned as an obstacle to

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[3]Telephone conversation with Peter Nowak, September 22, 1988.

participation by a majority of those interviewed (73-percent or 22 of 30 farmers). Their objections were varied. Some worried that the yearly payment would not be sufficient to keep up with escalating property taxes. Others may wish to sell or transfer ownership of their cropland within ten years. Others were optimistic that commodity prices will go up and the market for grain will improve.

Five of those interviewed held the strong opinion that if commodity prices go up and the demand for corn increases, then their ten-year contracts would be forgiven by the USDA.

The possibility of indexing yearly payments to account for inflation was discussed with 12 landowners. Only three of them indicated that this would influence their willingness to participate.

Use of retired cropland as wildlife habitat was popular. Seventy-five percent of current CRP participants manage their enrolled acreage as wildlife habitat. The majority of those farmers interested in setting aside filter strips indicated that they would consider managing them to enhance the wildlife habitat.

In terms of management of filter strips, farmers were asked to consider the width of filter strips. Currently, the CRP regulations specify that filter strips must be 66 to 99 feet wide. Farmers' reactions to this specification were varied. Farmers with haying equipment were interested in wider filter strips, preferably wide enough for two passes with their mowers. On the other hand, annual vegetable growers were interested in more narrow filter strips. They asked whether the area in filter strips could be measured from the water level in the drainage ditches adjacent to their fields and along

the slope of the ditch bank, rather than only measuring the level area next to the ditch. Farmers' opinions about the width of filter strips were correlated with the opportunity costs of the acreage adjacent to streams and ditches in alternative uses.

Respondents' assessments of their eligibility for filter strips

The personal interviews provided a useful opportunity to verify data from the mail survey concerning landowners' eligibility for the filter strip program. In the mail questionnaire, respondents were asked to consider whether they have cropland harvested twice between 1981 and 1985 which is adjacent to a stream, river, or drainage ditch. They calculated the number of feet eligible and multiplied this figure by a factor to estimate how many acres of filter strips they might consider enrolling in a ten-year program.

Observations during the personal interviews indicated that some respondents made errors in estimating their eligibility for a filter strip program. In some cases, landowners did not identify acreage which would, in fact, be eligible for filter strips (Type I error). In other cases, landowners assumed that woodland acres or cropland which has not been harvested for several years would be eligible (Type II error).

Among 30 interviewees, 18 indicated that they are eligible for filter strip in responding to the mail survey. Three of these respondents are actually not eligible. In one case, the cropland has not been harvested since the 1970s (Type II error). In the other two cases, the area adjacent to the stream is already wooded; the fields are separated from the streams by several hundred feet of woodland.

Five respondents miscalculated their eligibility. Two respondents underestimated the number of acres which could be set aside as filter strips in their mail questionnaire responses. Three farmers overestimated how many acres would qualify as filter strips. In one case, 32-percent of the acreage on the farm was reported eligible for filter strips and actually only 11-percent would qualify. In another case, the respondent indicated that they would set aside 15-percent of the acreage on a 40 acre farm, but actually only two acres (5-percent) would qualify. In both of these cases, the problem was arithmetic errors. In the third case, the landowner calculated that 20 acres would be eligible and actually only five would qualify. This mistake was due to a misunderstanding about the cropland eligibility criterion.

Representatives from SCS, ASCS, and CES in Newaygo County reviewed the survey research results.[4] According to their experience in the county, they consider it unlikely for any farm to have more than 25-percent of the acreage on the farm eligible for filter strips. Ten-percent of the respondents to the mail questionnaire estimated their eligibility at 25- to 50-percent of the acreage on the farm (Table 5.1 and Table 5.2). The average respondent reported 12.4 acres eligible for filter strips. For Newaygo County, a total of 2037 acres were reported eligible. If filter strips were installed on all 2037 acres, they would cover approximately 96 miles of stream banks and ditch banks on both sides.

Among 12 farmers interviewed who had not identified acreage on

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[4]Presentation of research results to Glenn Lamberg, Armando Rosalez, Carolyn Morton, and Norm Myers, February 17, 1989, Fremont, Michigan.

Table 5.1: Acreage eligible for filter strips on Newaygo County farms

Acreage	Responses
Less than 4 acres	25-percent of respondents
Less than 7 acres	25-percent of respondents
Less than 15 acres	25-percent of respondents
Less than 30 acres	15-percent of respondents
30 to 101 acres	10-percent of respondents
TOTAL	100-percent of respondents

Table 5.2: Proportion of acreage on the farm eligible for filter strips

Proportion	Responses
Less than 3-percent of cropland	25-percent of respondents
Less than 8-percent of cropland	25-percent of respondents
Less than 16-percent of cropland	25-percent of respondents
Less than 25-percent of cropland	15-percent of respondents
25- to 50-percent of cropland	10-percent of respondents
TOTAL	100-percent of respondents

their farms eligible for filter strips, three had committed Type I errors. In discussing rules for participation, they realized that they do have acreage which would qualify to be set aside as filter strips which they had not reported in their responses to the mail survey.

Mail survey responses indicating no eligibility for filter strips

The first question on the mail survey asked respondents to identify whether they have ditches, streams, or rivers on or next to their farms that run on or along cropland. Fifty-nine percent of the respondents to the mail survey (243 of 412 respondents) did not identify any acreage on their farms which is eligible for filter strips. It is possible that some of these respondents made Type II errors in evaluating their eligibility.

Written comments from 36-percent of the respondents (88 individuals) who did not identify acreage eligible for the CRP offered some insight about why this group is not eligible to participate in a filter strip program (Table 5.3). However, nothing is known about the other 155 respondents who did not identify acreage eligible for filter strips and did not write comments on their returned questionnaires.

If respondents miscalculated the number of acres eligible for filter strips on their farms, then these errors are a potential source of error in the results. The observations from the personal interviews suggest that miscalculations may have occurred. However, the magnitude or the frequency of these errors is unknown.

Suggested modifications in the mail survey instrument

For the most part, discussions during the personal interviews indicated that mail survey respondents provided accurate, thoughtful

Table 5.3: Written comments from mail survey respondents not eligible for the filter strip program

Reason	Responses
No longer farming	15%
No cropland	15%
Deceased	13%
No cropland eligible	10%
Sold farm	10%
No water adjacent to cropland	9%
Dislike government programs	6%
Farm is not in Newaygo County	5%
No water on the farm	5%
No erosion problem	5%
Anticipated management problems	4%
Miscellaneous	3%
TOTAL	100%

responses to the mail questionnaire. In addition to the problems discussed above concerning respondents' estimations of their eligibility for filter strips, two other questions were identified which may have been misleading to some respondents.

The first potentially problematic question asks for a measure of farm size. Respondents were asked, "How many acres of cropland did you farm in 1987?" They filled in two blank spaces, one for owned acres and one for rented acres. Discussions with landowners during the personal interviews suggest that some may have misunderstood the question. They reported <u>total</u> acreage, including woodlots, buildings, and roads, rather than only the land in cultivation. It may have been more clear to ask for three numbers: total acreage on the farm, total owned cropland, and total rented cropland. To respond with to these three questions, respondents would have been encouraged to recognize that they were being asked for two different figures, total acreage and total cropland. In statistical analysis concerning participation in a filter strip program, only total cropland is likely to be an important variable. However, by asking respondents to provide both figures, they may provide more accurate estimates of total cropland.

The second question which may have been misleading for respondents concerns household income. During personal interviews, three respondents (10-percent) indicated that they had reported only farm-related income. Since household income is the relevant variable for this analysis of farmers' willingness to accept yearly payments to set aside filter strips, it would be useful to provide respondents with another sentence describing what is meant by household income. For

example, "Your earnings and your spouse's earnings both on and off the farm are all included as household income."

Finally, the personal interviews revealed that farmers may have been confused in estimating how many acres of their cropland are eligible to be set aside as filter strips. In most cases, difficulties stemmed from interpreting the eligibility criteria and applying them correctly to their particular case, rather than from problems with calculations to convert feet bordering a stream or drainage ditch into acres. For most farmers, the problem with correctly designating which acreage is eligible for filter strips is related to understanding the definition of cropland, acreage which is regularly planted and harvested. To improve the questionnaire, a sentence or two to make the definition of cropland more specific would be helpful. It would also be useful to include in the text of the questionnaire a telephone number and to encourage respondents to call if they have difficulty interpreting the eligibility criteria or in applying the eligibility criteria to their particular case.

A profile of survey respondents

In response to the mail questionnaire, 167 landowners in Newaygo County identified acreage eligible for filter strips.

Age

The average respondent is 52 years old. Twenty-percent are older than 65 and 20-percent are younger than 40.

Education

Twenty-percent of the respondents did not finish high school. Forty-percent graduated from high school. Thirty-percent have had some

college. Ten-percent have attended college beyond four years.

Agency participation

Respondents identified the agencies they have contacted within the past three years for advice about farm management or farm programs. Twenty-one percent have visited ASCS, SCS and CES in the past three years. Fifty-five percent have visited SCS and/or ASCS. Six-percent have visited only CES. Eighteen-percent have visited none of these agencies.

Income from farming

Twenty-five percent of the respondents are full-time farmers. Ten-percent rely on farming for over half of the family's income. Fifteen-percent rely on farming for 20- to 50-percent of their household income. Fifty-percent rely on farming for less than 20-percent of their household income.

Farm types

Landowners reported one or several important income-generating enterprises on their farms. Fifty-four percent of those responding grow hay or forage crops. Fifty-percent plant corn. Twenty-percent have dairy operations. Thirty-six percent have livestock operations. Thirteen-percent grow annual vegetables. Six-percent have orchards.

Farm size

The average farm is 190 acres. Twenty-five percent of respondents' farms are less than 40 acres. Twenty-five percent are 41 to 100 acres. 25-percent are 101-250 acres. Twenty-five percent are 251 to 1050 acres.

Yields

On acreage eligible for filter strips, the average estimated corn yield is 94 bushels per acre. Fifteen-percent of respondents estimate their yields at 30 to 75 bushels per acre. Thirty-five percent estimate their yields at 76 to 90 bushels per acre. Thirty-percent estimate their yields at 90 to 100 bushels per acre. Twenty-percent estimate their yields at 101 to 175 bushels per acre.

Cash rental rates

Respondents estimated the going cash rent for the most productive cropland on their farm and for the least productive cropland. Forty-percent of the respondents estimated that their least productive cropland would rent for less than $20 per acre. Forty-percent estimated the cash rent for their least productive land at between $20 and $40 per acre. Twenty-percent estimated that their least productive cropland would be worth $45 to $180 on the land rental market.

For the most productive cropland on their farms, forty-percent of respondents estimated that they could get less than $40 per acre to rent the land. Twenty-five percent estimated that their most productive cropland would be worth $40 to $55 on the land rental market. Fifteen-percent estimated their most productive cropland would rent for $60 to $100 per acre. Ten-percent estimated that their most productive cropland would rent for between $100 and $500 per acre.

CONCLUSIONS AND IMPLICATIONS

The primary objective of this research was to assess farmers' willingness to set aside cropland as filter strips. The research was a unique application of contingent valuation methods to collect data about a farm management decision problem. Survey responses were analyzed to identify the economic factors which make a difference in farmers' decisions about participating in a conservation program. Data describing farmers' responsiveness to yearly payments as conditioned by economic factors were used to develop a measure of the estimated marginal costs of increasing participation in a conservation program.

Farmers' willingness to participate in a filter strip program was considered as a utility maximization problem: farmers make choices about whether to accept or reject a yearly payment to set aside filter strips for ten years according to their preferences and values, subject to economic constraints including opportunity costs, transaction costs, and expectations about the future.

Statistical analysis using a two-limit Tobit model shows that among the farmers surveyed in Newaygo County, yearly payment offers, preferences, opportunity costs, and expectations about the future are important criteria for decisions about participating in a filter strip program. For a yearly payment of $40 per acre, the survey responses indicate that Newaygo County farmers as a group would set aside 26-

percent of their eligible acreage as filter strips. If the yearly payment were $80 per acre they would set aside 41-percent of their eligible acreage as filter strips.

Sensitivity analysis was performed to show the extent to which farmers' preferences made a statistically important difference in their decisions about participating in a filter strip program. Farmers who are concerned about the environment are likely to set aside higher proportions of their eligible acreage in filter strips and to require lower yearly payments for participation. To set aside the same acreage in filter strips, on the average farmers who do not consider concern about the environment an important reason to participate would require a yearly payment approximately $35 higher than an individual who considers environmental quality an important reason to enter a filter strip program.

The option to cut hay on acreage enrolled in a filter strip program makes an important difference in farmers' willingness to participate in a filter strip program. For the yearly payments that respondents were offered in their mail questionnaires, as a group they were willing to set aside 74-percent of their eligible acreage as filter strips, compared with 49-percent under participation rules which prohibit haying.

The overall conclusion from these empirical results is that farmers' decisions about participating in a filter strip program are consistent with economic principles. Farmers are more willing to set aside filter strips when yearly payments are higher. If farmers are allowed the option to cut hay on their acreage enrolled in a filter

strip program, then they are willing to accept lower yearly payments to participate and they enroll higher proportions of their eligible acreage. If the contract period for a filter strip program were shorter than ten years, then more farmers would be likely to enroll.

Implications for policy design

The analysis of farmers' CV responses suggested three considerations for the design of more effective farm conservation programs and three considerations for program implementation.

To recruit higher levels of participation in a filter strip program, a potentially effective changes in policy design include modifying the levels of yearly payments offered to participants in a filter strip program, adjusting the program rules to allow haying on filter strips, and shortening the length of contracts might influence farmers' willingness to enter a filter strip program.

Yearly payment offers

Newaygo County farmers' survey responses suggest that as the financial incentives for entering a filter strip program for ten years are raised, more farmers are willing to participate. Changing the yearly payments offered to farmers is an important policy instrument for influencing farmers' willingness to enter a filter strip program. An estimated payment-participation response function provides a basis for calculating the marginal costs associated with recruiting higher levels of enrollment in a filter strip program.

It would be socially desirable to offer higher yearly payments to increase levels of participation in a filter strip program to the extent that marginal benefits exceed marginal costs. A large share of

the marginal benefits from filter strips, through improved water quality and enhanced recreational opportunities, are likely to accrue directly to local and state residents. The value of the potential marginal benefits from the increased use of filter strips may be sufficient to justify appropriation of state or local funding to supplement available federal funding. This type of a "piggy-backing" strategy is likely to improve a state's or a county's enrollment in a filter strip program.

Minnesota state conservation policy has set a precedent for this type of a piggy-backing scheme with the Re-invest In Minnesota (RIM) initiative, a program designed in conjunction with the CRP (Larson, 1987). The empirical research conducted in Newaygo County provides a framework that could be used for data collection and analysis to inform the design of a piggy-backing scheme in a state or a locality to improve participation in a filter strip program. The payment-participation response function provides the financial component of the data required to match marginal benefits with the marginal costs of recruiting higher levels of enrollment in a filter strip program.

Farmers' responsiveness to yearly payment offers may be different for long-term land retirement programs with different conservation objectives. A yearly payment which would be acceptable for retiring highly erodible land from production may be different from the financial incentive a farmer would expect to set aside filter strips. A farmer might require yet another yearly payment to take non-erosive cropland out of production to reduce the risk of groundwater contamination. Designing efficient conservation programs means

identifying the appropriate levels of financial incentives to offer to respondents. From a social perspective, effective policy design involves offering yearly payments to farmers to the extent that the marginal benefits from the conservation program exceed the marginal costs.

Allowing haying on filter strips

Structuring program rules to permit haying is likely to have a significant impact on farmers' decisions about participation in a filter strip program. In Newaygo County, mail survey respondents indicated that they would enroll higher proportions of their yearly payments and that they would accept lower yearly payments for participating if they were allowed to harvest a hay crop from their filter strips.

Among Newaygo County farmers, enrollment in a filter strip program doubled at a $40 yearly payment level when farmers were allowed to consider cutting hay on their filter strips. For a $40 yearly payment with haying allowed, farmers indicated that they would set aside 65-percent of their eligible acreage. Without the option to hay, they would enroll only 33-percent of their eligible acreage in a filter strip program. It is reasonable that Newaygo County farmers would be willing to accept a higher yearly payment to set aside filter strips with haying allowed. In a normal year in the county, average estimated net profits from hay production amount to $42 per acre per year.

Maintaining the option to cut hay on filter strips may have seemed a more important issue for Newaygo County farmers during the summer of 1988 than in normal years due to severe drought conditions.

High market prices for hay during August, 1988 when the mail survey was conducted (approximately double the normal market price) may have influenced some respondents' willingness to participate in a filter strip program and their expectations concerning an acceptable yearly payment. However, in response to a survey question, 75-percent of the respondents indicated that the summer's drought conditions had no impact on their willingness to set aside filter strips.

Length of contracts

A third policy instrument likely to have an effect on participation in a filter strip program is shortening the contract period. Analysis of the survey responses showed that making a ten-year commitment was a statistically important obstacle to participation in the filter strip program proposed to Newaygo County farmers. If a filter strip program were modified to allow participants to enter shorter contracts, then they would be likely to be more willing to participate. Offering yearly payments over a shorter period would reduce the cost of implementing the program by half. However, shortening the contract period for a filter strip program may involve a trade-off in reduced water quality benefits. Sediment delivery to streams would be likely to be lowered during the period when farmers are receiving a yearly payment to manage their enrolled acreage as filter strips. When their contracts end, farmers would be at liberty to return their acreage to crop production and benefits from filter strips are no longer guaranteed.

On the other hand, shorter contracts do not necessarily mean fewer water quality benefits. On-farm experience with filter strips

suggests that farmers may be willing to continue to use filter strips even after they stop receiving a yearly payment under some conditions. In a pilot program in the Black Creek watershed in northeastern Indiana, farmers were offered a one-time payment to establish filter strips along streams. Nine years after the first filter strips were established, 92-percent of the farmers involved in the project were still maintaining their filter strips (Walters, 1989). There were no rules to prohibit farmers from harvesting hay from their filter strips.

The survey data from Newaygo County suggest that a commitment to a ten-year contract would be less significant in farmers' participation decisions if haying was allowed on filter strips. The length of the contract was a statistically important obstacle to participation only in the case where haying is not allowed on filter strip acreage. When farmers were allowed to consider the option of cutting hay on their filter strips, then a ten-year commitment was no longer a statistically important impediment to participation.

If farmers were given the option to earn revenues from harvesting hay on enrolled acreage, then the length of the contract no longer seemed to have an significant effect on participation decisions. On the other hand, for conservation programs which prohibit haying, shortening the contract period would be likely to increase participation.

Implications for program implementation

The analysis of CV survey responses suggested three considerations for more effective implementation of farm conservation programs. First, if farmers were better informed about conservation

programs, then there might be a significant increase in participation. Second, information about conservation programs is reaching only a limited clientele. Recruitment efforts could be improved by identifying and contacting farmers who are likely to be eligible and interested, but who are not currently receiving publicity about new conservation programs. Finally, farmers need decision support tools to help them overcome uncertainty about participating in conservation programs.

Improving information delivery to farmers

In response to the mail survey, Newaygo County farmers indicated that they would be willing to set aside 26-percent of their eligible acreage as filter strips <u>if</u> they knew about and had access to a filterstrip program. However, respondents had very little information about the filter strip program offered through the CRP when the mail survey was conducted.

Since February, 1988 farmers in Newaygo County have been eligible to receive $40 yearly payments to set aside filter strips in the CRP. Although a filter strip program was available through the CRP for six months before the mail survey was conducted, no CRP contracts for filter strips were set up in the county. The difference between actual CRP participation and farmers' responses to the mail survey was due to a lack of information about filter strips. Respondents' written comments and feedback during personal interviews indicated that many farmers learned about filter strips for the first time through the mail survey.

The survey results suggested that the concise yet descriptive

scenario provided in the mail questionnaire provided a helpful framework to guide farmers in thinking through a decision about participating in a filter program. The nature of the information offered to respondents was simple. Three points of information were developed. First, respondents learned about the purpose of filter strips. They considered how setting aside filter strips and receiving a yearly payment would affect their farm operation. Second, they were given a formula to calculate how much cropland on their farm is eligible for filter strips. Finally, they were told how much they would be paid to set aside filter strips for ten years.

There are some fundamental differences between this presentation of information and typical publicity concerning the filter strip program available through the CRP. The most important difference is explicitly stating the yearly payment a farmer receives to participate. In publicity about the CRP, financial incentives have been discussed in terms of bids, without giving the actual dollar amount paid to participants. For example, non-specific terms were used to describe enrollment procedures and financial incentives in a pamphlet released in June, 1988 to publicize filter strips.

> To enroll land in the CRP, you submit an application to the ASCS stating the annual per acre payment you would accept for converting cropland. Periods when bids will be accepted are announced periodically by USDA. Your local ASCS office can tell you the rental rates paid in your locale during previous CRP sign-ups. If your bid is accepted, a 10-year contract is signed with USDA.

The appeal of a financial incentive is de-emphasized in this general presentation, where the procedures for bidding to enter the program are highlighted.

Since mid-1986, selection criteria for entering the CRP have not been based on bids. After the first sign-up for the program in February, 1986 maximum acceptable rental rates (MARR) were established for each county. Any bids to enter the CRP below the MARR have been accepted. The USDA has considered it unnecessary to explicitly advertise the MARR for each county (Esseks and Kraft, 1988). Farmers presumably learn about what kinds of CRP bids have been accepted through informal information channels, such as coffee shop gossip. ASCS personnel are authorized to disclose the MARR if farmers ask.

Empirical research results show that misinformation can result from farmers' reliance on informal channels to learn about acceptable CRP bids. In 1987, among a group of survey respondents who were eligible for the CRP but had not enrolled in the program, 49-percent did not know the MARR for their county or gave figures that were at least $5 lower than the actual yearly payments being offered (Esseks and Kraft, 1988).

Analysis of CV responses from Newaygo County farmers shows that the yearly payment offers are a significant consideration in their decisions about whether to participate in a filter strip program. Since yearly payments make an important difference in farmers' willingness to participate, it would be useful to explicitly state the dollar amount that they could receive to enter a filter strip program in program publicity and in decision support tools.

In addition to knowing the yearly payments levels, farmers need to know whether they would be eligible for a conservation program in order to seriously consider participating. In the mail questionnaire,

respondents were given a formula to actually calculate what proportion of the cropland on their farm is eligible for filter strips. Discussions during the personal interviews revealed that for the majority of those interviewed this was a useful exercise. In some cases, respondents have acreage which would be eligible, but did not immediately recognize their eligibility in reading through the scenario. When programs are publicized without specific information to help farmers determine whether they would qualify, then it is possible that some would dismiss the option of participation before considering it seriously.

Finally, in order to think through the possibility of entering conservation program, farmers can benefit from a framework to weigh the benefits and costs associated with participation. The mail questionnaire about filter strips identified the relevant trade-offs in simple terms.

> A yearly payment from the filter strip program provides a source of steady income. ... On the other hand, setting aside filter strips costs you money. You cannot harvest or graze filter strip acreage. ... This is why the program would pay you to put in filter strips: to make up for your lost income.[1]

Although actual costs and benefits may vary for different farmers, it is useful to itemize the categories which bear consideration. The SCS Economic Application Work Group considers the need for integrating economics into publicity for new programs an important opportunity for improving the use of economics in conservation operations. They recognize that timely analyses of conservation alternatives would

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[1]Mail questionnaire, Appendix A, p. 3.

improve efforts to effectively market conservation (Dodd, p. 3, 1988).

Integrating economic tools would help to improve the effectiveness of campaigns to promote new conservation programs. These efforts would be likely to pay off in significant increases in participation.

Reaching a wider clientele

A second consideration for improving the implementation of conservation programs is the potential for expanding recruitment efforts. Analysis of CV responses and feedback during personal interviews indicated that in Newaygo County there are farmers who may be eligible and interested in a filter strip program, but they are currently not aware of their opportunities to participate in conservation programs.

Among mail survey respondents in Newaygo County who identified acreage eligible for filter strips, 24-percent have contacted neither SCS nor ASCS in the past three years for farm management advice or for information about farm programs. These farmers may not be receiving or responding to notices about new conservation programs.

Efforts to make mailings from local SCS and ASCS more personalized and targeted than the conventional mass-produced newsletter would be likely to increase awareness concerning new conservation programs. Farmers are more likely to read something addressed specifically to them. If farmers become aware of conservation opportunities, then they are more likely to participate in new programs.

To achieve increased awareness may require looking beyond the

traditional clientele for conservation programs (full-time farm operators with relatively large operations). Among farmers in Newaygo County who identified acreage eligible for filter strips, only 25-percent are full-time farmers. Statistical analysis shows that farmers most likely to participate in a filter strip program are those who earn the smallest proportion of their income from farming. Among Newaygo County respondents, the majority earn less than 20-percent of their household income from farming. Over half of the respondents own less than 100 acres of cropland.

The benefits from entering a conservation program which would motivate part-time farm operators to participate may differ from the benefits which are important to full-time farm operators. To develop well-designed decision support tools involves identifying a wide range of potential benefits and costs associated with participation (including non-monetary benefits).

Providing decision support tools

The third consideration for making the implementation of farm conservation programs more effective is to recognize that farmers face uncertainty in deciding whether to enter a conservation program. They can benefit from tools to assist them in weighing the trade-offs associated with participation.

Working through the thought process outlined in the mail questionnaire seemed to provide a helpful framework for farmers to think through a decision about setting aside filter strips. Respondents considered the purpose for filter strips. They calculated how much of their cropland is eligible for the program. The basic

benefits and costs relevant to the participation decision were identified. Finally, respondents were asked to accept or reject a yearly payment to participate.

To integrate economic analysis into the conservation planning process, the SCS Economics Application Work Group suggests a simple model for decision-making (Dodd, p. 8-10, 1988). Their ideas are consistent with the empirical findings from this research. They suggest using "trade-off analysis" as a framework for helping farmers to compare the positive and negative aspects associated with a conservation alternative. Farmers compare various conservation alternatives options to use alternative conservation systems with a baseline situation where no conservation treatment is used. They identify the expected changes from using conservation compared with the status quo. The net effect for each of the alternatives is calculated and expressed as either a positive or negative change. The most important role identified for integrating economics into the conservation planning process is in "systematically identifying the advantages and disadvantages of conservation systems" (p. 9).

An important objective in improving the content of decision support tools is to offer concrete and accurate cost and benefit estimates. Different individuals are likely to require varying levels of detail in breaking down costs as they work through decisions among conservation alternatives. Some individuals consider categories of costs and benefits which would be irrelevant to others. In general, it is useful to provide baseline cost and benefit estimates.

For the case of a filter strip program, the choice problem of

deciding whether to participate or not in response to a specified financial incentive is easier than stating kind of a payment would be acceptable. People are accustomed to making economic choices in market situations, where they can look at a price tag and decide whether or not to buy a product. Having concrete economic values to quantify the net costs and benefits associated with various conservation alternatives helps farmers to make better decisions.

In addition to improving the content of decision support tools, it is worth considering the most effective ways to present information to farmers to help them weigh their conservation alternatives. The strength of the design of the mail questionnaire distributed in Newaygo County was its simplicity. The strategy behind the design was to anticipate questions a respondent might ask in weighing a participation decision. The information presented in the questionnaire was organized in an attempt to make the economic choice problem as straightforward as possible.

In developing tools to communicate risk information to consumers, Bettman and his co-authors (1987) stress congruence: their objective in designing decision support systems is "to determine how consumers are currently processing information and utilize formats that will make that type of processing easier" (p. 26). This principle applies for the design of decision support tools to help farmers with evaluating the trade-offs among conservation alternatives. An appropriate framework to maximize effectiveness in the delivery of information is to replicate the logical thought process a farmer would follow in considering their conservation options. To further facilitate choices

among alternatives, a well-designed decision support tool builds in supplementary information and asks the farmer to consider benefit and cost aspects which might otherwise be ignored.

Suggestions for future research

These research findings suggest three directions for future research. First, survey research among other groups of farmers could be structured to evaluate the usefulness of various decision support tools. Second, future research efforts would be useful to verify the empirical findings from Newaygo County including the statistical significance of the groups of explanatory variables representing transaction costs, preferences, and expectations about the future. Finally, it would be useful to vary the actual yearly payments offered to farmers for participating in a filter strip program as a basis for comparison with farmers' contingent behavior.

Evaluating decision support tools

Conducting follow-up CV studies would be a useful way to assess the relative effectiveness of decision support tools for choices about participation in conservation programs. Farmers need better information to weigh conservation alternatives; more research could help determine the kinds of information most helpful to compliment their decision-making processes.

To learn more about conservation behavior, a CV experiment could be designed where landowners are offered different types of information to assist them in their decisions about accepting financial incentives to set aside filter strips. For example, one group of respondents might be presented with statistics about the effectiveness of filter

strips in reducing erosion damages in various on-farm situations. A second group of landowners might visit on-farm demonstrations of filter strips in use. A third group of respondents might work through a budgeting routine presenting dollar estimates of the costs and benefits associated with filter strips, contrasted with several other conservation alternatives. Farmers who invest more decision resources, more time and more thinking, would be expected to make better decisions about participation in a conservation program.

To analyze the results from this CV experiment, following each of these different information treatments, farmers' responsiveness to financial incentives for setting aside filter strips would be tested. Comparative analysis would show how information influences individuals' choices among conservation alternatives and would help to identify which kinds of information are most helpful to landowners in their decision-making processes. These comparisons would also indicate whether having better information and investing more decision resources influences farmers to accept lower or higher yearly payments to participate in a ten year filter strip program. This type of systematic evaluation of decision support tools would provide helpful guidelines for those concerned about the content of conservation education programs and about strategies for marketing conservation programs.

There is a precedent for this type of CV research. Hoehn and Randall (1987) provide a theoretical and empirical framework for comparing respondents' contingent behavior in different situations. Their work shows that the amount of time and decision resources an

individual invests makes a difference in their willingness to pay for a proposed policy change (or, in this case, their willingness to accept a yearly payment to participate in a filter strip program). The accuracy and quality of respondents' valuations improves as they increase the time and energy devoted to thinking through a contingent valuation problem. Further research would be useful to identify which aspects of a decision support tool are most useful in helping respondents make satisfactory economic choices.

Verifying the research results

If this type of empirical research is to be used as the basis for policy recommendations, it is necessary to replicate the research in order to verify the findings. The results from this case study in Newaygo County are preliminary. They represent the behavior of a sample of farmers in one place at one point in time. To test the validity of these results, it would be useful to conduct similar CV studies among sample populations representative of the state or the nation as a whole.

In the course of conducting further research, it would be useful to work toward more precise specifications of the explanatory variables used to describe farmers' responsiveness to yearly payments for setting aside filter strips. The set of variables which needs the most attention is those chosen to represent the transaction costs a farmer considers in decisions about participating in a filter strip program. Defining a statistically important set of variables to represent transaction costs might improve researchers' ability to describe and understand farmers' conservation behavior. In turn, identifying the

transaction costs that make a difference in farmers' participation decisions would aid in the design of decision support tools.

Based on previous empirical research concerning the adoption of conservation practices, it was reasonable to expect that experience with SCS and ASCS would reduce the transaction costs associated with participating in a filter strip program. Statistical analysis using data collected in Newaygo County failed to identify correlation between participation and recent contacts with SCS and ASCS. In addition, renters were no less likely to set aside filter strips than those who own their cropland. Having a high proportion of cropland on the farm eligible for filter strips did not appear to make farmers more likely to enter a program.

Empirical results from Newaygo County suggested that the variables chosen to represent transaction costs do not appear statistically important in explaining farmers' willingness to enroll in a filter strip program. This evidence was not sufficient to dismiss these variables as irrelevant in farmers' participation decision in other locations and other time periods. Further research would be useful to test whether this group of variables representing transaction costs are statistically important among other groups of farmers. It would also be useful to search for other explanatory variables to capture the range of transaction costs relevant in decision-making about entering a filter strip program.

The set of variables to represent the preferences that make a difference in farmers' choices about filter strips could be specified in greater detail. In terms of concern about the environment, it would

be interesting to draw distinctions between various attributes of environmental quality, such as downstream water quality and wildlife habitat. Attitudes concerning government involvement in the agricultural economy may also play a role in farmers' decisions about participating in a filter strip program.

With respect to expectations about the future, it would be helpful to integrate variables to capture farmers' risk preferences as they may enter into decisions about committing to a fixed payment for ten years. If a ten-year contract period is too long, it would be useful to determine how shortening the contract to five years or offering a one-time payment to establish permanent vegetative cover on filter strips would affect farmers' willingness to consider using filter strips.

Comparing contingent behavior with actual behavior

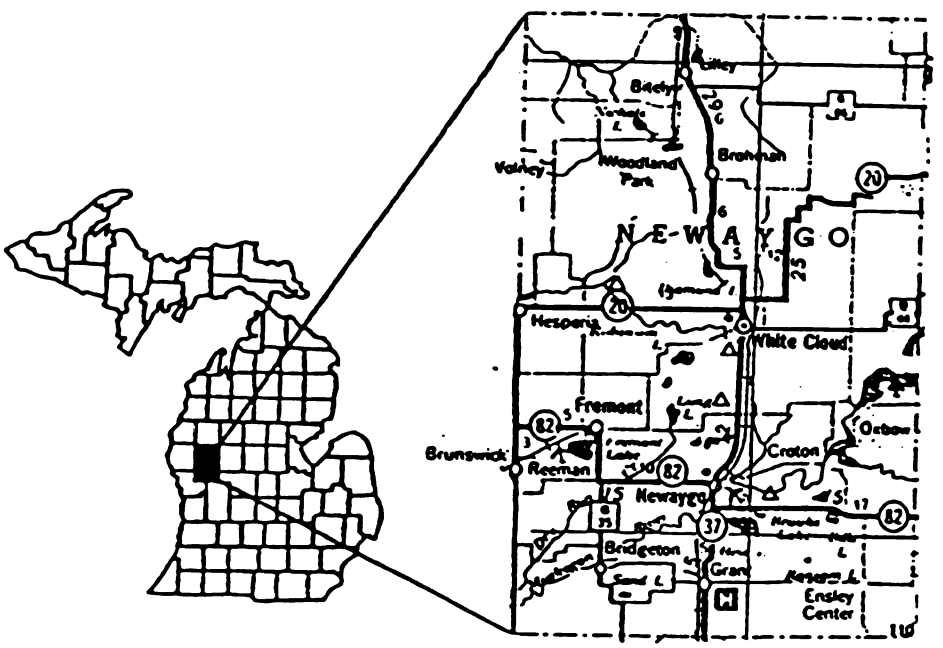
It would be instructive to conduct experiments where farmers are actually offered lower and higher yearly payments for signing contracts to set aside filter strips. An experiment of this type could compare what people say they would do in a CV survey setting with their actual behavior in response to a binding agreement. This type of experiment would offer a rigorous test to indicate the appropriate interpretation of CV results.

APPENDICES

APPENDIX A

WHAT NEWAYGO COUNTY LANDOWNERS THINK ABOUT FILTER STRIPS

A SURVEY



This questionnaire gives you an opportunity to express your opinion about filter strips. Your responses are confidential. To ensure privacy, the questionnaire is identified by number only.

Please answer all the questions. If you you would like to express additional opinions, please use the space provided on the last page. We will pay attention to your comments.

Please return this questionnaire to:

Amy Purvis, Project Coordinator
Department of Agricultural Economics
38 Agriculture Hall
Michigan State University
East Lansing, MI 48824

We appreciate your time and effort. Thank you!

WHAT ARE FILTER STRIPS?

Filter strips are bands of cropland 66 to 99 feet wide next to creeks or ditches. Filter strips are planted to a permanent vegetative cover. A filter strip helps stop topsoil and fertilizer from being washed into ditches and creeks.

Filter strips reduce the need for cleaning ditches, streams, rivers, and lakes. They also improve the water quality for fishing and recreation.

Starting in February, 1988 landowners can enroll filter strips in the Conservation Reserve Program (CRP). Any cropland on your farm qualifies as filter strips if:

- It is next to a lake, river, creek, or ditch. Roadside ditches, county ditches, and privately-built ditches are all considered ditches.

and

- It has been harvested any two of the years between 1981 and 1985. Eligible acreage includes cropland used for cash crops, alfalfa, specialty crops, and orchards. Acreage used for pasture or for Christmas trees is not eligible.

IS LAND ON YOUR FARM ELIGIBLE FOR FILTER STRIPS?

1. Do you have any ditches, streams, or rivers on or next to your farm that run through or along cropland? (circle number)

1 YES

2 NO

If you answered YES, please continue to Question 2 on the next page.

If you answered NO, then you do not need to fill in answers to the rest of the questions. *Please return the questionnaire in the enclosed envelope. Your cooperation is important to find out how many farms would not be eligible for the filter strip program. Thank you very much for your help.*

2. **How many feet of ditches, creeks, lakes or rivers running through or along <u>your cropland</u> do you have on or next to your farm? (1/4 mile = 1320 feet)**

   A. I HAVE _____ FEET OF DITCHES, STREAMS OR RIVERS BORDERED ON <u>ONE</u> SIDE BY MY CROPLAND.

   B. I HAVE _____ FEET OF DITCHES, STREAMS OR RIVERS BORDERED ON <u>BOTH</u> SIDES BY MY CROPLAND.

3. **How much of your land is eligible for filter strips?**

   PLEASE CALCULATE YOUR ELIGIBLE ACRES USING THIS INFORMATION:

   Filter strips average 85 feet wide. One acre in filter strips amounts to a stretch of land that runs 500 feet along one side of a creek or ditch <u>or</u> a stretch 250 feet long on both sides.

   Figure your eligible filter strips acreage by dividing the answer to Question 2A (above) by 500 and dividing the answer to Question 2B by 250. Add these to get total eligible acres.

   I HAVE _____ ACRES ELIGIBLE FOR FILTER STRIPS.

   <u>THE FILTER STRIP PROGRAM WORKS LIKE THIS</u>:

   - Landowners make a bid stating the yearly payment per acre they would need to put cropland into filter strips. Before they sign a contract, the Soil Conservation Service visits the farm to help in designing the filter strips and to measure their length and width.

   - When the contract is signed, it runs for ten years. Landowners receive a yearly payment based on the acreage actually enrolled in the filter strip program.

   - The acreage put into the filter strip program must be planted to a permanent vegetative cover, either grass, legumes or trees. The Agricultural Stabilization and Conservation Service (ASCS) would pay 50% of the cost of establishing permanent vegetative cover.

ARE FILTER STRIPS FOR YOU?

A yearly payment from the filter strip program provides a source of steady income. Filter strips can be used on head land, as travelways or as turn strips. Some farmers use filter strips to square up their fields.

On the other hand, setting aside filter strips costs you money! You cannot harvest or graze filter strip acreage, except in severe drought years. You must mow once a year to keep down noxious weeds. This is why the program would pay you to put in filter strips: to make up for your lost income.

4. Suppose you were offered a yearly payment of $80.00 an acre for each acre that you put into filter strips for ten years. Would you put any land into filter strips? (circle number)

1 YES

2 NO

If you answered NO, please skip to Question 6.

5. If you answered YES to Question 4, how many of your eligible acres would you put into filter strips for ten years if the yearly payment were $80.00 an acre?

_____ ACRES IN FILTER STRIPS

6. If you could cut hay on filter strips every year, how many of your eligible acres would you put into filter strips for a yearly payment of $80.00 an acre?

_____ ACRES WITH HAYING ALLOWED

7. Suppose you planted corn on the filter strip acreage instead of putting it into the filter strip program. What average yield would you expect? (Please make an estimate for planting corn, even if you would usually plant another crop.)

_____ BUSHELS PER ACRE

YOUR REASONS

8. If you would enroll acreage in the filter strip program for $80.00 per acre per year, which of the following reasons explain your decision? (Please circle as many numbers as apply.)

1 THE YEARLY PAYMENT IS MORE THAN I EXPECT TO EARN FROM PRODUCING ON THE ELIGIBLE LAND.

2 THE YEARLY PAYMENT IS MORE THAN I COULD EARN FROM RENTING OUT THE LAND.

3 THE YEARLY PAYMENT WOULD COVER MY LAND TAXES FOR THE ACREAGE IN THE PROGRAM OVER THE NEXT TEN YEARS.

4 CONCERN ABOUT CONSERVING SOIL ON MY FARM.

5 CONCERN ABOUT THE ENVIRONMENT.

6 OTHER _____

_____

9. If you would not enroll any acreage in the filter strip program for $80.00 per acre per year, which of these reasons explain why not? (Please circle as many numbers as apply.)

1 TOO FEW ACRES WOULD BE ELIGIBLE TO MAKE IT WORTH MY WHILE.

2 I DO NOT LIKE THE HASSLE OF GOVERNMENT PROGRAMS.

3 I COULD NOT PAY MY HALF OF THE EXPENSES TO ESTABLISH A PERMANENT VEGETATIVE COVER.

4 I EXPECT TO EARN MORE PRODUCING ON THE ELIGIBLE LAND THAN THE AMOUNT PROPOSED AS A YEARLY PAYMENT.

5 TEN YEARS IS TOO LONG TO BE COMMITTED TO A FIXED PAYMENT.

6 OTHER _____

_____

YOU AND YOUR FARM

This final section of questions is to collect information that will help us evaluate which landowners are most likely to participate in the filter strip program.

10. What enterprises on this farm contribute an important share of your cash income? (Please circle as many as apply.)

1 DAIRY

2 LIVESTOCK

3 CORN

4 HAY/ALFALFA

5 ORCHARDS

6 ANNUAL VEGETABLES

7 OTHER _____

8 OTHER _____

11. How many acres of cropland did you farm in 1987?

A. _____ ACRES OWNED

B. _____ ACRES RENTED

12. Suppose you were to rent out the **most productive** cropland on your farm this year. What cash rent could you get for one acre for one year?

$_____ PER ACRE PER YEAR

13. Suppose you were to rent out the **least productive** cropland on your farm this year. What cash rent could you get for one acre for one year?

$_____ PER ACRE PER YEAR

14. Over the next ten years, do you expect farm prices to rise faster or slower than inflation? (circle number)

1 FASTER

2 SLOWER

3 ABOUT THE SAME AS INFLATION

4 DON'T KNOW

15. Over the last three years, have you used any of the following agencies for farm management advice or for information about farm programs? (Please circle as many as apply.)

1 SCS

2 ASCS

3 COOPERATIVE EXTENSION SERVICE

4 NONE OF THESE AGENCIES

16. What is your age?

_____ YEARS

17. How many years of school have you completed?

_____ YEARS

The financial situation on your farm is important in determining whether you are willing or able to participate in conservation programs. Please answer Questions 18 and 19 to help us evaluate who is most likely to put in filter strips. Your responses are confidential.

18. What percent of your family's income came from farming in 1987?

_____ % FROM FARMING

19. What was your household income in 1987? (circle number)

1 LESS THAN $15,000
2 $15,001 TO $30,000
3 $30,001 TO $45,000
4 $45,001 TO $60,000
5 $60,001 TO $75,000
6 $75,001 TO $90,000
7 $90,001 TO 105,000
8 105,001 TO 120,000
9 GREATER THAN $120,001

20. **Weather conditions in 1988 appear to be unusual. How does this year's drought affect your decision about putting land into filter strips for the next ten years? (circle number)**

1 MORE LIKELY TO PUT IN FILTER STRIPS

2 LESS LIKELY TO PUT IN FILTER STRIPS

3 NO IMPACT ON MY DECISION

We welcome your comments. Please use the space below to write about anything else you think we should consider.

We appreciate your taking the time and effort to give your opinions for this research project.

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF AGRICULTURAL ECONOMICS
AGRICULTURE HALL

EAST LANSING · MICHIGAN · 48824-1039

August 2, 1988

Dear

You have been selected to participate in a research project undertaken by the Department of Agricultural Economics at Michigan State University. The enclosed questionnaire is designed to get your reactions concerning participation in a new conservation program outlined in the 1985 farm bill.

The new program would pay farmers to put land into filter strips. Filter strips are bands of cropland next to creeks and ditches that are planted in a permanent vegetative cover. Filter strips help to keep soil in place and reduce the need for cleaning ditches, streams, rivers and lakes.

Your name was selected to represent people like you who own cropland in Newaygo County. You may be eligible for this new program. Your viewpoint, along with feedback from other respondents, will be compiled to develop a profile of Newaygo County landowners' reactions to the program.

The results of this study will be discussed with government officials in Newaygo County, Lansing, and Washington, D.C. Your opinions will be used to help represent the preferences of thousands of potential farm program participants across the United States. For this research project to accurately reflect the thinking of Newaygo County's whole farm community, it's important that it include responses from the widest variety of landowners--people with small farms, large farms, livestock, cash crops, and orchards.

Please take 10 or 15 minutes of your time to fill out the questionnaire. Your responses are very important to us. You may be assured of complete confidentiality. The questionnaire is marked with an identification number to allow us to check your name off the mailing list when your questionnaire is returned. Your name will never be written on the questionnaire. You indicate your voluntary agreement to participate in this research project by completing and returning this questionnaire.

We would be glad to send you a summary of the results if you print "copy of results requested" on the back of the return envelope and write your name and address below it.

If you have any questions about filling out the questionnaire or about this project, please feel free to call me (924-4661). Thanks for your help!

Sincerely,

Amy Purvis
Project Coordinator

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF AGRICULTURAL ECONOMICS
AGRICULTURE HALL

EAST LANSING · MICHIGAN · 48824-1039

August 23, 1988

Dear

About three weeks ago, I wrote to you ask for your opinion about putting filter strips into the Conservation Reserve Program. As of today, we have not received your completed questionnaire here at Michigan State University.

Our research group has developed this study because of the belief that landowners' opinions should be considered in evaluating conservation programs. Your opinion will be important in determining which aspects of conservation programs should stay the same and which aspects should be changed.

I am writing to you again because of the importance of your response. You were selected as part of a small and representative group of landowners and farmers. For our study to truly represent the agricultural community in Newaygo County, it is essential that you complete and return the questionnaire.

I have enclosed a replacement questionnaire just in case the original has been misplaced. Please remember that your opinion is confidential. Your name and individual opinion will not be revealed.

If you have any questions about filling out the questionnaire or about the research project, please call me at 616-924-4661.

Thank you for your cooperation.

Cordially,

Amy Purvis
Project Coordinator

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF AGRICULTURAL ECONOMICS
AGRICULTURE HALL

EAST LANSING · MICHIGAN · 48824

September 20, 1988

Dear

I am writing to you about our study of filter strips on cropland in Newaygo County. We have not yet received your completed questionnaire.

The large number of questionnaires already returned is very encouraging. However, whether we will be able to describe accurately how Newaygo County landowners would respond to an opportunity to put filter strips into the Conservation Reserve Program depends on you. You may have quite different opinions concerning conservation programs than those who have already returned them.

This is the first time an intensive study of landowners' opinions about filter strips has ever been done. The results are of particular importance to decision-makers in Newaygo County, Lansing, and Washington, D.C. who are concerned about designing conservation programs to best meet the needs of people like you.

It is for these reasons that I am sending another copy of this questionnaire to your household. Many earlier respondents have commented that they failed to return the questionnaire sooner because they are not eligible to enroll filter strips into the Conservation Reserve Program. Even if you are not eligible, your response is important. We are just as interested in learning how many Newaygo County landowners would not be eligible for the program as we are in those respondents who would be eligible to participate.

I'll be happy to send you a copy of the results. Simply write your name, address, and "copy of results requested" on the back of the return envelope.

Your contribution to the success of this study will be greatly appreciated.

Sincerely,

Amy Purvis
Project Coordinator

APPENDIX B

CONFIDENTIAL

WHAT NEWAYGO COUNTY LANDOWNERS THINK ABOUT FILTER STRIPS

AN INTERVIEW

Date of Interview _____

Respondent's Name _____

Starting Time _____

Finishing Time _____

Michigan State University
Department of Agricultural Economics
38 Agriculture Hall
East Lansing, MI 48824-1024

(517) 353-7898
(616) 924-4661

Thank you for taking the time to return the mail questionnaire and for agreeing to let me come today to ask you a few more questions about the Conservation Reserve Program.

For landowners who would enroll all their acreage eligible for filter strips into the CRP:

1. In your mail survey response, you offered to put in _____ acres of filter strips for a yearly payment of $65.00. However, currently, in Newaygo County, the maximum yearly payment offered to CRP participants is $40.00 per acre. How many acres would you consider putting into filter strips at $40.00 per acre?

   _____ ACRES

2. Suppose that public funds for the program ran out and the program could no longer offer a $65.00 per acre yearly payment. What is the lowest yearly payment you would consider to put this _____ acres into filter strips? (Probe up from $40.00 in $5.00 increments.)

   $ _____ PER ACRE

For landowners who would not enroll all their acreage eligible for filter strips in the CRP:

3. In the mail survey, you said that you would not be interested in putting filter strips into the CRP for a yearly payment of $65.00 per acre. Suppose that public funds became available to offer landowners higher yearly payments for filter strips. What kind of a yearly payment would you need to put your eligible acres into filter strips? (Probe: $5.00 increments)

   $ _____ PER ACRE

   _____ ACRES — If zero, then skip to Question 5.

4. What are the most important factors in your decision about how much to bid?

   1 YEARLY PAYMENT IS MORE THAN EXPECTED REVENUES FROM CROP PRODUCTION

   2 YEARLY PAYMENT IS MORE THAN EXPECTED CASH RENTS.

   3 YEARLY PAYMENT WOULD COVER LAND TAXES.

   4 YEARLY PAYMENT WOULD COVER REAL ESTATE MORTGAGE PAYMENTS.

   5 OTHER _____

5. If you would not enroll filter strips at any price, then you must have a good reason why not. Why wouldn't you be interested in putting in filter strips?

   1 TOO FEW ACRES WOULD BE ELIGIBLE TO MAKE IT WORTH MY WHILE.

   2 I DO NOT LIKE THE HASSLE OF GOVERNMENT PROGRAMS.

   3 MANAGEMENT _____

   4 OTHER _____

THE LAND ON YOUR FARM

The CRP started in 1986. The original rules did not allow for putting in filter strips. Instead, highly erodible land was eligible for the program. Erosion happens when soil blows or when topsoil washes away. Almost all farms have some places that are prone to erosion during some times of the year, if they're not managed carefully.

- *Soil erosion can lower crop yields.*
- *Sediment from erosion ends up in streams and lakes.*

6. The technical name for land that erodes above a critical level is "highly erodible." Do you think that you have any "highly erodible cropland" on your farm? (circle number)

   1 YES

   2 NO

7. Has it been determined by the Soil Conservation Service (SCS) that you have "highly erodible cropland" (HEL) on your farm? (circle number)

   1 YES

   2 NO

   3 DON'T KNOW

HOW DOES ENROLLING HIGHLY ERODIBLE LAND DIFFER FROM FILTER STRIPS?

- *2/3 of a field must be "highly erodible" to be put into the CRP. To qualify, the cropland must have been harvested two of the years between 1981 and 1985.*
- *The acreage put into the CRP must be planted to a permanent vegetative cover, either grass, legumes or trees. ASCS (Agricultural Stabilization and Conservation Service) pays 50% of the cost of establishing permanent vegetative cover. Haying is allowed only in years of severe drought.*

8. Please make your best estimate of how many acres of highly erodible cropland on your farm would qualify for the Conservation Reserve Program. (Consult aerial farm map)

_____ HIGHLY ERODIBLE ACRES

9. During future sign-ups, suppose the yearly payment was $65.00 each year for each acre of highly erodible land you put into the CRP for ten years. Would you put any land into the program? (circle number)

1 YES

2 NO — If NO, please skip to Question 13.

10. If you answered YES to Question 9, how many acres of highly erodible land would you agree to put into the CRP for ten years if the yearly payment were $65.00 per year?

_____ ACRES

11. Currently, in Newaygo County, the maximum yearly payment offered to CRP participants is $40.00 per acre. How many acres would you consider retiring for ten years at $40.00 per acre per year?

_____ ACRES

12. Suppose the public funds for the program ran out and the program could no longer offer a $65.00 per acre yearly payment. What is the lowest yearly payment you would consider to retire this _____ acres from crop production? (Probe up from $40.00 in $5.00 increments.)

$ _____ PER ACRE — Please skip to Question 14.

13. If NO, suppose that public funds became available to offer higher payments for landowners retiring highly erodible land. What kind of a yearly payment would you need to put your eligible acres into the CRP? (Probe: $5.00 increments)

$ _____ PER ACRE

_____ ACRES

14. If haying was allowed every year, how many acres of highly erodible land would you enter into the CRP for a yearly payment of $65.00?

_____ ACRES WITH HAYING ALLOWED

15. In your opinion, would the <u>costs</u> of putting in and managing filter strips be more or less than the costs of retiring highly erodible land?

1 FILTER STRIPS WOULD COST MORE.

2 FILTER STRIPS WOULD COST LESS.

3 THE COSTS WOULD BE SIMILIAR.

4 I DON'T KNOW.

16. In your opinion, should the yearly CRP <u>payments</u> for filter strips and for highly erodible land should be the same or different?

1 HIGHER FOR FILTER STRIPS: $ _____

2 LOWER FOR FILTER STRIPS: $ _____

3 SAME

CRITICAL FACTORS IN SELECTING A CRP BID

The land you are thinking about putting into the CRP is now, or was recently, in production. Let's think about what that land is worth when you are farming it. In this next section, we will work step by step through how your revenues and expenses would change if you put acreage into the CRP.

17. In this section, we will talk about the costs and benefits of enrolling either filter strips or highly erodible land, or both, into the CRP.

A. _____ ACRES OF HIGHLY ERODIBLE LAND

B. _____ ACRES OF FILTER STRIPS

CHANGES IN YOUR ENTERPRISE MIX

18. In 1987, you farmed a total of _____ acres. In the mail survey, you said that (the following enterprises) contribute an important share of your cash income. What share of your cash income comes from each of them?

19. Would you expect your cash income from these enterprises to change if you put acreage into the CRP?

	18. PROPORTION	19. CHANGE (CIRCLE ONE)
1 DAIRY	A. _____ %	A. UP DOWN
2 LIVESTOCK	B. _____ %	B. UP DOWN
3 CORN	C. _____ %	C. UP DOWN
4 HAY/ALFALFA	D. _____ %	D. UP DOWN

	18. PROPORTION	19. CHANGE (CIRCLE ONE)
5 ORCHARDS	E. _____ %	E. UP DOWN
6 ANNUAL VEGETABLES	F. _____ %	F. UP DOWN
7 OTHER _____	G. _____ %	G. UP DOWN
8 OTHER _____	H. _____ %	H. UP DOWN

CHANGES IN FARM EQUIPMENT REQUIREMENTS

17. If you entered the CRP, how would your use of farm machinery change?

1 INVEST IN A MOWER

2 BORROW A MOWER

3 LESS USE OF FIELD EQUIPMENT

4 LESS USE OF HAYING EQUIPMENT

5 LESS USE OF LIVESTOCK EQUIPMENT

6 OTHER _____

18. Would you sell any farm equipment?

1 YES

2 NO

19. Would you slow down replacements of farm machinery?

1 YES

2 NO

20. Please estimate your net savings from changes in farm equipment requirements if you put acreage into the CRP.

$ _____ PER ACRE

CHANGES IN OPERATING EXPENSES

21. If you put acreage into the CRP, how many of your expenses for farm supplies would go down by more than 10%?

1 FERTILIZER

2 PESTICIDES AND HERBICIDES

3 SEED

4 FUEL

5 INTEREST EXPENSES (BORROWING)

6 NO SIGNIFICANT CHANGES

7 OTHER _____

22. Please estimate your net savings from lower operating costs if you put acreage into the CRP.

$ _____ PER ACRE

23. What type of permanent vegetative cover would you establish on your CRP acreage?

1 GRASSES/LEGUMES

2 WILDLIFE HABITAT

3 TREES

23. What is your best estimate of your costs for establishing one acre of land in a permanent vegetative cover?

$_____ PER ACRE FOR H.E.L.

$_____ PER ACRE FOR FILTER STRIPS

24. What is your best estimate of your costs for maintaining one acre of land in a permanent vegetative cover for one year?

A. $_____ PER ACRE FOR H.E.L.

B. $_____ PER ACRE FOR FILTER STRIPS

CHANGES IN YOUR FARM LABOR REQUIREMENTS

25. Would putting acreage into the CRP mean a significant change in the number of people working and in how much they work?

1 LESS LABOR REQUIRED

2 NO CHANGE — Please skip to Question 28.

26. Please estimate the cost savings which would result from changes in labor requirements if you enroll acreage in the CRP.

$ _____ PER ACRE

27. What would you do with the extra time/labor?

1 OFF-FARM EMPLOYMENT
2 LAY OFF HIRED HELP
3 CUT DOWN MY WORK LOAD
4 CUT DOWN FAMILY MEMBERS' WORK LOAD
5 RETIREMENT
6 OTHER _____

FUTURE EXPECTATIONS

In the mail survey, you said that overall you expect farm prices to rise _____ than inflation. On the farm, your revenues are based on the market prices of what you produce plus your payments from participating in farm programs. Let's look at what you think might happen over the next ten years.

28. What do you expect will happen to the market prices of your farm products over the next ten years relative to general inflation? (trend)
(CIRCLE ONE)

1	DAIRY	UP	DOWN	NO CHANGE
2	LIVESTOCK	UP	DOWN	NO CHANGE
3	CORN	UP	DOWN	NO CHANGE
4	HAY/ALFALFA	UP	DOWN	NO CHANGE
5	ORCHARDS	UP	DOWN	NO CHANGE
6	VEGETABLES	UP	DOWN	NO CHANGE
7	OTHER _____	UP	DOWN	NO CHANGE
8	OTHER _____	UP	DOWN	NO CHANGE

9 DON'T KNOW FOR ALL COMMODITIES

29. Government farm programs are an important source of farm income for many landowners. Which farm programs have you been involved with in the past?

1 PRICE SUPPORTS
2 SET-ASIDE PAYMENTS
3 DAIRY PROGRAMS
4 COST-SHARING FOR CONSERVATION
5 COST-SHARING TO PLANT TREES
6 OTHER_____

30. If you were to put acreage into the CRP, if you would lose "base," approximately how much less would your receive in payments from farm programs?

1 ABOUT $_____ PER ACRE LESS
2 NO CHANGE IN FARM PROGRAM PAYMENTS

31. Over the next ten years, do you predict that you will receive more, less, or about the same amount from government programs?

1 MORE
2 LESS
3 ABOUT THE SAME
4 DON'T KNOW

32. If you sign a CRP contract for a yearly payment of $65.00, then you know that you will receive this amount each year for the next ten years. Unlike other farm programs, the CRP offers you a "sure thing." Is that important to you?

1 YES
2 NO
3 HAD NOT CONSIDERED IT

33. Would you think of the yearly CRP payment as an important way to meet your fixed expenses, such as land taxes or real estate mortgage payments, or to save for the future?

1 LAND TAXES
2 REAL ESTATE MORTGAGE PAYMENTS
3 RETIREMENT FUND
4 EDUCATION FOR MY CHILDREN
5 OTHER _____
8

34. Do you expect any changes in the ownership of your farm over the next then years?

1 YES

2 NO

3 DON'T KNOW

35. Some of your expenses, like land taxes and real estate mortgage payments, must be paid regardless of what happens to farm prices or inflation. In the mail survey, you said that you expect farm prices to rise _____ than inflation. As the program stands now, you would receive the same CRP payment each year, no matter what happens to prices or inflation. Suppose that CRP payments were adjusted every year so that payments would keep up with inflation. How many more of your eligible acres would you consider putting into the CRP?

_____ MORE OF MY ELIGIBLE ACRES

36. If the yearly payment were adjusted to keep up with inflation, would you consider entering the CRP for a lower yearly payment?

1 YES: $ _____ PER ACRE PER YEAR

2 NO

The nitty-gritty part of the interview is over. Let's look back over the list which we discussed earlier before going on. How do the costs associated with entering the CRP compare with your possible savings from entering the CRP?

COSTS OF ENTERING THE CRP:

37. Establishing permanent vegetative cover (Question 23) $ _____ PER ACRE PER YEAR (consider cost-sharing)

38. Maintaining the CRP acreage (Question 24) $ _____ PER ACRE PER YEAR

POSSIBLE SAVINGS FROM ENTERING THE CRP:

39. Net change: farm equipment costs (Question 20) $ _____ PER ACRE PER YEAR

40. Net change: operating expenses (Question 22) $ _____ PER ACRE PER YEAR

41. Net change: farm labor (Question 26) $ _____ PER ACRE PER YEAR

42. Net change: farm program payments (Question 30) $ _____ PER ACRE PER YEAR

43. At the beginning of the interview, you said you would be interested in entering the CRP for a $ _____ yearly payment. Does looking at this specific lis of the costs of entering the CRP and the possible savings from participating sugest that you might change your earlier CRP bid?

A. $ _____ PER ACRE PER YEAR (FILTER STRIPS)

B. $ _____ PER ACRE PER YEAR (HIGHLY ERODIBLE LAND)

44. Among the factors we just discussed, which were the most important for you in deciding how much to bid for the CRP? (Code from Question 37-42.)

A. _____ MOST IMPORTANT

B. _____ SECOND MOST IMPORTANT

Alternative uses of CRP acreage:

45. If you enter the CRP, you can choose to plant grasses, shrubs and trees which provide good wildlife habitat. 50% cost-sharing is available from ASCS for wildlife plantings on CRP acreage. How many of your CRP acres would you manage as wildlife habitat?

A. _____ ACRES OF FILTER STRIPS

B. _____ ACRES OF HIGHLY ERODIBLE LAND

46. 50% cost-sharing from ASCS is available to you if you plant trees on your CRP acreage. Would you consider planting trees?

1 YES

2 NO — If NO, then please skip to Question 48.

47. If YES, then how many acres of trees would you plant?

A. _____ ACRES ON FILTER STRIPS

B. _____ ACRES ON HIGHLY ERODIBLE LAND

48. If NO, you would not plant trees, then why not?

1 HIGH MAINTENANCE COSTS

2 HIGH ESTABLISHMENT COSTS

3 FLEXIBILITY TO RETURN THE LAND TO PRODUCTION AFTER 10 YEARS

4 POOR SOILS ON CRP ACREAGE

5 OTHER _____

Conservation efforts on your farm:

49. Do you receive a newsletter from the Newaygo County Soil Conservation District?

1 YES

2 NO — If no, then please skip to Question 59.

50. According to the records, you developed a conservation plan with the Newaygo County Soil Conservation District in _____. (year) When is the last time you remember anyone visiting from the District?

_____ DATE OF LAST VISIT

51. Which of these conservation practices have you tried on your farm to help control soil erosion?

1 PERMANENT VEGETATIVE COVER	5 TERRACES
2 STRIP CROPPING	6 GRASSED WATERWAYS
3 MINIMUM TILLAGE	7 WIND BREAKS (TREES)
4 NO TILL	8 OTHER _____

52. Have you ever received cost-sharing from ASCS to install conservation practices on your farm?

1 YES

2 NO — If NO, then please skip to Question 62.

53. If YES, then for what kinds of practices?

1 PERMANENT VEGETATIVE COVER	5 TERRACES
2 STRIP CROPPING	6 GRASSED WATERWAYS
3 MINIMUM TILLAGE	7 WIND BREAKS (TREES)
4 NO TILL	8 OTHER _____

_____

_____

We appreciate your taking the time and effort to give your opinions for this research project. If you have any additional comments, we will consider them carefully. Thank you!

APPENDIX C

DATA LISTS

To perform hypothesis tests, Tobit equations were estimated using data from a mail survey conducted among a random sample of 600 landowners in Newaygo County, Michigan in August, 1988.

In this Appendix, questions used to elicit data to specify the explanatory variables are identified. They are labeled according to the numbering system used on the mail survey instrument. (A copy of the mail questionnaire is displayed in Appendix A.) Procedures used to group responses in order to specify dichotomous variables are described. Following these descripitons, a list of the data used to estimate Tobit equations is provided.

Participation

The dependent variable (FSTOBIT) is the proportion of eligible acreage set aside as filter strips (Ratio; Response to Question 5 over the response to Question 3).

HAYTOBIT is the proportion of eligible acreage set aside as filter strips <u>with haying allowed</u> (Ratio; Response to Question 6 over the response to Question 3).

Payment

Twelve different versions of the mail questionnaire were distributed randomly among respondents. PAYMENT is the yearly payment offer presented to each particular respondent ($20, $35, $45, $65, $80,

$90, $100, $125, $150, $175, $200, or $550).

Preferences

To test the hypothesis that PREF make a difference in landowners' decisions about conservation, two variables are specified to show whether landowners consider conserving soil and environmental quality important reasons for setting aside filter strips.

Conserving soil (SCETHIC): A dummy variable measures whether or not respondents selected "concern about conserving soil on my farm" as an important reason to enroll acreage in filter strips (Question 8, Response 4).

Environmental quality (ENVETHIC): A second dummy variable shows whether or not respondents consider "concern about the environment" as an important reason to set aside filter strips on their farms (Question 8, Response 5).

Opportunity costs

Four variables represent farmers' OC from retiring cropland to set aside filter strips: yield, rent, income and farm income.

Yield (YIELD): The yield variable is an estimate of the average expected corn yield for the acreage eligible for filter strips (Question 7).

Rent (RENT): The estimated cash rent for the most productive land on the farm is a measure of the opportunity cost of land. Two values for estimated cash rental rates were collected on the CV questionnaire, for the most productive and the least productive cropland on the farm. The estimated cash rents for the most productive cropland on the farm was chosen to specify this variable. Opinions

expressed in personal interviews with Newaygo County farmers during August, 1988 indicate that, in most cases, in Newaygo County the acreage eligible for filter strips among the most productive cropland on the farm (Question 12).

Farm income (FINCOME): Farm income is included as a in the group of opportunity cost variables. Respondents reported their farm incomes as a percentage of family income. These proportions, ranging from zero to 100-percent, are used to specify this variable (Question 18).

Household income (INCOME): Respondents indicated the level of their 1987 household income within a $15,000 range. The mean value for is evaluated as an estimate of family income. For example, for individuals who responded that their household income is between $15,000 and $30,000, $22,500 is the observed value (Question 19).

Farm types:

Respondents to the mail questionnaire indicated which enterprise(s) on their farms contribute an important share of cash income: dairy, livestock, corn, hay and alfalfa, orchards, and annual vegetables (DAIRY, LIVESTCK, CORN, HAY, ORCHARDS, VEG). Respondents could select as many of the enterprises as apply to describe their farm activities (Question 10).

Transaction costs

Four variables are designated as proxies for the effect of transaction costs on landowners' decisions about enrolling filter strips: contact with ASCS or SCS in the past three years, tenure arrangements, and the proportion of acreage eligible for the CRP compared with the total cropland on the farm.

ASCS and SCS contacts (ASCS, SCS): Two dummy variables are included in the group of TC variables to indicate whether or not respondents have had contact with ASCS and SCS within the past three years (Question 15).

Tenure (TENURE): A third dummy variable is tested to capture the effect of rental arrangements on a landowner's decision to enroll filter strips in the CRP. This dichotomous variable distinguishes between those who rent over fifty percent of the land they farm and those who own the majority of their cropland (Question 11).

Proportion of acreage eligible for filter strips (PROPELG): This variable represents the relationship between the number of acres eligible for filter strips compared with the total cropland acreage farmed (Ratio; Question 3 over the sum of parts A and B of Question 11).

Future expectations

Two dummy variables describe how FE are likely to affect landowners decisions about participating in the CRP: one describes price expectations over the next ten years and the other gauges willingness to enter a ten year contract.

Length of contract (TOOLONG): In the CV context, landowners who were not interested in filter strips were asked to respond to a list of reasons for not accepting the yearly payment offered. This variable distinguishes those respondents who reacted positively to the statement "ten years is too long to be tied to a fixed payment" (Question 9, Response 5).

Price expectations (PEXPECT): Respondents were asked whether

they believe farm prices will rise faster or slower than inflation. This dummy variable compares respondents who believe that farm prices will rise slower than inflation (PEXPECT = 1) with other respondents (PEXPECT = 0) who believe farm prices will either keep up with or outpace inflation (Question 14).

Non-categorized variables

Three explanatory variables are identified which are likely to play a role in farmers' decisions about setting aside filter strips. Age and education might be categorized in more than one of the groups of economic factors designated. Farm size (the total number of acres of cropland on a farm) is likely to be collinear with the variable representing farm income. These three non-categorized (NC) variables are analyzed in a separate group.

Age (AGE): The respondent's age is measured in years (Question 16).

Education level (EDUCATE): This variable shows how many years of schooling the respondent has completed (Question 17).

Farm size (TOT): The total number of acres of cropland farmed in 1987, including both owned and rented acreage, is used to indicate the size of the farm operation (Question 11, the sum of parts A and B).

Data lists

Tobit equations were estimated using 22 explanatory variables and 93 observations. The data set is comprised of only observations where all of the data is complete for each explanatory variable. The data set is listed by variable and is labeled using the acronyms identified in the preceding section of this Appendix.

LISTING OF RAW DATA (Current sample)

Line	Observ.	PAYMENT	FSTOBIT	HAYTOBIT	SCETHIC	ENVETHIC
1	2	80.000	96.150	96.150	1.0000	.00000
2	3	80.000	.00000	75.760	1.0000	.00000
3	4	80.000	50.000	100.00	1.0000	1.0000
4	5	80.000	100.00	100.00	1.0000	.00000
5	6	80.000	47.350	100.00	.00000	.00000
6	8	35.000	46.150	76.920	1.0000	.00000
7	9	35.000	100.00	100.00	1.0000	1.0000
8	11	35.000	.00000	.00000	.00000	.00000
9	12	35.000	.00000	100.00	1.0000	1.0000
10	16	35.000	.00000	100.00	1.0000	.00000
11	18	35.000	.00000	100.00	1.0000	.00000
12	22	45.000	.00000	.00000	.00000	.00000
13	23	45.000	.00000	.00000	1.0000	1.0000
14	25	45.000	71.090	71.090	1.0000	1.0000
15	26	45.000	.00000	100.00	1.0000	1.0000
16	28	45.000	100.00	100.00	1.0000	1.0000
17	29	45.000	.00000	.00000	.00000	.00000
18	32	65.000	.00000	100.00	1.0000	1.0000
19	34	65.000	.00000	.00000	.00000	.00000
20	38	65.000	75.000	75.000	1.0000	1.0000
21	40	65.000	.00000	100.00	1.0000	1.0000
22	43	65.000	.00000	100.00	1.0000	1.0000
23	44	80.000	100.00	100.00	1.0000	1.0000
24	45	80.000	100.00	100.00	1.0000	1.0000
25	47	80.000	.00000	.00000	.00000	.00000
26	49	80.000	.00000	100.00	1.0000	1.0000
27	53	80.000	.00000	100.00	.00000	.00000
28	54	90.000	100.00	100.00	1.0000	1.0000
29	56	90.000	100.00	100.00	.00000	.00000
30	57	90.000	100.00	100.00	1.0000	.00000
31	59	90.000	.00000	100.00	1.0000	1.0000
32	62	90.000	100.00	100.00	1.0000	1.0000
33	63	90.000	.00000	.00000	1.0000	.00000
34	65	90.000	100.00	100.00	1.0000	.00000
35	66	90.000	100.00	100.00	1.0000	1.0000
36	67	90.000	66.670	100.00	.00000	1.0000
37	68	90.000	100.00	100.00	1.0000	1.0000
38	70	100.00	.00000	100.00	.00000	.00000
39	72	100.00	100.00	100.00	.00000	.00000
40	73	100.00	.00000	100.00	.00000	.00000
41	77	100.00	100.00	100.00	1.0000	1.0000
42	79	100.00	100.00	100.00	1.0000	1.0000
43	81	125.00	31.250	31.250	.00000	1.0000
44	82	125.00	.00000	.00000	.00000	.00000
45	85	125.00	100.00	100.00	1.0000	1.0000
46	89	125.00	.00000	100.00	1.0000	1.0000

LISTING OF RAW DATA (Current sample)

Line	Observ.	PAYMENT	FSTOBIT	HAYTOBIT	SCETHIC	ENVETHIC
47	90	125.00	.00000	100.00	1.0000	.00000
48	91	125.00	50.000	100.00	1.0000	.00000
49	92	125.00	100.00	100.00	1.0000	1.0000
50	95	150.00	100.00	100.00	.00000	.00000
51	96	150.00	.00000	.00000	.00000	.00000
52	97	150.00	100.00	100.00	1.0000	1.0000
53	98	150.00	100.00	100.00	1.0000	.00000
54	99	150.00	73.680	100.00	1.0000	1.0000
55	100	150.00	.00000	.00000	1.0000	.00000
56	103	150.00	100.00	100.00	1.0000	1.0000
57	104	150.00	.00000	100.00	.00000	.00000
58	106	175.00	.00000	100.00	1.0000	.00000
59	107	175.00	.00000	.00000	1.0000	1.0000
60	108	175.00	100.00	100.00	1.0000	1.0000
61	109	175.00	100.00	100.00	1.0000	1.0000
62	110	175.00	.00000	100.00	1.0000	.00000
63	114	200.00	100.00	100.00	.00000	.00000
64	115	200.00	100.00	100.00	.00000	1.0000
65	116	200.00	100.00	64.290	1.0000	1.0000
66	117	200.00	.00000	100.00	1.0000	1.0000
67	119	200.00	.00000	96.770	1.0000	.00000
68	121	200.00	100.00	100.00	1.0000	1.0000
69	125	550.00	43.360	43.360	1.0000	1.0000
70	126	550.00	100.00	100.00	1.0000	1.0000
71	129	550.00	83.330	83.330	1.0000	1.0000
72	130	550.00	100.00	100.00	1.0000	1.0000
73	131	550.00	100.00	100.00	1.0000	1.0000
74	132	550.00	100.00	100.00	.00000	.00000
75	133	550.00	.00000	100.00	.00000	.00000
76	134	550.00	100.00	100.00	1.0000	.00000
77	135	550.00	100.00	100.00	1.0000	.00000
78	136	80.000	.00000	.00000	1.0000	1.0000
79	139	90.000	75.630	75.630	1.0000	1.0000
80	141	100.00	.00000	50.000	.00000	.00000
81	143	100.00	100.00	100.00	1.0000	.00000
82	145	100.00	.00000	.00000	.00000	.00000
83	149	100.00	100.00	100.00	1.0000	1.0000
84	150	45.000	.00000	100.00	1.0000	1.0000
85	153	45.000	.00000	100.00	1.0000	1.0000
86	155	80.000	100.00	100.00	1.0000	.00000
87	156	90.000	.00000	100.00	1.0000	1.0000
88	157	100.00	100.00	100.00	1.0000	1.0000
89	158	150.00	100.00	100.00	1.0000	1.0000
90	159	550.00	100.00	60.000	1.0000	.00000
91	160	550.00	.00000	.00000	.00000	.00000
92	162	200.00	100.00	100.00	1.0000	1.0000
93	164	35.000	.00000	.00000	.00000	.00000

LISTING OF RAW DATA (Current sample)

Line	Observ.	YIELD	RENT	INCOME	FINCOME	TOTACRES
1	2	80.000	60.000	52500.	52500.	57.000
2	3	80.000	40.000	15000.	15000.	173.00
3	4	80.000	50.000	22500.	2250.0	52.000
4	5	87.000	40.000	22500.	22500.	710.00
5	6	70.000	50.000	22500.	22500.	380.00
6	8	80.000	37.500	37500.	5625.0	65.000
7	9	100.00	100.00	82500.	82500.	740.00
8	11	115.00	55.000	82500.	28875.	440.00
9	12	70.000	30.000	22500.	3375.0	104.00
10	16	90.000	50.000	22500.	14625.	460.00
11	18	140.00	100.00	22500.	22500.	500.00
12	22	100.00	50.000	67500.	20250.	290.00
13	23	100.00	50.000	22500.	.00000	70.000
14	25	85.000	40.000	37500.	1875.0	160.00
15	26	100.00	55.000	52500.	2625.0	29.000
16	28	75.000	35.000	22500.	9450.0	276.00
17	29	100.00	25.000	22500.	22500.	120.00
18	32	110.00	60.000	22500.	6750.0	33.000
19	34	100.00	40.000	22500.	4500.0	80.000
20	38	130.00	70.000	15000.	15000.	300.00
21	40	80.000	50.000	37500.	1125.0	17.000
22	43	100.00	50.000	15000.	15000.	200.00
23	44	60.000	35.000	15000.	.00000	50.000
24	45	60.000	70.000	22500.	450.00	23.000
25	47	110.00	50.000	22500.	225.00	10.000
26	49	80.000	20.000	37500.	28125.	40.000
27	53	90.000	50.000	37500.	37500.	1050.0
28	54	90.000	83.000	22500.	450.00	6.0000
29	56	80.000	30.000	22500.	225.00	30.000
30	57	110.00	35.000	22500.	.00000	161.00
31	59	60.000	40.000	22500.	22500.	34.000
32	62	85.000	40.000	.11250E+06	22500.	140.00
33	63	90.000	35.000	22500.	11250.	50.000
34	65	90.000	25.000	37500.	3750.0	130.00
35	66	30.000	75.000	22500.	225.00	55.000
36	67	120.00	80.000	52500.	52500.	911.00
37	68	70.000	40.000	22500.	22500.	58.000
38	70	100.00	50.000	15000.	7500.0	54.000
39	72	33.000	.00000	15000.	.00000	24.000
40	73	140.00	75.000	37500.	3750.0	50.000
41	77	100.00	50.000	37500.	7500.0	80.000
42	79	40.000	10.000	22500.	2250.0	255.00
43	81	120.00	250.00	22500.	18000.	500.00
44	82	80.000	35.000	22500.	2250.0	40.000
45	85	85.000	50.000	52500.	21000.	80.000
46	89	100.00	80.000	52500.	5250.0	68.000

LISTING OF RAW DATA (Current sample)

Line	Observ.	YIELD	RENT	INCOME	FINCOME	TOTACRES
47	90	100.00	85.000	67500.	6750.0	60.000
48	91	70.000	50.000	37500.	37500.	600.00
49	92	80.000	50.000	37500.	5625.0	17.000
50	95	80.000	25.000	37500.	3750.0	70.000
51	96	125.00	60.000	52500.	52500.	500.00
52	97	60.000	50.000	67500.	60750.	400.00
53	98	110.00	35.000	37500.	750.00	100.00
54	99	85.000	40.000	82500.	8250.0	245.00
55	100	85.000	100.00	37500.	37500.	58.000
56	103	100.00	40.000	22500.	22500.	280.00
57	104	175.00	75.000	22500.	22500.	1000.0
58	106	100.00	50.000	37500.	15000.	115.00
59	107	85.000	30.000	37500.	375.00	30.000
60	108	90.000	30.000	52500.	525.00	24.000
61	109	85.000	50.000	97500.	4875.0	20.000
62	110	120.00	35.000	15000.	13500.	80.000
63	114	80.000	70.000	15000.	10500.	120.00
64	115	125.00	40.000	15000.	3000.0	18.000
65	116	87.000	25.000	37500.	750.00	104.00
66	117	40.000	50.000	37500.	1875.0	18.000
67	119	75.000	25.000	22500.	3375.0	30.000
68	121	100.00	30.000	15000.	12000.	160.00
69	125	95.000	40.000	22500.	16875.	350.00
70	126	85.000	50.000	15000.	1500.0	55.000
71	129	80.000	100.00	37500.	3750.0	183.00
72	130	90.000	50.000	37500.	7500.0	110.00
73	131	100.00	35.000	15000.	4500.0	90.000
74	132	120.00	60.000	52500.	36750.	377.00
75	133	100.00	25.500	15000.	150.00	55.000
76	134	95.000	45.000	37500.	7500.0	67.000
77	135	100.00	65.000	22500.	9000.0	105.00
78	136	100.00	300.00	37500.	37125.	195.00
79	139	80.000	25.000	15000.	15000.	152.00
80	141	125.00	30.000	22500.	22500.	200.00
81	143	100.00	20.000	37500.	9375.0	190.00
82	145	150.00	40.000	37500.	7500.0	280.00
83	149	80.000	40.000	37500.	3750.0	30.000
84	150	90.000	50.000	67500.	67500.	550.00
85	153	110.00	40.000	15000.	15000.	215.00
86	155	60.000	100.00	52500.	52500.	870.00
87	156	100.00	50.000	37500.	18750.	134.00
88	157	80.000	50.000	37500.	7500.0	50.000
89	158	90.000	50.000	37500.	1125.0	97.000
90	159	70.000	100.00	52500.	525.00	10.000
91	160	100.00	20.000	22500.	2250.0	50.000
92	162	90.000	40.000	52500.	7875.0	50.000
93	164	100.00	150.00	15000.	15000.	216.00

LISTING OF RAW DATA (Current sample)

Line	Observ.	FEXPECT	TOOLONG	AGE	EDUCATE	ORCHARDS
1	2	1.0000	.00000	24.000	12.000	.00000
2	3	.00000	.00000	38.000	13.000	.00000
3	4	1.0000	.00000	37.000	12.000	.00000
4	5	.00000	.00000	52.000	10.000	.00000
5	6	1.0000	.00000	65.000	12.000	.00000
6	8	1.0000	.00000	45.000	16.000	.00000
7	9	1.0000	.00000	43.000	12.000	.00000
8	11	1.0000	1.0000	54.000	20.000	.00000
9	12	.00000	.00000	64.000	10.000	.00000
10	16	1.0000	1.0000	39.000	16.000	.00000
11	18	1.0000	.00000	37.000	15.000	.00000
12	22	.00000	1.0000	41.000	12.000	.00000
13	23	.00000	.00000	56.000	10.000	.00000
14	25	1.0000	.00000	53.000	12.000	1.0000
15	26	.00000	1.0000	50.000	14.000	.00000
16	28	1.0000	.00000	45.000	17.000	.00000
17	29	.00000	1.0000	75.000	14.000	.00000
18	32	.00000	1.0000	50.000	12.000	.00000
19	34	.00000	.00000	44.000	13.000	.00000
20	38	1.0000	1.0000	48.000	12.000	.00000
21	40	1.0000	.00000	39.000	19.000	.00000
22	43	1.0000	.00000	64.000	13.000	1.0000
23	44	1.0000	.00000	52.000	13.000	.00000
24	45	.00000	.00000	54.000	17.000	1.0000
25	47	.00000	.00000	66.000	13.000	.00000
26	49	1.0000	1.0000	42.000	17.000	.00000
27	53	.00000	.00000	32.000	14.000	.00000
28	54	.00000	.00000	68.000	18.000	.00000
29	56	.00000	1.0000	50.000	14.000	.00000
30	57	.00000	.00000	43.000	13.000	.00000
31	59	.00000	.00000	47.000	14.000	.00000
32	62	1.0000	1.0000	60.000	17.000	.00000
33	63	.00000	.00000	74.000	8.0000	.00000
34	65	1.0000	.00000	52.000	12.000	.00000
35	66	.00000	.00000	63.000	12.000	.00000
36	67	.00000	.00000	39.000	14.000	.00000
37	68	.00000	1.0000	46.000	16.000	.00000
38	70	.00000	1.0000	68.000	9.0000	.00000
39	72	.00000	.00000	69.000	12.000	.00000
40	73	.00000	1.0000	57.000	14.000	.00000
41	77	1.0000	.00000	67.000	12.000	.00000
42	79	.00000	.00000	42.000	14.000	.00000
43	81	1.0000	.00000	38.000	17.000	.00000
44	82	.00000	1.0000	57.000	12.000	.00000
45	85	.00000	.00000	38.000	15.000	.00000
46	89	.00000	1.0000	51.000	19.000	.00000

LISTING OF RAW DATA (Current sample)

Line	Observ.	FEXPECT	TOOLONG	AGE	EDUCATE	ORCHARDS
47	90	1.0000	.00000	40.000	19.000	.00000
48	91	.00000	.00000	35.000	13.000	.00000
49	92	.00000	.00000	40.000	12.000	.00000
50	95	.00000	.00000	50.000	16.000	.00000
51	96	.00000	.00000	65.000	12.000	.00000
52	97	.00000	.00000	55.000	15.000	.00000
53	98	1.0000	.00000	45.000	12.000	.00000
54	99	.00000	.00000	32.000	17.000	.00000
55	100	.00000	1.0000	46.000	16.000	.00000
56	103	1.0000	.00000	40.000	13.000	.00000
57	104	1.0000	1.0000	30.000	12.000	.00000
58	106	1.0000	1.0000	60.000	13.000	.00000
59	107	1.0000	.00000	57.000	12.000	.00000
60	108	.00000	.00000	41.000	14.000	.00000
61	109	.00000	.00000	59.000	16.000	.00000
62	110	1.0000	1.0000	30.000	13.000	.00000
63	114	1.0000	.00000	46.000	11.000	.00000
64	115	.00000	1.0000	76.000	8.0000	.00000
65	116	1.0000	.00000	52.000	13.000	.00000
66	117	1.0000	.00000	31.000	19.000	1.0000
67	119	.00000	.00000	34.000	17.000	.00000
68	121	.00000	.00000	66.000	8.0000	.00000
69	125	.00000	.00000	50.000	15.000	.00000
70	126	1.0000	.00000	67.000	11.000	.00000
71	129	.00000	.00000	42.000	19.000	1.0000
72	130	.00000	1.0000	48.000	18.000	.00000
73	131	1.0000	.00000	30.000	12.000	.00000
74	132	1.0000	.00000	44.000	18.000	.00000
75	133	.00000	.00000	77.000	10.000	.00000
76	134	.00000	1.0000	24.000	13.000	.00000
77	135	.00000	.00000	71.000	8.0000	.00000
78	136	.00000	.00000	31.000	14.000	.00000
79	139	1.0000	.00000	45.000	12.000	.00000
80	141	.00000	1.0000	48.000	12.000	.00000
81	143	1.0000	.00000	27.000	16.000	.00000
82	145	1.0000	.00000	48.000	12.000	.00000
83	149	1.0000	1.0000	36.000	12.000	.00000
84	150	.00000	1.0000	35.000	12.000	.00000
85	153	.00000	1.0000	-999.00	13.000	.00000
86	155	.00000	.00000	46.000	12.000	.00000
87	156	.00000	1.0000	27.000	12.000	.00000
88	157	1.0000	.00000	58.000	18.000	.00000
89	158	.00000	.00000	55.000	17.000	.00000
90	159	.00000	1.0000	50.000	17.000	.00000
91	160	1.0000	1.0000	38.000	12.000	.00000
92	162	1.0000	.00000	38.000	12.000	1.0000
93	164	.00000	.00000	46.000	14.000	.00000

LISTING OF RAW DATA (Current sample)

Line	Observ.	SCS	ASCS	PROPELG	TENURE
1	2	1.0000	1.0000	18.250	.00000
2	3	.00000	1.0000	2.2900	.00000
3	4	.00000	1.0000	11.540	1.0000
4	5	.00000	1.0000	1.4100	.00000
5	6	1.0000	1.0000	8.3400	.00000
6	8	1.0000	1.0000	40.000	1.0000
7	9	.00000	1.0000	13.650	.00000
8	11	1.0000	1.0000	.91000	.00000
9	12	.00000	1.0000	2.8800	1.0000
10	16	1.0000	1.0000	6.7400	.00000
11	18	.00000	1.0000	1.6000	.00000
12	22	.00000	1.0000	1.7200	.00000
13	23	.00000	1.0000	15.000	1.0000
14	25	1.0000	1.0000	26.380	1.0000
15	26	.00000	1.0000	9.4800	1.0000
16	28	1.0000	1.0000	4.3500	.00000
17	29	.00000	.00000	23.330	.00000
18	32	.00000	1.0000	39.390	.00000
19	34	.00000	1.0000	3.1300	.00000
20	38	1.0000	1.0000	6.6700	.00000
21	40	1.0000	.00000	35.290	1.0000
22	43	.00000	1.0000	2.5000	1.0000
23	44	1.0000	1.0000	5.0000	1.0000
24	45	1.0000	1.0000	22.960	1.0000
25	47	.00000	.00000	15.000	1.0000
26	49	.00000	.00000	7.5000	1.0000
27	53	1.0000	1.0000	1.4300	.00000
28	54	.00000	1.0000	50.000	1.0000
29	56	.00000	1.0000	33.330	1.0000
30	57	.00000	1.0000	3.1100	1.0000
31	59	.00000	1.0000	23.290	1.0000
32	62	1.0000	1.0000	2.1400	.00000
33	63	1.0000	1.0000	1.0000	1.0000
34	65	.00000	1.0000	16.150	.00000
35	66	.00000	1.0000	4.5500	.00000
36	67	.00000	1.0000	.33000	.00000
37	68	1.0000	1.0000	6.9000	1.0000
38	70	.00000	1.0000	3.5200	1.0000
39	72	1.0000	1.0000	41.670	1.0000
40	73	1.0000	1.0000	12.000	1.0000
41	77	1.0000	1.0000	3.7500	1.0000
42	79	.00000	1.0000	10.200	.00000
43	81	.00000	1.0000	8.0000	.00000
44	82	1.0000	1.0000	10.500	1.0000
45	85	1.0000	1.0000	10.630	1.0000
46	89	.00000	.00000	4.9000	1.0000

LISTING OF RAW DATA (Current sample)

Line	Observ.	SCS	ASCS	PROPELG	TENURE
47	90	.00000	1.0000	17.500	1.0000
48	91	1.0000	1.0000	2.6700	.00000
49	92	1.0000	.00000	17.650	1.0000
50	95	1.0000	.00000	12.860	1.0000
51	96	.00000	.00000	1.4000	.00000
52	97	1.0000	1.0000	1.9500	.00000
53	98	1.0000	1.0000	2.6400	1.0000
54	99	1.0000	1.0000	7.7600	.00000
55	100	1.0000	1.0000	8.6200	1.0000
56	103	1.0000	1.0000	2.8200	.00000
57	104	.00000	1.0000	1.4600	.00000
58	106	.00000	1.0000	6.8700	.00000
59	107	.00000	1.0000	20.000	1.0000
60	108	.00000	.00000	29.170	.00000
61	109	.00000	1.0000	55.000	1.0000
62	110	1.0000	1.0000	6.6000	1.0000
63	114	.00000	1.0000	10.000	1.0000
64	115	.00000	1.0000	18.890	.00000
65	116	.00000	1.0000	13.460	1.0000
66	117	.00000	1.0000	16.670	1.0000
67	119	1.0000	1.0000	20.670	1.0000
68	121	.00000	1.0000	3.1300	1.0000
69	125	1.0000	1.0000	10.540	.00000
70	126	.00000	1.0000	4.7300	1.0000
71	129	.00000	1.0000	3.2800	.00000
72	130	1.0000	1.0000	7.2700	1.0000
73	131	.00000	1.0000	8.8900	1.0000
74	132	1.0000	1.0000	2.0400	.00000
75	133	.00000	.00000	28.800	.00000
76	134	.00000	1.0000	11.940	1.0000
77	135	.00000	1.0000	7.5200	.00000
78	136	1.0000	1.0000	21.540	.00000
79	139	.00000	1.0000	15.660	.00000
80	141	.00000	1.0000	2.5000	.00000
81	143	.00000	1.0000	5.2600	1.0000
82	145	.00000	.00000	21.690	1.0000
83	149	1.0000	1.0000	16.670	1.0000
84	150	1.0000	.00000	2.0400	.00000
85	153	1.0000	.00000	2.3300	.00000
86	155	.00000	1.0000	3.0300	.00000
87	156	1.0000	.00000	13.910	.00000
88	157	.00000	1.0000	8.0000	1.0000
89	158	1.0000	.00000	5.4400	.00000
90	159	.00000	.00000	50.000	1.0000
91	160	.00000	1.0000	24.160	1.0000
92	162	.00000	.00000	2.4000	.00000
93	164	1.0000	1.0000	15.000	.00000

LISTING OF RAW DATA (Current sample)

Line	Observ.	HAY	CORN	DAIRY	LIVESTCK	VEG
1	2	1.0000	1.0000	1.0000	.00000	.00000
2	3	.00000	.00000	1.0000	1.0000	.00000
3	4	1.0000	1.0000	.00000	1.0000	.00000
4	5	1.0000	1.0000	1.0000	.00000	.00000
5	6	.00000	.00000	1.0000	.00000	.00000
6	8	1.0000	.00000	.00000	1.0000	.00000
7	9	1.0000	1.0000	1.0000	1.0000	.00000
8	11	.00000	1.0000	.00000	.00000	.00000
9	12	1.0000	1.0000	.00000	1.0000	.00000
10	16	.00000	.00000	1.0000	.00000	.00000
11	18	.00000	.00000	1.0000	.00000	.00000
12	22	1.0000	1.0000	.00000	.00000	.00000
13	23	.00000	1.0000	.00000	.00000	.00000
14	25	.00000	1.0000	.00000	.00000	.00000
15	26	1.0000	1.0000	.00000	.00000	.00000
16	28	1.0000	1.0000	.00000	1.0000	.00000
17	29	.00000	.00000	1.0000	.00000	.00000
18	32	.00000	1.0000	.00000	.00000	1.0000
19	34	.00000	1.0000	.00000	1.0000	.00000
20	38	1.0000	1.0000	1.0000	.00000	1.0000
21	40	1.0000	.00000	.00000	.00000	.00000
22	43	1.0000	.00000	.00000	.00000	.00000
23	44	1.0000	.00000	.00000	.00000	.00000
24	45	1.0000	1.0000	.00000	.00000	.00000
25	47	1.0000	.00000	.00000	.00000	.00000
26	49	.00000	.00000	.00000	.00000	.00000
27	53	.00000	.00000	1.0000	1.0000	.00000
28	54	1.0000	.00000	.00000	.00000	.00000
29	56	.00000	.00000	.00000	.00000	.00000
30	57	1.0000	.00000	.00000	.00000	.00000
31	59	.00000	.00000	.00000	1.0000	.00000
32	62	.00000	.00000	.00000	1.0000	.00000
33	63	1.0000	.00000	.00000	1.0000	.00000
34	65	1.0000	1.0000	.00000	.00000	.00000
35	66	.00000	.00000	.00000	1.0000	.00000
36	67	1.0000	1.0000	1.0000	1.0000	.00000
37	68	1.0000	1.0000	.00000	.00000	1.0000
38	70	1.0000	1.0000	.00000	.00000	.00000
39	72	1.0000	1.0000	.00000	1.0000	.00000
40	73	1.0000	1.0000	.00000	.00000	.00000
41	77	1.0000	1.0000	.00000	.00000	.00000
42	79	1.0000	1.0000	.00000	1.0000	.00000
43	81	.00000	.00000	.00000	.00000	1.0000
44	82	.00000	1.0000	.00000	1.0000	.00000
45	85	1.0000	1.0000	.00000	.00000	.00000
46	89	.00000	.00000	.00000	1.0000	.00000

LISTING OF RAW DATA (Current sample)

Line	Observ.	HAY	CORN	DAIRY	LIVESTCK	VEG
47	90	1.0000	1.0000	.00000	.00000	.00000
48	91	1.0000	1.0000	.00000	1.0000	.00000
49	92	1.0000	1.0000	.00000	1.0000	.00000
50	95	.00000	1.0000	.00000	.00000	.00000
51	96	1.0000	1.0000	1.0000	.00000	.00000
52	97	.00000	.00000	.00000	.00000	1.0000
53	98	1.0000	1.0000	.00000	.00000	.00000
54	99	1.0000	1.0000	.00000	1.0000	.00000
55	100	.00000	.00000	.00000	.00000	1.0000
56	103	1.0000	.00000	1.0000	.00000	.00000
57	104	.00000	.00000	1.0000	.00000	1.0000
58	106	1.0000	1.0000	.00000	.00000	.00000
59	107	1.0000	1.0000	.00000	.00000	.00000
60	108	.00000	.00000	.00000	.00000	.00000
61	109	.00000	1.0000	.00000	1.0000	.00000
62	110	.00000	1.0000	.00000	1.0000	.00000
63	114	1.0000	1.0000	1.0000	.00000	.00000
64	115	1.0000	.00000	.00000	.00000	.00000
65	116	1.0000	1.0000	.00000	.00000	.00000
66	117	1.0000	.00000	.00000	.00000	.00000
67	119	.00000	.00000	.00000	1.0000	.00000
68	121	1.0000	1.0000	.00000	1.0000	.00000
69	125	1.0000	1.0000	1.0000	1.0000	.00000
70	126	1.0000	1.0000	.00000	.00000	.00000
71	129	.00000	.00000	.00000	.00000	1.0000
72	130	1.0000	1.0000	.00000	1.0000	.00000
73	131	1.0000	1.0000	.00000	1.0000	.00000
74	132	1.0000	1.0000	.00000	.00000	.00000
75	133	.00000	.00000	.00000	.00000	.00000
76	134	1.0000	.00000	.00000	1.0000	.00000
77	135	1.0000	1.0000	.00000	.00000	.00000
78	136	.00000	.00000	.00000	.00000	1.0000
79	139	.00000	.00000	.00000	1.0000	.00000
80	141	.00000	.00000	1.0000	.00000	.00000
81	143	1.0000	1.0000	.00000	.00000	.00000
82	145	.00000	1.0000	.00000	1.0000	1.0000
83	149	1.0000	1.0000	.00000	.00000	.00000
84	150	.00000	.00000	.00000	1.0000	.00000
85	153	1.0000	1.0000	1.0000	1.0000	.00000
86	155	.00000	.00000	.00000	.00000	1.0000
87	156	.00000	.00000	1.0000	.00000	.00000
88	157	.00000	.00000	.00000	1.0000	.00000
89	158	.00000	1.0000	.00000	.00000	.00000
90	159	1.0000	.00000	.00000	1.0000	.00000
91	160	1.0000	1.0000	.00000	.00000	.00000
92	162	.00000	.00000	.00000	1.0000	.00000
93	164	.00000	.00000	1.0000	1.0000	.00000

APPENDIX D

Table D.1: Correlation matrix with 22 variables

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
1-LPAYMENT	1.0000000				
2-LYIELD	.0076133	1.0000000			
3-LRENT	-.0531638	.3624903	1.0000000		
4-LINCOME	-.0373437	.0453193	.2123409	1.0000000	
5-LFINCOME	-.0630658	.2992895	.3916186	.2200041	1.0000000

BY

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
6-ASCS	-.0296068	-.1188480	.0527869	-.1549432	.0228452
7-SCS	-.1451798	-.0945223	-.0216696	.0976478	.1154802
8-LPROPELG	.1154242	-.2327822	-.1468989	-.0919557	-.3568234
9-TENURE	.1304355	-.1415013	-.2086913	-.0859112	-.4144444
10-TOOLONG	-.0430624	.2741986	.0221784	.0326313	.1816962

BY

	6-ASCS	7-SCS	8-LPROPELG	9-TENURE	10-TOOLONG
6-ASCS	1.0000000				
7-SCS	.0175226	1.0000000			
8-LPROPELG	-.1300664	-.0438145	1.0000000		
9-TENURE	.0430997	-.0280386	.3714712	1.0000000	
10-TOOLONG	-.1020321	.0715865	-.0105956	.0014983	1.0000000

BY

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
11-FEXPECT	-.0460999	.1448552	-.0009805	.0074141	.0956726
12-SCETHIC	.0003656	-.2854555	.0683131	.1529633	-.0217086
13-ENVETHIC	-.0209231	-.2111333	.0940197	.0621323	-.0501254
14-HAY	.1783022	-.0389590	-.1492927	-.0491320	-.1341926
15-CORN	.0722187	.0983549	-.1915097	.0575913	.0069232

BY

	6-ASCS	7-SCS	8-LPROPELG	9-TENURE	10-TOOLONG
11-FEXPECT	.1764138	.0099385	-.0046916	.0815818	-.1016665
12-SCETHIC	.0897420	.0858609	.0844299	.1409005	-.1677656
13-ENVETHIC	-.0479998	.0215462	.0984378	.0515083	-.1206449
14-HAY	.2072502	.0089623	-.0013409	.2887977	-.1184707
15-CORN	.1857452	.0900997	-.0096225	.1589972	-.0421289

BY

	11-FEXPECT	12-SCETHIC	13-ENVETHIC	14-HAY	15-CORN
11-FEXPECT	1.0000000				
12-SCETHIC	.1220839	1.0000000			
13-ENVETHIC	.0451152	.5078969	1.0000000		
14-HAY	.1221019	.1590796	.0655754	1.0000000	
15-CORN	.0706240	-.0141491	.0251631	.4772471	1.0000000

BY

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
16-DAIRY	-.2271838	.2672081	.1612478	-.1735221	.3649699
17-LIVESTCK	.0039368	-.2241921	-.1689284	-.0069138	.1064063
18-ORCHARDS	.0515707	-.1859805	.0781624	.0097946	-.0531543
19-VEG	.0150776	.1266424	.3627515	.0113115	.2198988
20-LAGE	.0940019	-.1071312	-.0709057	-.0026985	-.1962860

BY

	6-ASCS	7-SCS	8-LPROPELG	9-TENURE	10-TOOLONG
16-DAIRY	-.0232993	.0738903	-.2778762	-.4882203	.0431313
17-LIVESTCK	-.0239522	.0676025	-.0568871	.0185246	-.1060700
18-ORCHARDS	.0109591	-.0513323	.0041282	.0791074	-.1767767
19-VEG	.0870750	.0180788	-.0298161	-.1783895	.1128394
20-LAGE	.1554428	-.1811542	.1190766	.1470850	-.1501721

BY

	11-FEXPECT	12-SCETHIC	13-ENVETHIC	14-HAY	15-CORN
16-DAIRY	.0325064	-.2139090	-.1969835	-.0738923	-.1034820
17-LIVESTCK	-.1832766	.1333172	.1171190	-.0676025	.0114476
18-ORCHARDS	.1316178	.1592324	.2435372	-.0370733	-.1134844
19-VEG	-.0413564	-.0032302	.0725269	-.2870908	-.1359718
20-LAGE	-.0365261	-.1684993	-.0679339	-.0443740	-.0442305

BY

	16-DAIRY	17-LIVESTCK	18-ORCHARDS	19-VEG	20-LAGE
16-DAIRY	1.0000000				
17-LIVESTCK	-.0398643	1.0000000			
18-ORCHARDS	-.1374579	-.1188451	1.0000000		
19-VEG	-.0296278	-.2227156	.0393482	1.0000000	
20-LAGE	-.2588506	-.1791727	.0107116	-.0320077	1.0000000

BY

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
21-LEDUCATE	-.0202056	-.1316603	.1833236	.4260807	.0860595
22-LTOT	-.1971697	.2811518	.2069030	.1178794	.5013023

BY

	6-ASCS	7-SCS	8-LPROPEL6	9-TENURE	10-TODLONG
21-LEDUCATE	-.0864444	.2243202	.1217488	.0599293	.0323538
22-LTOT	.1806542	.1020273	-.6593900	-.6179524	-.0783934

BY

	11-FEXPECT	12-SCETHIC	13-ENVETHIC	14-HAY	15-CORN
21-LEDUCATE	.1196651	.1323193	.1273154	-.1754353	-.1739044
22-LTOT	.1227559	-.1400781	-.1554959	-.1530263	.0513409

BY

	16-DAIRY	17-LIVESTCK	18-ORCHARDS	19-VEG	20-LAGE
21-LEDUCATE	-.1165799	.0047831	.1443543	.0861610	-.1543253
22-LTOT	.5124319	.0410690	-.0869931	.2408611	-.1852939

BY

	21-LEDUCATE	22-LTOT
21-LEDUCATE	1.0000000	
22-LTOT	-.0540759	1.0000000

BY

Table D.2: Hypothesis-testing using the take-away approach

EQUATION[1]	HYPOTHESIS	LOG-LIKELIHOOD VALUE	TEST STAT	CHI-SQUARED VALUE	(L^R/L^U) RESULT
$\frac{R^{OC}}{U}$	Eliminating the set of OC variables does not change the explanatory power of the unrestricted equation in a statistically important way.	L^U = -128.47 L^R = -134.37 22 degrees of freedom	11.8 (90-percent confidence interval)	30.8	FAIL TO REJECT
$\frac{R^{TC}}{U}$	Eliminating the set of TC variables does not change the explanatory power of the unrestricted equation.	L^U = -128.47 L^R = -129.24 22 d.f.	1.54 90% C.I.	30.8	FAIL TO REJECT
$\frac{R^{FE}}{U}$	Eliminating the set of FE variables does not change the explanatory power of the unrestricted equation.	L^U = -128.47 L^R = -130.36 22 d.f.	3.78 90% C.I.	30.8	FAIL TO REJECT
$\frac{R^{PREF}}{U}$	Eliminating the set of PREF variables does not change the explanatory power of the unrestricted equation.	L^U = -128.47 L^R = 131.20 22 d.f.	5.46 90% C.I.	30.8	FAIL TO REJECT
$\frac{R^{NC}}{U}$	Eliminating the set of NC variables does not change the explanatory power of the unrestricted equation.	L^U = -128.47 L^R = -130.99 22 d.f.	5.04 90% C.I.	30.8	FAIL TO REJECT
$\frac{R^{FT}}{U}$	Eliminating the set of FT variables does not change the explanatory power of the unrestricted equation.	L^U = -128.47 L^R = -131.71 22 d.f.	6.48 90% C.I.	30.8	FAIL TO REJECT

[1] R^{OC} = (TC, FE, PREF, NC, FT)
R^{TC} = (OC, FE, PREF, NC, FT)
R^{FE} = (OC, TC, PREF, NC, FT)
R^{IP} = (OC, TC, FE, NC, FT)
R^{NC} = (OC, TC, FE, PREF, FT)
R^{FT} = (OC, TC, FE, PREF, NC)
U = (OC, TC, FE, PREF, NC, FT)

Table D.3: Hypothesis-testing using the add-to approach

EQUATION[2] (L^R/L^U)	HYPOTHESIS	LOG-LIKELIHOOD VALUE	TEST STAT	CHI-SQUARE VALUE	RESULT
$\frac{LPAYMENT}{U^{OC}}$	Eliminating the set of OC variables does not change the explanatory power of the equation in a statistically important way.	L^U = -142.24 L^R = -148.11 4 degrees of freedom	11.74 (95-percent confidence interval)	11.1	REJECT
$\frac{LPAYMENT}{U^{TC}}$	Eliminating the set of TC variables does not change the explanatory power of the equation.	L^U = -145.94 L^R = -148.11 5 d.f.	4.34 95% C.I.	11.1	FAIL TO REJECT
$\frac{LPAYMENT}{U^{FE}}$	Eliminating the set of FE variables does not change the explanatory power of the equation.	L^U = -143.32 L^R = -148.11 3 d.f.	9.58 95% C.I.	9.35	FAIL TO REJECT
$\frac{LPAYMENT}{U^{PREF}}$	Eliminating the set of PREF variables does not change the explanatory power of the equation.	L^U = -142.44 L^R = -148.11 3 d.f.	11.34 95% C.I.	11.3	REJECT
$\frac{LPAYMENT}{U^{NC}}$	Eliminating the set of NC variables does not change the explanatory power of the equation.	L^U = -146.26 L^R = -148.11 5 d.f.	3.7 95% C.I.	11.1	FAIL TO REJECT
$\frac{LPAYMENT}{U^{FT}}$	Eliminating the set of FT variables does not change the explanatory power of the equation.	L^U = -143.69 L^R = -148.11 7 d.f.	8.84 95% C.I.	14.1	FAIL TO REJECT

[2]LPAYMENT = Unrestricted equation with one explanatory variable
U^{OC} = f(LPAYMENT, OC)
U^{TC} = f(LPAYMENT, TC)
U^{FE} = f(LPAYMENT, FE)
U^{PREF} = f(LPAYMENT, PREF)
U^{NC} = f(LPAYMENT, SEC)
U^{FT} = f(LPAYMENT, FT)

Table D.4: Correlation matrix with 9 variables

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
1-LPAYMENT	1.0000000				
2-LYIELD	.0076133	1.0000000			
3-LRENT	-.0531638	.3624903	1.0000000		
4-LINCOME	-.0373437	.0453193	.2123409	1.0000000	
5-LFINCOME	-.0630658	.2992895	.3916186	.2200041	1.0000000

BY

	1-LPAYMENT	2-LYIELD	3-LRENT	4-LINCOME	5-LFINCOME
6-TOOLONG	-.0430624	.2741986	.0221784	.0326313	.1816962
7-FEXPECT	-.0460999	.1448552	-.0009805	.0074141	.0956726
8-SCETHIC	.0003656	-.2854555	.0683131	.1529633	-.0217086
9-ENVETHIC	-.0209231	-.2111333	.0940197	.0621323	-.0501254

BY

	6-TOOLONG	7-FEXPECT	8-SCETHIC	9-ENVETHIC
6-TOOLONG	1.0000000			
7-FEXPECT	-.1016665	1.0000000		
8-SCETHIC	-.1677656	.1220839	1.0000000	
9-ENVETHIC	-.1206449	.0451152	.5078969	1.0000000

BY

Table D.5: Elasticities for the payment-participation relationship

Yearly Payments	Estimated proportion of eligible acreage enrolled in filter strips	Elasticities
$ 10.00	7.5-percent	1.10
$ 20.00	15.0-percent	.91
$ 30.00	21.2-percent	.80
$ 40.00	26.3-percent	.72
$ 50.00	30.7-percent	.67
$ 60.00	34.5-percent	.62
$ 70.00	38.0-percent	.58
$ 80.00	40.9-percent	.55
$ 90.00	43.6-percent	.53
$100.00	46.0-percent	.50
$110.00	48.2-percent	.48
$120.00	50.2-percent	.46
$130.00	52.1-percent	.45
$140.00	53.8-percent	.42
$150.00	55.4-percent	.42
$160.00	56.9-percent	.40
$170.00	58.3-percent	.39
$180.00	59.5-percent	.38
$190.00	60.8-percent	.37
$200.00	62.0-percent	.36
$300.00	70.5-percent	.28
$400.00	76.0-percent	.23
$500.00	79.8-percent	.21

Table D.6: Elasticities: the index function

Yearly Payments	Estimated proportion of eligible acreage enrolled in filter strips	Elasticities
$ 80.00	.99-percent	125.14
$ 90.00	15.6-percent	7.95
$100.00	28.6-percent	4.32
$110.00	40.4-percent	3.06
$120.00	51.2-percent	2.42
$130.00	61.1-percent	2.03
$140.00	70.3-percent	1.76
$150.00	78.8-percent	1.57
$160.00	86.8-percent	1.43
$170.00	94.3-percent	1.31
$180.00	101.4-percent	1.22

Table D.7: Elasticities for the function with haying allowed

Yearly Payments	Estimated proportion of eligible acreage enrolled in filter strips	Elasticities
$10	17.10	.57
$20	24.62	.49
$30	29.73	.44
$40	33.62	.41
$50	36.77	.39
$60	39.42	.37
$70	41.69	.36
$80	43.69	.34
$90	45.45	.33
$100	47.04	.32
$110	48.61	.31
$115	49.81	.30
$120	51.02	.30
$130	52.15	.29
$140	52.15	.29
$150	53.20	.28
$160	54.17	.28
$170	55.09	.27
$180	55.95	.27
$190	56.76	.26
$200	57.52	.26

APPENDIX E

PROGRAM TO ADJUST FOR CENSORING

This appendix contains a program written for LIMDEP to adjust the estimated Tobit equation for censoring.

The file ATRIAL is simply a vector of yearly payment offers (P). These payments are logged (LP).

The variables created (LY, LR, LI, LFI, TL, FE, SC, EE) are the estimated coefficients for the explanatory variables in the Tobit equation (LYIELD, LRENT, etc.) multiplied by the mean of the observed values from the data set of 93 observations. BTA is the estimated coefficient for LPAYMENT.

YP is the sum of ten terms: the intercept, BTA multiplied by the vector of logged yearly payments, and the 8 explanatory variables (coefficients multiplied by their mean values).

This output from this program is seven lists:

P = yearly payment level

YP = value of the index (mean values * coefficients)

YPT = predicted Y corrected for censoring per McDonald and Moffitt

GO = probability of Y equal to 0

GM = probability of 0 < Y < 100

NG1 = probability of Y = 100

ELASP = elasticity of YP with respect to payment

ELASPT = elasticity of YPT with respect to payment

```
read; nrec=80; nvar=1;names=p;
file=b:atrial$
create; lp=log(p)$
create; ly= -188.318*4.48447$
create; lr = -47.9172*3.81829$
create; li = 87.4372*10.33138$
create; lfi = -11.4992*8.46658$
create; tl = -124.858*.31183$
create; fe = 60.5797*.41935$
create; sc = 52.0413*.73118$
create; ee = 102.152*.53763$
create; bta=123.785$
create; yp=-399.401+bta*lp+ly+lr+li+lfi+tl+fe+sc+ee$
create; sgma=210.686$
create; z0=-yp/sgma$
create; temp1=100/sgma; z1=z0+temp1$
create; g0=phi(z0)$
create; g1=phi(z1)$
create; f0=n01(z0)$
create; f1=n01(z1)$
create; gm=g1-g0$
create; ng1=1-g1; y1=100*ng1$
create; ym=yp*g1-yp*g0$
create; yu=sgma*f0-sgma*f1$
create; ypt=y1+ym+yu$
create; b1=100*f1*bta/sgma$
create; b2=yp*f0*bta/sgma-yp*f1*bta/sgma$
create; b3=bta*g1-bta*g0+bta*z0*f0-bta*z1*f1$
create; dydp=b1+b2+b3$
create; elasp=bta/yp$
create; elaspt=dydp/ypt$
create; g0=g0*100$
create; gm=gm*100$
create; ng1=ng1*100$
list; p,yp,ypt$
list; p,ypt,g0,gm,ng1$
list; p,yp,elasp,ypt,elaspt$
```

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BIBLIOGRAPHY

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