ABSTRACT

Title of Thesis: EVALUATING DETERMINANTS OF PARTICIPATION IN VOLUNTARY RIPARIAN BUFFER PROGRAMS: A CASE STUDY OF MARYLAND'S BUFFER INCENTIVE PROGRAM

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Forest or grass buffers planted along streams or other waterbodies are receiving considerable attention by policy makers as a way of providing a range of environmental benefits for society, especially prevention of non-point source water pollution from agricultural land. The current emphasis of riparian buffer discussions focuses on voluntary rather than regulatory initiatives, both nationally and in the Chesapeake Bay region.

This is not a project about the behavior of buffers; rather, it is about the behavior of people. Why would a landowner plant a riparian buffer on his land if he bears many of the costs, while the benefits might occur largely downstream? This project compares the decision-making process of a sample of landowners who are participating in Maryland's voluntary Buffer Incentive Program and a sample of farmers who are not in the program. More than 600 telephone interviews were conducted to gather original data about the landowners' demographic characteristics, their awareness of the riparian buffer concept, and the weight they gave to various economic and attitudinal factors during their riparian buffer adoption decision-making process.

Water quality or other environmental benefits to the community, creation of fish and wildlife habitat, control of erosion, and the grant from the Buffer Incentive Program were the most important factors in the adoption decision for Buffer Incentive Program participants interviewed. Non-participating farmers cited most often erosion control, water quality or other environmental benefit to the community, compliance with current or future land use regulations, and the grant payment from the Buffer Incentive Program.

EVALUATING DETERMINANTS OF PARTICIPATION IN VOLUNTARY RIPARIAN BUFFER PROGRAMS: A CASE STUDY OF MARYLAND'S BUFFER INCENTIVE PROGRAM

by

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PREFACE

Gonna plant a weeping willow
By the bank's green edge, it will grow, grow, grow

Robert Hunter, "Brokedown Palace"

DEDICATION

To my parents

ACKNOWLEDGEMENTS

Many people helped me develop this research project. Space precludes listing everyone who provided guidance, materials, and various types of support to me, but I would especially like to recognize the members of my faculty committee and of the Chesapeake Executive Council's Riparian Forest Buffer Technical Panel, notably Rick Cooksey, John Lipman, and Tom Simpson. Data collection and analysis would have been impossible without the support received from the following people. Don VanHassent of the Maryland Department of Natural Resources provided access to information about the Buffer Incentive Program, and 53 participants in the program provided valuable insights about their experience during telephone interviews with me. Erik Lichtenberg and Ivar Strand allowed me to use demographic data they had collected from a survey of a sample of farmers in Maryland on their use of best management practices. Bruce West, Harry DeLong, and their colleagues at the Maryland Agricultural Statistics Service went beyond the call of duty in carrying out a follow-up survey to these farmers with regard to riparian buffers. Their comments improved the quality of the survey instrument tremendously. More than 600 landowners or farm operators were interviewed for this project: Much of what I now know about the adoption of riparian buffers I learned from them.

Finally, thanks to Jan Mazurek, Allen Blackman, and Tim Ward for their guidance on research and computer matters and for putting up with my frequent panic attacks.

The people mentioned above share the credit for anything that is good about this project. As for anything that is incorrect in this thesis, as B.B. King once said, "It's my own fault, baby."

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INTRODUCTION

Riparian buffers are receiving considerable attention by policy makers as a way of providing a range of environmental benefits for society, especially prevention of non-point source water pollution from agricultural land. These buffers consist of trees, grass, or other vegetation planted in the riparian zone, defined as the land adjacent to streams or other waterbodies. Depending on the landscape or type of vegetation planted, riparian buffers can range from a few feet to more than 100 feet in width on one or both sides of the body of water.

Both nationally and in the Chesapeake Bay region, riparian buffers are being examined for their potential for production of environmental functions, and of economic and social benefits derived from those functions that may or may not outweigh the costs. While many studies have focused on the potential environmental benefits of buffers, little attention has been paid to what factors may influence a landowner to put a riparian buffer on his or her land. These factors are particularly important in the case of agricultural land, because of its predominance as a nonpoint source of water pollution and because it may also provide some of the best opportunities for habitat and other environmental improvements.

This is not a project about the behavior of buffers; rather, it is about the behavior of people. Why would a landowner plant a riparian buffer on his or her land if he or she bears many of the costs, while the benefits might occur largely downstream? This project compares the decision-making process of a sample of landowners who are participating in Maryland's voluntary Buffer Incentive Program and a sample of Maryland farm owners who are not in the program. More than 600 telephone interviews were conducted to gather original data about the landowners' demographic characteristics, their awareness of the concept of riparian buffers, and the relative weight they gave to various possible economic and attitudinal factors during their riparian buffer adoption decision-making process.

Understanding the farmer's process for adopting this conservation behavior is essential in order to design and implement effective riparian buffer policies, for two reasons described in greater detail in a policy context section in Chapter 1. First, the current political prominence of property rights advocates suggests that economic

incentives and voluntary programs, rather than environmental regulations, may provide the most promising opportunities for establishment of buffers. Second, budgetary constraints limit the availability of funds for outright purchase of riparian lands, and other voluntary programs must use their limited resources for public outreach, cost-sharing, grants, and technical assistance in the most cost-effective way.

Following a description of the riparian buffer policy context, Chapter 1 continues with a discussion of the possible costs and benefits of buffers, particularly as they are perceived by landowners. To what extent do farmers not participate in voluntary riparian buffer programs simply because they are unaware of their availability and of the benefits of buffers? To what extent are farmers driven by attitudinal factors, such as dislike for government programs, as opposed to perceived "pure" economic costs, such as the possible row-crop income lost by taking riparian land out of production?

When it comes to analysis of riparian buffer policy around the United States, one size does not fit all. Chapter 1 includes a discussion of how riparian buffers provide different environmental functions and values in different ecosystems, and how landowners from state to state present different attitudinal and economic issues that policy-makers need to address when promoting buffers. Thus the most useful policy insight is apt to come from examination of programs on a state or local scale, the approach taken in this study.

Chapter 2 summarizes a review of agricultural economics, rural sociology, and other literature that was undertaken to learn about previous work on the factors influencing voluntary planting of riparian buffers. A number of studies have examined how landowner attributes such as age, percentage of income from farming, wealth, and commitment to conservation affect the willingness of a landowner to adopt innovative conservation practices on agricultural lands. Little attention has been focused on adoption of tree or grass planting exclusively in the riparian zone, particularly in the case of trees, pointing to the need for original data collection and analysis on voluntary planting of riparian buffers.

Chapter 3 describes this study's analytical framework, which is based to a large degree on the adoption research on other land set-aside programs reviewed in Chapter 2. Adoption of riparian buffers is described as a decision-making process including an initial awareness stage followed by a weighing of perceived costs and benefits.

Chapter 4 describes the general approach taken in this study, including the development of hypotheses about the extent to which a combination of attitudinal and "pure" economic factors drive the behavior of farmers with regard to voluntary riparian buffer programs. Based on the literature for other land set-aside and best management

practices programs, these hypotheses predict that the behavior of farmers is not always driven solely by economic considerations. Chapter 4 also includes a description of the telephone survey instruments developed for this study to gather original data from more than 600 farmers on riparian buffer adoption decisions.

The results of these interviews are described in Chapter 5. Key research findings include the following:

Awareness

- Thirty-one percent of farm owners interviewed for this study who are not in the Buffer Incentive Program said that they do not own riparian land. Many of these responses were from farm owners on Maryland's Eastern Shore, where one would expect a much higher percentage of eligible riparian land.

- Eighty-five percent of non-adopting farm owners interviewed are aware of the riparian buffer concept, but this awareness comes from contact with different sources than for Buffer Incentive Program participants.

Perceived Costs and Benefits

- Buffer Incentive Program participants interviewed earn a much smaller percentage of income from farming than do non-participants interviewed. 81% of Buffer Incentive Program participants indicated that lost agricultural income from the land along the stream was not a factor or not a very important factor in their decision, while 42% of farmers interviewed who have not planted a forest or grass buffer indicated that lost agricultural income was a critical or somewhat important factor.

- Water quality or other environmental benefits to the community was the most important factor in the adoption decision for Buffer Incentive Program participants interviewed, followed by creation of fish and wildlife habitat, control of erosion, and the grant from the Buffer Incentive Program.

- For non-adopters, erosion control was the most important factor, followed by water quality or other environmental benefits to the community, compliance with current or future land use regulations, and the grant payment from the Buffer Incentive Program.

- There is some evidence that non-adopting farm owners prefer grass buffers rather than forest buffers, and that land owners are less willing to participate in riparian buffer set-aside programs if they require that the buffer be kept in place for longer periods of time or permanently.

These findings may have important policy implications for cost-share, grantmaking, and outreach programs designed to promote forest and grass buffers. In Chapter 6, conclusions are drawn from this research and recommendations are made for development of public policy and future research programs.

CHAPTER 1

BACKGROUND

Policy Context for Riparian Buffers

In 1996, for some environmental policy makers, "riparian forest buffers" is the buzzword of the day, joining the hallowed ranks of acid rain, greenhouse warming, biological diversity, environmental justice, and ecosystem management from previous years. Nationally, the immediate interest in riparian forest and grass buffers is a result of debates over the 1995 Farm Bill and reauthorization of the Clean Water Act (which continued into 1996 as part of federal budget negotiations). The Farm Bill addresses the expiration of the first set of 10-year land set-aside contracts in the Conservation Reserve Program (CRP); targetting CRP funds toward riparian forest and grass buffers is a prominent alternative proposed by legislators to provide more environmental protection while tying up less farmland and spending less taxpayer dollars than the existing CRP approach. In the Chesapeake Bay watershed, riparian forest buffers (and, to a lesser degree, grass buffers) are being promoted by elected leaders to help meet the 1987 Chesapeake Bay Agreement goal of a 40% reduction in nutrient loadings in the Bay by the year 2000.

Agricultural land has been a focal point of riparian buffer policy debates, both in the Chesapeake Bay and nationally, because of its predominance as a nonpoint source of water pollution. Agriculture has been identified as a major or minor contributor to water quality problems in 72 percent of river miles and 43 percent of estuarine waters nationwide (United States Department of Agriculture, 1994). Agriculture, including conventional cropland, conservation cropland, pasture, and animal waste facilities, accounts for 69 percent of total nitrogen non-point source loadings and 79 percent of total phosphorus non-point source loadings in the Chesapeake Bay watershed (Lowrance, et al. 1995). While reductions in N and P loadings are only two of the possible environmental benefits of riparian buffers, these examples nonetheless point to the need for riparian buffer programs geared toward agricultural land.

The political support for riparian forest or grass buffers is remarkably bi-partisan.[1] For example, buffers received special emphasis in the Agricultural Resources Conservation Act of 1995 (S854, also known as the Conservation Title of the Farm Bill), which was co-sponsored by Sen. Richard Lugar (R-Ind) and Sen. Patrick Leahy (D-Vt.). In Congressional testimony concerning the Conservation Title, a range of interest groups urged policies to assist the restoration of riparian buffers, including the American Farm Bureau Federation, the Association of Metropolitan Water Agencies, and the National Audubon Society (U.S. Congress. Senate. Committee on Agriculture, Nutrition, and Forestry).

Emphasis on Voluntary Buffer Programs

The bipartisan support of buffers comes with a caveat largely shared across the political spectrum: efforts should focus on voluntary initiatives for landowners. In his introduction to S854, Sen Leahy cited a poll of 10,000 farmers in 15 leading agricultural states. Of the farmers polled, 43% agreed that the government should insist they plant filter strips along stream banks to protect water quality, but 40% disagreed. In Sen. Lugar's introductory comments, he noted that the legislation creates no new environmental mandates for farmers (U.S. Congress. Senate. *Agricultural Resources Conservation Act of 1995*). In testimony supporting many of the concepts of S854, Deputy Secretary of Agriculture Richard Rominger said that voluntary and flexible incentive-driven programs are the "centerpiece" of the Clinton Administration's 1995 Farm Bill proposals (U.S. Congress. Senate. Committee on Agriculture, Nutrition, and Forestry). Clearly, past debates, including those surrounding wetlands policy, have struck a property rights chord that resonates with riparian buffer policy makers.

The Clean Water Act

The current interest in riparian buffers can be traced back to non-point source water pollution reduction requirements of Section 208 and Section 319 of the Federal Water Pollution Control Act (Clean Water Act) of 1972 and amendments made in 1977. That act stated as its first goal that the discharge of pollutants into the navigable waters of

1. At the 1995 annual meeting of the Chesapeake Executive Council, Virginia Governor George Allen, a Republican, and Maryland Governor Parris Glendening, a Democrat, both urged policies to promote riparian forest buffers, with Governor Allen calling riparian forest buffers "a top priority" for his administration.

the United States be eliminated by 1985. Five additional goals in the act described ways in which that ambitious first goal might be achieved. While progress was made in cleaning up pollution from "point" sources such as factories and wastewater treatment plants, by 1987 the elimination of pollutant discharge into navigable waters was still not a reality. In the 1987 Clean Water Act re-authorization, Congress added a seventh goal emphasizing the need for control of nonpoint sources of pollution, such as urban and agricultural run-off. Section 319 describes ways in which nonpoint source reduction can be achieved, including identification of best management practices. Section 319 also suggests the need for voluntary measures to control nonpoint source pollution, because of the pervasive nature of the problem and the difficulty in regulating land use (*Federal Water Pollution Control Act.* 1977).

The Conservation Reserve Program

The Conservation Reserve Program (CRP), an agricultural land retirement program established in 1985, was originally designed primarily to control erosion and soon also emphasized water quality and wildlife habitat goals. The Conservation Reserve Program has generally received high marks from policy-makers, environmentalists, and the agricultural community, but at a cost of more than $1 billion per year in rental payments to farmers (Stevens 1995; Lovejoy and Lee 1995). The 1995 Farm bill debate recognized the current federal budget realities, and thus the Lugar/Leahy bill proposed that the Conservation Reserve be capped at 36 million acres, its current level of enrollment at the time of the bill (U.S. Congress. Senate. *Agricultural Resources Conservation Act of 1995).*

In preparation for the expiration of the first set of CRP 10-year contracts in 1995, policy-makers began to explore land set-aside alternatives that would improve upon the environmental benefits of CRP, but at less taxpayer expense. In introducing the bill, Sen Lugar also noted that too much land currently in the Conservation Reserve could be farmed without harming the environment and thus should be returned to agricultural commodity production. Targetting CRP funds to more environmentally sensitive lands is a goal stated by both the bill's sponsors and the Clinton Administration (U.S. Congress. Senate. Committee on Agriculture, Nutrition, and Forestry).

One way in which the Lugar/Leahy bill proposes to meet this targetting goal is by instructing the Secretary of Agriculture to enroll in CRP by the year 2000 at least 4 million acres of land for water quality purposes, primarily buffer strips along permanent water bodies and intermittent streams. By comparison, only 52,000 acres of riparian buffers

had been planted in CRP through 1993 (Osborn, Schnepf and Keim 1993). While the bill does not specify whether these buffers should be planted in grass or in trees, the bill emphasizes trees by suggesting that, to the maximum extent practicable, not less than 1/8 of the land in the Conservation Reserve be devoted to hardwood trees (U.S. Congress. Senate. *Agricultural Resources Conservation Act of 1995).*[2]

The increased emphasis on riparian buffers is also reflected in the thirteenth CRP sign-up held in September 1995. Bids involving riparian buffers received a 10 percent higher bid cap, which caused the enrollment of buffers to jump from 1,227 acres in 1994 to 33,900 acres in 1995, a 2,700% increase (Kinsley 1995).

The Chesapeake Bay Agreement

While Maryland has a relatively small percentage of its land in the Conservation Reserve Program, it has an additional factor driving interest in buffers: the 1987 Chesapeake Bay Agreement. That agreement, signed by the governors of Maryland, Pennsylvania, and Virginia, the mayor of the District of Columbia, the administrator of the U.S. Environmental Protection Agency, and the chair of the Chesapeake Bay Commission, stated as its principal goals the restoration of water quality and living resources in the Chesapeake Bay. To meet that goal, the signatories agreed to reduce nutrients in the main stem of the Chesapeake Bay by 40% by the year 2000. The signatories, who comprise the Chesapeake Executive Council, issued a directive in June 1994 to develop riparian forest buffer policies for the Bay watershed, citing their finding that riparian forest buffers "deliver the greatest range of environmental benefits of any type of stream buffer." The Council convened a panel to recommend riparian forest buffer policy by December 1996 (Chesapeake Executive Council 1994).

Regulatory Initiatives

Despite the current emphasis of policy-makers (and this research project) on voluntary initiatives, there are examples of regulation in the riparian zone at the national,

2. A recent study by John Lee and Stephen Lovejoy of Purdue University suggests that the farm bill's four million acre goal for riparian buffers on agricultural land may be difficult to attain. Using a geographic information system, the authors estimated that only two million acres (or about five per cent of the total 36 million acres in CRP) of agricultural cropland and pasture may be potentially available nationwide for riparian buffers (Lee and Lovejoy 1995).

state, and local level.[3] Nationally, Section 6217 of the 1990 Coastal Zone Act Reathorization Amendments included the first federally mandated program requiring specific measures to deal with agricultural nonpoint source pollution (Heimlich and Barnard 1995). Although the Act does not specifically require forest or grass buffers, it does provide leeway for states to include buffers as a component in a required management plan (U.S. Environmental Protection Agency 1990).

Statewide regulatory initiatives include Maryland's Chesapeake Bay Critical Areas Act, which was established in 1984 to control development within 1,000 feet of tidal waters. A mandatory 100-foot vegetated buffer is required for all tidal waters, tidal wetlands, and tributary streams in the Critical Area, including both perennial and intermittent streams. Buffers on agricultural land may be reduced to 25 feet; agricultural buffers may be reduced further if a Soil Conservation and Water Quality Plan with best management practices is approved for the property (Chesapeake Bay Commission 1995). Sixty local jurisdictions in Maryland are affected by this law (Plummer 1993), including the easternmost 16 of Maryland 23 counties.

Some local governments have also considered regulations to protect riparian areas. For example, Carroll County, Maryland is considering a proposed ordinance for cluster zoning which would require buffers of 100 feet on either side of a stream (Conaway 1995).

Why have policy-makers expressed such an interest in voluntary and regulatory riparian buffer initiatives? The next section summarizes the environmental benefits that might be achieved by planting riparian forest or grass buffers and discusses the challenges and opportunities for incorporating those environmental benefits into policy analyses.

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3. For a summary of riparian forest buffer policies in Maryland, Pennsylvania, and Virginia, see Chesapeake Bay Commission 1995. For a national overview of state wetlands and riparian area protection programs, see Steiner, et al.

Potential Benefits of Riparian Buffers

Policy-makers are interested in riparian forest or grass buffers largely because of an increasing body of literature about the ability of buffers to carry out biological, chemical, and physical functions or processes for streams and riparian land. This section includes only a summary of those environmental functions, as well as a brief discussion of the opportunities and challenges for translating the environmental functions into an economic framework for policy analysis.[4] This research project is about the behavior of people, not buffers, and so the section concludes with a discussion of how a landowner might perceive the possible environmental, economic, and other benefits of voluntarily planting a riparian forest or grass buffer on his or her property.

What is a Riparian Buffer?

It is important to recognize that there are no standard definitions of the words "riparian," "forest buffer," and "grass buffer" used across the board by policy-makers. How these terms are defined can have implications for what environmental benefits might be achieved, for landowner perceptions of both benefits and costs, and, ultimately, for development of policy.

Webster's Dictionary defines "riparian" as "relating to or living or located on a bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater." Bohlen and King describe riparian zones as "the lands along surface waters that are closely tied to surface water systems through flooding, groundwaters flows, physical transport, and biotic exchanges" (Bohlen and King 1996). The Chesapeake Executive Council's Riparian Forest Buffer Panel defines the riparian area as "streams, rivers and other bodies of water and the land adjacent to them, which serves as a transitional environment and directly affects or is affected by the presence of that water" (Chesapeake Executive Council Riparian Forest Buffer Panel 1995).

Some authors have used the word "streamside" as a synonym for riparian in order to make debates about riparian buffer policy more understandable to policy-makers and the general public (see for example Lowrance, et al. 1995; Welsch 1991; Alliance for the Chesapeake Bay 1993). Reconciling the "streamside" definition with the others described

4. For comprehensive reviews of the literature on riparian buffer environmental performance, see Bohlen and King 1996; Lowrance et al. 1995.

here, especially the Maryland Buffer Incentive Program reference to land adjacent to water "flowing for any one-month period during the year" reminds one of the "when it's wet, it's wet" comment of Vice President Dan Quayle during the wetlands delineation controversy. A landowner may be unlikely to perceive that land adjacent to an ephemeral first order stream is in fact riparian and thus apt to provide environmental benefits if planted in trees or grass. A case study of the German Branch watershed in Queen Anne's County, Maryland found that many "blue line" streams on U.S.G.S. maps were actually farmed as part of row-crop fields (Bohlen and King 1996).

A riparian forest buffer was defined in 1995 by the Chesapeake Executive Council buffer panel as "a forested area situated between a land use and adjacent body of water" which is designed and maintained to provide several environmental functions (Chesapeake Executive Council Riparian Forest Buffer Panel 1995). The panel at that time had not stated explicitly the required buffer width or what types of trees or land uses are allowed within the forest buffer.

A more elaborate three-zone Riparian Forest Buffer System has been proposed in a report prepared by David J. Welsch of the U.S. Forest Service. The first zone of the buffer system extends 15 feet from the top of the stream bank and is designed to create a stable ecosystem adjacent to the water's edge. The dominant vegetation in this zone is composed of native riparian tree and shrub species that are not harvested. A 60-foot wide Zone 2 is also forested, but periodic harvesting and timber stand improvement are allowed to provide environmental benefits such as removal of nutrients sequestered in tree branches. Zone 3 consists of grazed or ungrazed grasslands and should be at least 20 feet in width. The purpose of Zone 3 is to provide sediment filtering, nutrient uptake, and the space necessary to convert concentrated flow to uniform, shallow sheet flow (Welsch 1991).

Zone 3 of the Riparian Forest Buffer System is a grass buffer, also known as a "vegetated filter strip." Many of the environmental goals that proponents of riparian forest buffers or the 95-foot Riparian Forest Buffer System hope to attain might also be achieved by planting grass buffers. Grass buffers should not be confused with "grassed waterways," which are constructed to provide drainage for fields. Some landowners may find grass buffers to be a more palatable alternative to forest buffers, as described in Chapter 5. Thus the benefits of both forest and grass riparian buffers are discussed in this section.

Since this project is examining the determinants of participation in Maryland's Buffer Incentive Program, the definitions from that program's guidelines are used in the survey instruments described in Chapters 4 and 5. Buffer Incentive Program guidelines

state lands must meet one of the following criteria to be considered riparian and thus eligible for the program: The land must be within 300 feet of a stream, river, pond, tidal or non-tidal wetland, or other open water, and additional land may be eligible in highly sloped areas. The water must appear on a U.S. Geological Survey 7.5 minute quad map (a "blue line" stream) or have flowing water for any one-month period during the year. Wetlands must appear on a U.S. Fish and Wildlife Service wetlands map or be otherwise classifiable as a wetland based on current State of Maryland criteria. Land within a 100-year floodplain is also eligible (Maryland Department of Natural Resources). The Buffer Incentive Program requires a minimum 50-foot width and does not allow Christmas tree or orchard planting in the buffer; harvesting of trees in the buffer is not allowed during the term of the contract. For more details on the eligibility requirements of the Buffer Incentive Program, see page 44.

Possible Environmental Benefits of Riparian Buffers

Bohlen and King use the terms "functions, processes, and values" to describe the performance of riparian buffers. "Functions and processes" refer to the physical, biological, and chemical phenomema that occur due to riparian buffer implementation. "Values" refer to more subjective experiences that might also depend on ethical, economic, and other systems. Values are addressed primarily in later parts of this chapter through discussion of economic benefits and landowner perceptions of benefits (Bohlen and King 1996).

Bohlen and King separate the functions or processes of riparian buffers into the following eight categories:

1. Sediment Retention
2. Nitrogen removal
3. Phosphorus removal
4. Thermal effects on streams
5. Effects on physical structure of streams
6. Effects on the energetics of streams
7. Direct effects on preservation of biodiversity
8. Establishment of movement corridors across the landscape

The extent to which environmental benefits can be gained in these eight categories depends upon a number of factors, such as stream width, buffer slope and width, subsurface hydrology, soil drainage, existing land use (upstream, downstream, and on the landowner's property), and complementary use of other best management practices.

Because these factors and the relative importance of each of the eight categories of functions vary widely from watershed to watershed, it is difficult to generalize about the opportunities for environmental improvement from buffers (Bohlen and King 1996). This is the case even within the Chesapeake Bay watershed. Lowrance et al. describe three distinct physiographic regions of the Chesapeake Bay watershed (coastal plain, the Piedmont, and valley and ridge), each with different physical and land use characteristics that can have an impact on the performance of riparian buffers (Lowrance et al. 1995).

The first three environmental functions Bohlen and King list for buffers--sediment retention, nitrogen removal, and phosphorus removal--receive high priority nationally, through initiatives such as the Conservation Reserve Program, and in the Chesapeake Bay area, because of the commitment there to a 40% reduction in nutrients by the year 2000. These functions are listed together here because the literature suggests that, depending on the situation, grass buffers may perform as well or better than forest buffers in providing these functions (Lowrance et al. 1995). In the Chesapeake Bay watershed, where the 40% nutrient reduction goal is to a large extent driving the policy discussions on buffers, grass buffers may be a particularly important option for landowners who might resist planting trees.

Buffers affect sediment, nitrogen, and phosphorus input into streams in the following ways. Sediment is controlled largely by converting channelized flow outside the buffer to sheet flow within the buffer, thus slowing its rate of transport. In this respect, grass may be superior to trees. Lowrance et al. cite studies suggesting that grass buffers can remove up to 98% of incoming sediment and that they are effective immediately after establishment. The down side, however, is that these studies also conclude that grass buffers probably have a relatively short useful life span, thus requiring periodic removal of vegetation or other maintenance (Dillaha et al. 1989; Magette et al. 1989; Lowrance et al. 1995). This may be an important consideration for a landowner, as discussed in the next section. By trapping sediment, a buffer can also be effective in trapping sediment-bound phosphorus. Nitrogen can be removed by bacteria to the atmosphere as less available nitrogen gas, and can be sequestered by plants and microorganisms within living biomass (Bohlen and King 1996).

The literature suggests that the five other environmental functions cited by Bohlen and King favor forest buffers over grass buffers, on balance.

The first of these functions is the ability of a buffer to provide shade over a stream, thus moderating temperature variations and improving conditions for trout and other wildlife. This function is particularly valuable for lower order (smaller) streams, since higher order streams are often too wide to be effectively shaded. (Overall, the

Lowrance panel's report suggests that buffers are likely to be most beneficial around headwaters and lower order streams.) A mature forest buffer has a clear advantage over a grass buffer in providing shade to the stream, but these benefits may take years or decades to develop.

This benefit lag-time is also true in the case of aquatic habitat and stream geomorphology benefits. A forest buffer may provide important habitat and geomorphological functions through development of overhanging banks, debris tangles, and riffle-pool complexes, and through input of coarse woody debris, which may dissipate stream energy and reduce sediment transport. There is still considerable uncertainty about the role of woody debris; in any case, input of coarse woody debris to a stream may require an even longer time span than that needed for the development of effective shading.

A buffer might also provide a useful function for the energetics of a stream, which can come from a combination of in-stream and terrestrial production. For a forest buffer, this function is provided in part by production of leaf litter, which might take as long as a decade to have an appreciable impact on stream energetics (Bohlen and King 1996).

The final two functions of buffers that Bohlen and King outline--biodiversity preservation and wildlife movement corridors--also depend a great deal on land use both upstream and downstream. For example, is a buffer linking other areas providing habitat for wildlife? For some wildlife, a forest buffer is likely to provide more opportunities for movement than a grass buffer. It is important to remember, however, that the relative benefits for wildlife from grass or forest buffers depend a great deal on the area of the country in which they are established.

The possible provision of wildlife corridors points to a question that is relevant for all of the possible functions of a riparian buffer: To what extent is it essential to have contiguous buffers upstream and downstream? If a stream is seriously degraded upstream or downstream, a buffer may make little or no headway in providing functions for the stream and adjacent riparian land. When examining a voluntary program (like Maryland's Buffer Incentive Program), this is a particularly relevant question. Pritchard, Lee and Engel note that a problem with voluntary participation in any water quality program is the enlistment of enough participants to make it successful. They suggest that it may be more cost-effective to require 100 percent participation in a riparian buffer program in a watershed than to allow partial participation in a group of watersheds (Pritchard, Lee and Engel 1993).

Economic Benefits of Riparian Buffers

The environmental benefits of buffers, described above as categories of functions and processes, are not the same as the benefits of buffers viewed through the lens of an economist, who would measure the benefits of buffers through the aggregate amount society would be willing to pay for the resulting changes in water quality, habitat, and the other functions of buffers (Krupnick 1988). The possible environmental functions of riparian buffers present problems for policy analysis using an economic cost/benefit or cost-effectiveness framework, since these functions include both market and non-market benefits and on-site and off-site benefits, many of which are difficult to measure.

Many of the benefits to society of buffers accrue downstream from the landowner, while the costs may be borne primarily by the landowner. This is complicated further by the difficulty in monitoring accurately the contribution of each landowner to the complex environmental functions described in the previous section. Griffin and Bromley have described this situation as one with a "non-point externality" (Griffin and Bromley 1982; Lovejoy, Lee and Beasley 1985; Crutchfield, Feather, and Hellerstein). A rational landowner in a competitive market might act in a way that does not take the downstream effects into account, thus not maximizing collective social welfare, defined as the aggregate of individual preferences (Krupnick 1988). This is a classic case of "market failure" described in the environmental economics literature, and thus may be grounds for intervention by the government (Pearce and Turner 1990).

Since these environmental benefits are not necessarily traded in markets, indirect methods of estimation, such as contingent valuation surveys, travel cost calculations, and hedonic pricing, are often used for economic analysis. A number of studies have attempted to estimated the net social benefits that could be gained from water quality improvements, the primary focus of riparian buffer implementation (for a review of these studies, see Crutchfield, Feather and Hellerstein). For land retirement programs, one study of particular relevance is Ribaudo's 1989 estimate that reducing erosion by retiring 40 to 45 million acres of cropland through the Conservation Reserve Program (CRP) would generate $3.5 to $4.5 billion in annual water quality benefits. The CRP also includes land outside the riparian zone, and riparian buffers may provide benefits beyond the reduction of erosion, but this study nonetheless gives some indication of the on- and off-site benefits that a land retirement program might achieve, including those to recreational fishing, navigation, water storage and treatment, and flood control (Ribaudo, Osborn, and Konyar 1994).

Such estimates for a particular riparian buffer may be very difficult to calculate: as described earlier in this chapter, the benefits of a buffer depend not only on what is planted, but where it is planted, and what the conditions are both upstream and downstream. (For a discussion of these complications for reducing agricultural non-point source pollution in the Chesapeake Bay watershed through best management practices, see Krupnick 1988)

The Landowner's Perception of Riparian Buffer Benefits

This project is based on the premise that policy-makers are already moving forward with initiatives to promote buffers as a cost-effective environmental improvement, both in the Chesapeake Bay region and nationally. The question being addressed is not, "Are buffers a good thing for society?" (Or, from an economist's perspective, "Do they improve net social benefits?") Rather, this project follows the lead of policy-makers in assuming that this is likely to be the case, and thus addresses the question of how to get a landowner to put a riparian buffer on his or her land if one does not already exist. To do that, it is necessary to understand the benefits of planting a riparian buffer that a landowner might perceive. It is important to understand these perceptions in order to help target public funds to voluntary programs in areas that are likely to provide the most cost-effective investments in environmental improvements through implementation of buffers.

When viewed from the landowner's perspective, the environmental and economic benefits described by natural scientists or economists might look very different, or even be ignored. But like a natural or social scientist, a landowner is likely to think of the possible benefits of buffers in terms of where they occur and when they occur: Do the benefits accrue to the landowner, to his immediate community, or to society in general? Do the benefits occur now, or at some point in the distant future?

Farmers might perceive both market and non-market on-site benefits from a riparian buffer. Young farmers in particular might perceive that a buffer could provide future income from harvesting grass or trees, but this would most likely be weighed against the alternative best use of the riparian land, as discussed in more detail in the next section. A farmer might have a different perception of the possible on-site benefits from a forest buffer than a residential or commercial landowner; the presence of trees might actually increase the immediate value of residential or commercial property, which might not be the case on agricultural land. Provision of fish and wildlife habitat might also provide on-site benefits for a farmer interested in providing recreational access to his property. On the Eastern Shore of Maryland, some farmers earn income by providing

access for waterfowl hunting in the winter. A grass buffer might be perceived as superior for that on-site use.

For other wildlife, especially deer and endangered species, the increased habitat possibly provided by a forest buffer might provide an aesthetic benefit to some landowners, but to others this might be seen as a negative factor, as discussed in the next section. Erosion control is one possible on-site benefit of riparian buffers, particularly for farmers with a long-term investment in the property, but this might best be achieved in combination with conservation tillage practices, rather than solely relying on taking land out of production altogether.

Another possible perceived on-site benefit of riparian buffers might come from the psychological effects of restoration discussed in the restoration ecology literature. A landowner might feel a strong sense of personal renewal from the act of restoration on his or her property, although research on this topic in the field of environmental psychology has focused largely on urban environments and factors such as noise and crowding (Hartig, Bowler, and Wolf 1994). But even in a more open agricultural setting, a farmer might perceive benefits from activities taken as a steward of his property, which in some cases may have been owned by his family for generations.

Although a landowner might perceive on-site environmental and economic benefits from buffers, benefits are likely to accrue primarily to the community and to society at large. How would a landowner perceive these landscape-wide benefits? Will he think that he is bearing a disproportionate burden for environmental protection that others in his community are not? In this sense, the benefits of riparian buffers are similar to the problems that Curtis Bohlen has described for wetlands protection: some landowners might not recognize that other landowners in the community also pay for environmental protection measures through taxes for sewage treatment and other environmental facilities (Bohlen 1992). Mark Sagoff has described individual decision-making as being based on a combination of private and public values, or those made as a consumer and those made as a citizen (Sagoff 1988). The weight given to the perceived community benefits of riparian buffers by a landowner can be seen as the extent to which those public values are driving his or her decision.

Most people probably want to be good citizens. Would a landowner perceive that planting a forest or grass buffer is part of being a good citizen? How would a landowner learn about the environmental and economic benefits to his community and society described above? Public outreach and the experience of neighbors and peers are two likely ways in which a landowner would learn about the possible benefits of buffers and form opinions about them. A landowner in a watershed with well-publicized water

quality and environmental problems might give much greater weight to the community benefits of a riparian buffer than would a landowner in a watershed with little or no publicity about such problems. The perception of benefits might be greatly affected by the way in which environmental and economic benefits have been presented to the landowner: Did a landowner first learn about buffers from a government representative he views as a regulatory adversary, rather than as a resource for technical assistance? Were buffers described in an inflexible way that did not take into account the landowner's unique situation? A landowner who has seen the environmental benefits of buffers planted by neighbors and peers might be more likely to plant one himself.

The benefits of planting a riparian buffer that a landowner perceives are likely to depend upon his age, education, income, percentage of income from farming, the location of his farm, the effectiveness of local outreach efforts, and other factors. Chapter 3 describes the literature on the effects of these and other perceived benefits in determining participation in other best management practice or land set-aside programs. These perceived benefits are, of course, only part of the equation for a landowner considering participation in a voluntary riparian buffer program. In the next section, some of the perceived costs that might influence a landowner's decision are described, as well as other possible attitudinal factors.

Potential Costs for Landowners

The landowner's decision-making process includes comparing perceived benefits of buffers to perceived costs. While many of the benefits of buffers may go to the community at large, the landowner is likely to weigh those benefits against costs that he perceives as being borne primarily by himself. Attitudinal factors may also heavily influence the relative weight given to various costs in the decision-making process. The perceived private costs for a landowner can be divided into three categories: opportunity costs, planting and maintenance costs, and transactions costs.

Opportunity Costs

Ideally, implementing a cost-effective voluntary riparian buffer program might simply involve identifying the land parcels likely to provide the most environmental benefits from buffer establishment, then providing economic incentives to the owners of those identified land parcels, starting with those who are willing to accept the lowest compensation for use of his riparian land. Opportunity costs for riparian buffers can be seen as the foregone earnings from other possible uses of that land; thus they are a good measure of what landowners might be willing to accept for use of their riparian land, once planting, maintenance, and transactions costs are taken into consideration.

The policy context and possible environmental benefits of riparian buffers, described in previous sections, point to some difficulties in calculating opportunity costs of land set aside as riparian buffers. For a discussion of these difficulties and how they affect the research approach taken in this project, see "Problems with Calculation of Opportunity Costs" on page 20.

Perceived opportunity costs include possible reduction in current or future income from agricultural use of riparian land set aside as a buffer, as well as possible lost or reduced potential income from conversion of the land to residential or commercial development. For some farmers, the opportunity cost of riparian land may be quite high if that is the most productive land for row crops or if extensive water access is needed for animals. Some farmers might be more receptive to buffers if they were allowed to earn some income by occasionally harvesting grass or trees in the buffer area farthest from the stream. For farmers involved in commodity support programs, buffers may also reduce base acreage for calculation of commodity support program payments, although this may now be a moot point because of the Farm Bill legislation in 1996.

Farmers might also perceive numerous problems that a forest buffer might present for adjacent land. For example, added habitat might lead to destruction of crops by deer. Trees might shade adjacent fields or draw moisture or nutrients from them, thus lowering yields. Tree limbs might fall into adjacent fields, and buffers might cut into existing field configurations in a way that makes it difficult to operate farm machinery.

The second area of perceived opportunity costs for a farmer concerns the ability to convert riparian and adjacent land to other land uses. Property rights are an important element of these opportunity costs. Farmers might perceive that buffers would provide new habitat for rare or endangered species, thus subjecting the farmer to increased regulation and limiting future land use options. In addition, some areas that are left unfarmed for five years may be subject to regulation because they have reverted to wetlands (Alliance for the Chesapeake Bay 1993). If a forest buffer is planted, any future development of that land might be subject to tree replacement laws (such as Maryland's Forest Conservation Act). Depending on the location of the buffer and size of the stream, a lost or hindered scenic view might also be an important concern with regard to future residential development values. One study of the impact of parcel characteristics on the cost of development rights to farmland in New England estimated the per-acre cost of development rights to be 53 percent higher on farmland parcels that have a panoramic view of water than on parcels that have no water view (Wichelns and Kline 1993).

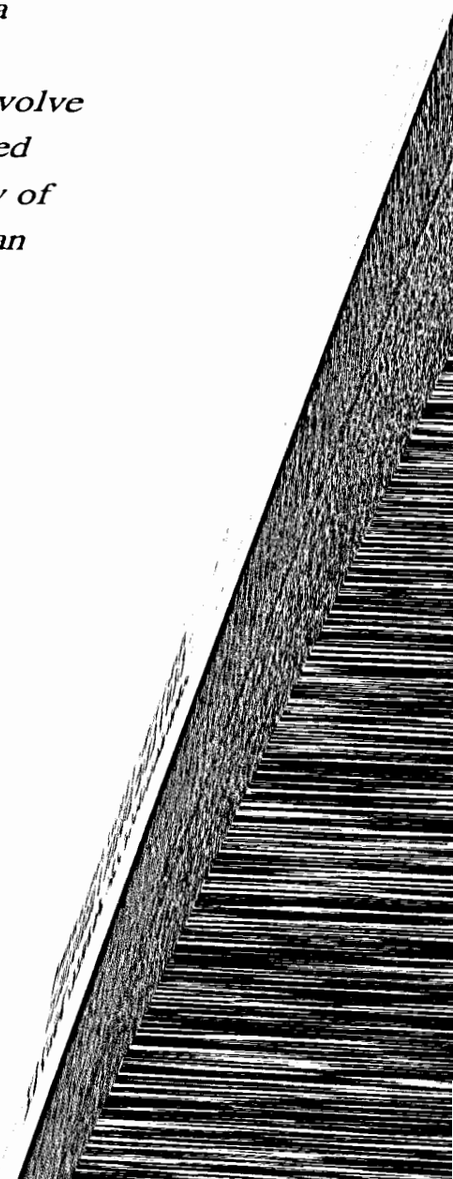
Buffers might provide opportunities for tax relief from federal, state, or local authorities, but property tax disincentives might also present costs to landowners. Property taxes are traditionally the domain of local governments, providing funding for schools and other community services. Some counties base their property tax formulas on soil type rather than land cover, thus discouraging taking productive soils out of production. Some counties might actually raise assessments on land put in buffers by changing its tax category from "agriculture" to "developable." Starting in 1995, landowners taking advantage of a 15-year special tax assessment through Maryland's Forest Conservation and Management Program were required to pay $100 every three years for a verification from the forester of continued compliance with program requirements.

A final opportunity cost issue relates to both future agricultural and development land uses. Since trees may need to grow for a period of longer than 10 years to begin to provide a full range of environmental benefits, farmers may be encouraged to set aside their land for a longer term or even permanently. Yet farmers may be unwilling to give up alternate uses of riparian land by placing it in a longer or permanent conservation easement.

Problems with Calculation of Opportunity Costs

The policy context and possible environmental benefits of riparian buffers point to some difficulties in calculating opportunity costs of land set aside as riparian buffers. The Conservation Reserve Program debate about targetting land set-asides to riparian land, rather than whole fields or farms, indicates that opportunity costs should be calculated specifically for the riparian land. As Senator Lugar pointed out in his remarks introducing the Conservation Title to the 1995 Farm bill, a reason for targetting riparian land is that there may be a lot of productive land that is not being farmed because it is in the Conservation Reserve (U.S. Congress. Senate. Agricultural Resources Conservation Act of 1995). Also, as discussed in the environmental benefits section, it is difficult to generalize about the environmental benefits across watersheds. In some areas, such as the valley and ridge physiographic zone of western Maryland, the riparian land might be the only land that can be farmed; in others, it might be so wet as to be unproductive as cropland. For an individual farmer, is his land within 25, 50, 100, or 300 feet of a stream his most productive or least productive?

Ideally, calculation of opportunity costs of planting riparian buffers would involve determining the rental value of that riparian land. Land values are essentially capitalized rents, and thus are a measure of a buyer's willingness to pay for the future productivity of that soil, although there are other factors that affect land values (Miranowski and Cochran 1993). The problems with generalizing about land values and riparian buffer benefits point to a need for farm-level data about the opportunity costs of riparian land in different watersheds. This level of detail is not readily available from public sources. Land sales, being public transactions, would be a source of information. But only 3% of farmland nationwide is transferred in a given year, and that includes gifts and inheritance; for land values at a county level, there are so few farms sold in a given year in a county that appraisers often have to go to surrounding counties to get estimates, according to John Jones of the U.S. Department of Agriculture's Economic Research Service. Jones noted in an interview with the author that the agricultural census has a line item on amount paid for rent, but it is not broken down by land type or by acreage associated with the rent. One problem with collecting farm level data is that if farmers knew what other farmers were saying in opinion surveys like the agricultural census, they would change their bids for government programs accordingly. Since the census figures reflect just one person's opinion, and are not based on any farm-by-farm appraisal, the USDA cannot provide that information to the public. The agricultural census only surveys 20% of farmers, anyway, so it might be of little value at the county level. USDA's National Agricultural Statistics



Service (NASS) has begun a June Agricultural Survey that includes some more specific information, but that is designed to come up with state-by-state numbers, not county-level information. The Farm Costs and Returns Survey only breaks down information by region of the country. Within that, farm values would vary widely, depending on option value for development and other factors (Jones 1995).

The Maryland Agricultural Statistics Service (a joint program between NASS and Maryland Department of Agriculture) conducts a survey for MDA in support of land preservation programs and has a series dating back to 1988. MASS estimates county averages for cash rents, not weighted by soil type. MASS contacts farm operators and ask them how much they pay in rent. The surveyors ask about the entire parcel, which might also include other uses, but the focus of the land use is on cropland. MASS also has statewide figures for pasture land, which don't vary greatly from county to county in Maryland, according to State Statistician Bruce West (West 1995). While not at the level of detail that would provide estimates of opportunity costs solely in the riparian zone, the county- and state-wide information collected by MASS should at least provide an initial determination of riparian land values if coupled with information about land use in various counties. For example, if data collected for Maryland's western counties indicated that riparian land is used as prime cropland, then this could be coupled with the county-level rental estimates compiled by MASS. If research finds that the impact of a buffer on adjacent land is a widespread perceived opportunity cost for a farmer in a watershed, then these county-level estimates might be considered more adequate, since they would give an indication of rental value of land that is actually used as cropland as opposed to riparian land that may or may not be farmable.

Planting and maintenance costs

Depending on the size and type of buffer, a farmer can incur significant planting and maintenance costs. Additional up-front and maintenance costs would be incurred if streambank crossings are needed for animals. Even if buffer cost-share or grant programs eventually cover a farmer's out of pocket expenses, the initial outlay may deter some farmers from considering participation if there is a lag time between planting and reimbursement. In addition, some programs may require planting at an inconvenient time of the year for a farmer. Maintenance to ensure survival of the trees during the first several years may require a significant time commitment for mowing and herbicide application. Grass buffers may require occasional maintenance throughout their life. As may be the case with planting, maintenance may be required at particularly busy times of

year for a farmer. In addition, forest and grass buffers may present problems with noxious weed control, which is required by law to protect other farmers.

A program in Ohio called "TREES" was started in 1993 specifically to deal with this time-of-planting problem, according to Ohio Department of Natural Resources forester Kathy Smith. TREES is a contract service to help landowners plant and maintain healthy trees in riparian and other areas. Because the optimal time for planting coincides with corn and bean planting, Smith asked, "Who has the time, and who will do the work?" The landowner, in consultation with the forester, pays a flat fee to the local Resource Conservation and Development Council for a three-year planting and maintenance contract. In some cases, state or federal cost share programs, such as the Stewardship Incentive Program, help offset costs (Smith 1995; Terrene Institute 1995).

Michael Huneke, a Maryland Department of Natural Resources forester, prepared the following cost analysis for one Buffer Incentive Program project in Harford County, which is reprinted with his permission. While buffer implementation projects vary widely from property to property, this analysis provides some indication of the up-front costs a successful project might require. In this example, the labor and seedlings for the tree planting itself are a relatively minor up-front expense. Fencing and stream crossings added considerably to the up-front, out-of-pocket costs. State and federal cost-share programs covered almost all of these costs in this example, perhaps thanks in part to the forester's knowledge of these programs.

Table 1. Riparian Buffer Cost Analysis (18.5 Acre Forest Buffer)

by Michael Huneke
Maryland Department of Natural Resources Forester, Harford County

Component	Out-of-Pocket Cost	Cost Share or Grant	Source
Planting:			
Willow Posting (600 linear feet)			
willow material	$400		
contractor	269		
farm laborers	400		
Willow Posting Total	$1,069	$695	SIP
Fencing (8,000 linear feet)			
material	$1,634		
farm laborers	2,340		
Fencing Total	$3,974	$1,987	SIP
Tree Planting (18.5 acres)			
seedlings	$1,645		
flagging	92		
contractor	1,660		
Tree Planting Total	$3,397	$2,148	SIP
TOTALS	$8,440	$4,830	SIP
		grant: 5,550	BIP
		TOTAL FUNDING $10,380	
Estimated Maintenance Costs			
herbicide applications (2 per year)	$1,000	total (two years)	
reinforcement plantings	$750		
Stream Crossings (8 feet wide) (estimated costs)			
crossing #1	$4,969	$4,347	
crossing #2	2,676	2,341	
crossing #3	2,441	2,136	
TOTAL	$10,086	8,824	MACS
Summary:			
Buffer Establishment	$8,440	$10,380	BIP, SIP
Estimated Maintenance Costs	$1,750 (first two years)		
Stream Crossings	$10,086	$8,824	MACS
TOTALS	$20,276	$19,204	

SIP: Stewardship Incentive Program (65% cost share) (joint federal/state)

BIP: Buffer Incentive Program ($300/acre grant) (Maryland DNR)
MACS: Maryland Agricultural Cost Share (87.5% cost share) (Maryland Department of Agriculture)

Transactions Costs

The scale of the up-front costs in the previous example demonstrates why some landowners would be hesitant to participate in a voluntary program: perceived transactions costs. This category of costs for a farmer concerns the "hassle factor" of participating in a voluntary buffer program. While there may be cost-sharing, grants, or technical assistance benefits for participating, perceived difficulty and delays in obtaining these services may prevent a landowner from considering involvement in the program. Previous experiences a farmer has had with government agencies may have a considerable influence on the relative weight given to perceived transactions costs. The importance of these experiences is discussed in greater detail in the literature review of studies of diffusion and adoption of environmental innovations on agricultural land.

Problem Statement

The previous sections have outlined the case for riparian buffers: policy-makers see in buffers the potential for the production of a range of environmental functions, and of economic and social benefits derived from those functions that may or may not outweigh the costs. While many studies have focused on the potential environmental benefits of buffers, little attention has been paid to what factors may influence a landowner to put a riparian buffer on his or her land. These factors are particularly important in the case of agricultural land, because of its predominance as a nonpoint source of water pollution and because it may also provide some of the best opportunities for habitat and other environmental improvements.

Understanding the farmer's process for adopting this conservation behavior is essential in order to design and implement effective riparian buffer policies, for two reasons. First, the current political prominence of property rights advocates suggests that economic incentives and voluntary programs, rather than environmental regulations, may provide the most promising opportunities for establishment of buffers. Second, budgetary constraints limit the availability of funds for outright purchase of riparian lands, and other voluntary programs must use their limited resources for public outreach, cost-sharing, grants, and technical assistance in the most cost-effective way.

To what extent do farmers not participate in voluntary riparian buffer programs simply because they are unaware of their availability and of the benefits of buffers? To what extent are farmers driven by attitudinal factors, such as dislike for government programs, as opposed to perceived "pure" economic costs, such as the possible row-crop income lost by taking riparian land out of production?

When it comes to analysis of riparian buffer policy around the United States, one size does not fit all. Riparian buffers provide different environmental functions and values in different ecosystems, and landowners from state to state present different attitudinal and economic issues that policy-makers need to address when promoting buffers. Thus examination of programs on a state or local scale is apt to provide the most useful policy insight.

A review of agricultural economics, rural sociology, and other literature showed that a number of studies have examined how landowner attributes such as age, percentage of income from farming, wealth, and commitment to conservation affect the willingness of a landowner to adopt innovative conservation practices on agricultural lands. Similar adoption-of-innovation research is needed for riparian buffers, but little attention has been

focused on adoption of tree or grass planting exclusively in the riparian zone, particularly in the case of trees.

Empirical research is needed to test hypotheses about the extent to which a combination of attitudinal and "pure" economic factors drive the behavior of farmers with regard to voluntary riparian buffer programs. Based on the literature for other land set-aside and best management practices programs, these hypotheses predict that the behavior of farmers is not always driven solely by economic considerations. The extent to which that is true has important policy implications for cost-share, grantmaking, and outreach programs designed to promote forest and grass buffers.

CHAPTER 2
LITERATURE REVIEW

This research project addresses the following question: why would someone voluntarily plant a riparian buffer on his or her agricultural land? To help answer that question, an analytical framework is developed that extends an adoption-of-innovation approach used in the agricultural economics literature. A review of the broader adoption-of-innovations and diffusion-of-innovations literature provided guidance toward development of this framework. This discussion of that literature suggests possible strengths and limitations of the approach taken in this study.

Adoption and diffusion of innovation have been studied in a variety of academic disciplines besides agricultural economics, including rural sociology, communication, and marketing. While there are differences among these approaches, diffusion researcher Everett Rogers has found that they nonetheless produced many similar findings about the adoption process (Rogers 1983).

The synthesis and analytical framework used by Rogers provides a useful starting point for reviewing the literature on adoption of innovation. Discussion of the diffusion-of-innovation framework is followed in this review by examples of that framework being applied to diffusion of conservation practices by farmers. The second part of this literature review refers primarily to a 1985 analysis by Feder, Just and Zilberman, who discussed the literature on adoption of agricultural innovations in developing countries and provided a useful synopsis of the applicability of various adoption frameworks to agricultural issues. This discussion is followed by a summary of relevant studies in the agricultural economics literature on adoption of various sustainable agriculture, soil conservation, or best management practices in the United States. These models address a number of factors also important in models used for analysis of land set-aside conservation programs. The fourth part of this literature review focuses on several studies looking exclusively at such land set-asides.

The Diffusion and Adoption of Innovations

Planting riparian buffers to provide environmental benefits can be considered an "innovation," which Rogers defines as an idea, practice, or object that is perceived as new by an individual or other unit of adoption. An innovation presents an individual or an organization with a new alternative or alternatives for solving problems.

According to Rogers's framework, for something to be considered an innovation, it does not need to be "new in an objective sense or involve new knowledge; rather, if the individual perceives it is new in a particular setting, then it is an innovation" (Rogers 1983). For example, someone may have known about planting trees along streams, but may have not been aware of the extent of the potential benefits when framed within the context of nutrient control or environmental benefits for the Chesapeake Bay.

Rogers defines diffusion as a process by which an innovation is communicated over time through certain channels among members of a social system. He recognizes that the diffusion of an innovation is a process that may take many years between the innovation's first introduction and eventual widespread adoption. Economic, sociological, institutional, and psychological factors are part of the decision-making process for potential adopters of the innovation. The process is described as having five steps: initial knowledge, the formation of a favorable or unfavorable attitude about the innovation through persuasion, the decision to adopt or reject the innovation, implementation of the innovation, and confirmation, whereby the individual may reverse the earlier decision to adopt or not adopt. Rogers also describes the attributes of individuals in a series of categories of potential adopters, including innovators, early adopters, the early majority, the late majority, and laggards.

Rogers notes that the diffusion of innovation involves the twin concepts of information and uncertainty. He summarizes a literature finding that information typically comes from the subjective evaluations of peers or near-peers who have experimented with the innovation, rather than from scientific analysis. The role of "change agents" such as agricultural extension personnel are particularly important in providing this information. The successful change agent is described as someone who devotes a great deal of effort to initiating contact with potential adopters about the innovation, has empathy with the potential adopters about their needs, and has developed a degree of trust with the potential adopters. Rogers notes that for some government personnel, establishing trust may be particularly difficult, perhaps because they are seen as regulators as well. Zube and Sheehan focused on desert riparian area landscape perceptions and attitudes in Arizona, noting differences between resource managers and other interest groups such as farmers,

suggesting that this disconnect between managers and landowners might be particularly important in the case of voluntary riparian buffer programs (Zube and Sheehan 1994). In part because of this problem, the role of trusted opinion leaders in the community is also important. The experiences of opinion leaders helps individuals who are motivated to seek further information about the innovation to cope with the uncertainty innovation creates.

The diffusion of innovation approach described by Rogers has also been tested specifically with regard to environmental innovations on farms, with some debate in the rural sociology literature over its applicability. Articles by Pampel and Van Es (1977) and Nowak (1987) provide a useful summary of this debate.

Pampel and Van Es found that environmental innovation by farmers is not predicted well by the demographic variables commonly used in diffusion-of-innovation research. Rather, diffusion theories are better at explaining adoption of commercial agricultural practices. The authors distinguished between farm practices designed primarily to protect environmental and natural resources and those designed primarily to increase farm output.

Pampel and Van Es examine three explanations of adoptive behavior for these two categories of innovations. In the first explanation, the authors cite previous work by Rogers and other diffusion researchers which states that the most important causes of innovative behavior are psychological traits including attitudes about change and risk. This theory suggests that innovative farmers will try many new practices, with profit and environmental impact only secondary considerations. Thus both adoption of commercial agricultural practices and conservation innovations would be explained by this theory. The second theory is that a farmer's behavior is explained more by attitudes about profit than attitudes about risk. Thus a farmer would adopt profitable environmental practices, but not unprofitable ones. The third explanation the authors examine is the possible distinction between farmers who view farming as a business and farmers who view it as a way of life. Business-oriented farmers would adopt profitable and less profitable commercial practices alike that involve close participation in the agribusiness system; less business-oriented farmers would be less likely to adopt commercial practices and more likely to use environmental practices.

Pampel and van Es found that the orientation-to-farming explanation works best for environmental innovations. The authors concluded that the predictors of profitable innovations were different than predictors of unprofitable innovations (for example, land set-asides). Farm experience best explained adoption of conservation practices, while variables relating to farm size best explain adoption of commercial practices. In

particular, the authors question the extent to which the diffusion process is relevant for public benefit-oriented rather than private benefit-oriented innovations, since the perceived costs of most conservation innovations are apt to exceed the perceived short- and long-term benefits.

Nowak argues that the economic perspective taken by Pampel and Van Es complements the "information" perspective of adoption-diffusion research, which suggests that a farmer must be made aware of the need for the innovation, be able to obtain valid information to evaluate the consequences, and receive sufficient technical assistance to implement it. Nowak also adds ecological factors to the mix, noting that adoption of conservation innovations depends also on their appropriateness for a particular farm. To test this hypothesis, Nowak initiated a series of four contacts with farmers in two watersheds over a two-year period. Nowak asked about these farmers' use of four conservation practices seen as unprofitable, including buffer strips, and one seen as profitable, the use of conservation tillage.

The information factors discussed by Nowak refer to work by Rogers and others suggesting that a farmer's integration into local assistance and information networks and the credibility of change agents in the community can be major factors in an adoption decision. He collected data on the number of times farmers contacted extension personnel during the past year. Economic factors discussed by Nowak include farm size, amount of non-farm income, and credit use. He refers to a literature noting that operators with off-farm income have more flexibility to invest in conservation practices and that large-scale farmers should also be willing to invest in environmental innovations because they have more discretionary resources, flexibility, and ability to deal with risk and uncertainty.

Nowak concludes that both economic and information factors are important in the adoption of conservation innovations on farms. Information factors tended to increase in importance as the complexity of the innovation increases and decrease in importance as risk is reduced through cost-share or other institutional support. Nowak argues that the traditional economic perspective is insufficient in that it ignores insights from sociological research such as the implications of community networks and attitudes. He also recognizes limitations of research that he and others have done, noting that adoption and diffusion are processes occurring over time, and that research in this field needs to move beyond reliance on perceptual and aggregate economic and ecological data.

The Adoption of Agricultural Technologies

In a 1985 article, Feder, Just and Zilberman discuss the strengths and weaknesses of a range of studies in the agricultural economics literature on adoption of agricultural innovations in developing countries, particularly the adoption of high-yielding varieties of grain. While their examples are different in some respects from land set-aside programs, the authors outline various analytical frameworks used in the diffusion-of-agricultural innovation literature that are relevant for riparian buffer adoption. In the agricultural economics literature, the authors find that, generally, the innovation adoption decisions of a farmer in a given period are assumed to be derived from the maximization of expected utility or profit, subject to whatever constraints on land or other factors under which the farmer is operating (Feder, Just and Zilberman 1985).

The authors also describe different equations of motion that have been used to address the intertemporal nature of diffusion of innovations. These equations are particularly important to help understand changing perceptions of an innovation. One approach is the use of Bayesian learning rules, a statistical approach which helps describe the ways in which individuals operating under initial uncertainty change their behavior as they get more observations on which to base their perceptions. These Bayesian models also help explain the time lag between initial awareness of an innovation and actual adoption. The authors refer to studies by O'Mara and Lindner that build on concepts on experimentation developed by Rogers to address the question of risk and uncertainty. These studies show that in many cases farmers experiment with innovations on a small portion of their land.

This approach may be particularly useful in the study of riparian buffer diffusion, where the perception of costs to a farmer may be based to some degree on the experiences of peers and the extent of their opportunity costs, planting and maintenance costs, and transactions costs. For instance, if a farmer learns from his neighbor there is little red tape involved, that the upfront costs and ongoing maintenance were minimal, and that the buffer did not produce other regulatory problems or threats to adjacent fields, he might change his perception over time and consider planting a buffer at a future time.

Another approach that Feder, Just, and Zilberman note from the diffusion literature is one that recognizes explicitly the effects of extension efforts and human capital differences in changes in perception over time. Again, this approach has important relevance for riparian buffers, since many public agencies are involved in their promotion, and each agency is faced with limited funds for outreach and cost share budgets. Feder, Just and Zilberman also note the influence of perception of the extension service, citing a

1972 study by Harriss that indicated that lack of confidence in extension efforts may in some cases lead farmers to look to the success of neighbors, friends and relatives in adopting an innovation, rather than following the lead of an extension agent.

Feder, Just and Zilberman review a number of theoretical diffusion models, pointing out some key components of them. One already mentioned is the role of uncertainty and the degree of risk aversion for a farmer. A second is the possible relationship between farm size and fixed transactions costs, citing two studies showing that smaller farms are less likely to adopt agricultural innovations because of these fixed costs. A third is the extent to which innovations are adopted as part of a package. Again, this is a particularly important question in the case of riparian buffers, since additional best management practices on the farm may provide some of the same environmental benefits as the buffer and may reduce stress on the buffer, thus improving its performance. Other aspects of the diffusion literature that Feder, Just and Zilberman review include the effect that educational level, age, off-farm income, and extension effort have on a farmer's likelihood of adoption.

The authors also note that different conclusions may result from studies of different regions or countries because of different social, cultural, or institutional environments "aside from 'pure' economic factors."

The Adoption of Best Management Practices

The agricultural economics literature includes many articles about the adoption of various conservation practices on agricultural land. For many of these practices, the determinants of adoption may differ from those for land set-aside programs. A brief discussion of these studies is included here because they influenced the development of the analytical framework used for this study and others on participation in land set-aside programs.

Ervin and Ervin examined factors affecting the use of voluntary erosion control practices, developing a theoretical model based on institutional, personal, physical, and economic characteristics for the land and landowner. The authors found that education and the awareness of the degree of erosion play the most important roles in determination of a farmer's decision to invest in soil conservation practices. These variables were found to be inversely related to the number of years farming, thus younger farmers might be more apt to adopt conservation practices (Ervin and Ervin 1982).

Norris and Batie examined soil conservation decisions in Virginia. They found that financial factors, including higher incomes, larger farm size, and lower debt levels, were the most important element of such decisions, with awareness of erosion, educational level, and level of off-farm income also important (Norris and Batie 1987).

D'Souza, Cyphers and Phipps examined factors affecting the adoption of sustainable agricultural practices, including integrated pest management and rotational grazing. The authors describe a framework based on the agricultural technology adoption literature, with factors affecting technology adoption grouped into four categories: human capital, including age and educational level; structural and financial, including farm size, debt/asset ratio, and off-farm employment; institutional, including participation in farm commodity programs; and environmental, including factors such as ground water quality. The authors found that determinants of adoption differ from those for conventional agricultural technologies. The likelihood of adoption was found to most influenced by an "awareness effect," with regard to the severity of groundwater problems on the farm. Human capital characteristics were also found to be significant, while structural and institutional characteristics were not. Age and off-farm employment were negatively correlated with the adoption decision; educational level and level of groundwater contamination were positively correlated with the decision (D'Souza, Cyphers and Phipps 1993).

Feather and Cooper examined components of the U.S. Department of Agriculture's Water Quality Program designed to encourage the use of best management

practices. Feather and Cooper found that adoption of these practices was most strongly determined by the farmer's perception of their effect on profitability and that familiarity with conservation programs and a belief that the practices will help on-site water quality were also important in the decision (Feather and Cooper 1995).

Determinants of Participation in Land Set-Aside Programs

Planting a forest buffer is more akin to a land set-aside program like the Conservation Reserve Program than to many of the agricultural innovations described in the previous sections. It is particularly important to examine land set-aside programs, since the long-term benefits of taking land out of production may be perceived to accrue primarily to the community at large, whereas certain soil conservation practices may be perceived as being in the farmer's direct long-run interest.

Morris and Potter extend the diffusion of innovation framework to analyze participation in England's Environmentally Sensitive Areas Programme (ESA) (Morris and Potter 1995). The authors describes their survey of a cross-section of 101 farmers in South East England who are participating or not participating in ESA. Building on Rogers's conceptual framework, the authors place farmers on a participation spectrum ranging from resistant non-adopters to conditional non-adopters to passive adopters to active adopters. Resistant non-adopters are described as people who would not participate in the voluntary program under any circumstances. Conditional non-adopters would consider participating if the subsidy was made more attractive. Passive adopters, also called "the new conservationists," are attracted by financial inducements and would participate as long as they can do so with minimal cost and inconvenience. Active adopters tend to have a history of environmental innovation already. The authors also cite a literature describing the importance of enhancing conservation advice to farmers, in addition to financial incentives.

Bell, Roberts, English and Park investigated the likely effect of cost-share incentives on participation in the Tennessee Forest Stewardship Program and identified other factors that may contribute to participation. The authors developed a random utility model to determine the probability that a landowner will choose to participate in the program. Their model states that the indirect utility received by an individual for participating or not participating in Tennessee's Forest Stewardship Program is a function of the landowner's current income from all sources, the out-of-pocket costs associated with planting the trees, personal characteristics including age and occupation, farm features including size, current land use, and ownership type, and attitudes and beliefs about conservation practices. Their results indicate that attitudes and knowledge about forestry programs may be more influential than monetary incentives in a landowner's decision to participate. The results suggest that a negative attitude toward the program's goals could outweigh the program's monetary benefits to a landowner, to the point where the landowner would not participate, regardless of the cost share offered. The authors

suggest that resources might best be used by focusing on outreach efforts to change attitudes, rather than increasing the level of cost share (Bell, Roberts, English and Park 1994).

Studies of participation in the Conservation Reserve Program also provide an important source of guidance toward developing a conceptual framework for study of adoption of riparian buffers, although, like Tennessee's Forest Stewardship Program, the Conservation Reserve Program is not focused exclusively on riparian areas.

Esseks and Kraft conducted a survey of farmers in four diverse midwestern sites to learn why some eligible farmland owners participated or did not participate in the first four annual sign-ups of the Conservation Reserve Program. The survey included a series of closed- and open-ended questions to understand participation factors, comparing the results with information about the owner's personal and farm background. They found that, depending on the survey site, from one-third to one-half of the nonparticipating owners did not know they were eligible for the program and were unaware of the prevailing per-acre rent and other benefits of the program. A comparison to soil maps found that this perception was untrue in almost all cases. The authors indicate that this pointed to a need for better outreach, contradicting the findings of an earlier, national survey of county-level ASCS, SCS, and Cooperative Extension personnel, in which these agency representatives indicated that perception of erosion by the landowner was not an important reason for nonparticipation. Esseks and Kraft also note that their conclusions suggest that an increase in the per-acre rental rate and the right to graze or hay enrolled land would have increased participation. The authors' analysis noted several other significant determinants of participation, depending on the survey location. The most quantitatively important determinant was whether or not a landowner had received cost-sharing or conservation technical assistance during the past two years, suggesting that these landowners were thus more aware of the benefits of CRP. For one site (in Wisconsin), the authors also found level of education to be positively related to CRP bidding, and that the larger total revenues, the lower estimated probability of CRP bidding. The authors attribute this to the fact that higher incomes in that area tend to be associated with dairying, and if farmers do not intend to reduce the size of their herds, they may believe that they have little or no cropland to spare (Esseks and Kraft 1988).

Esseks and Kraft resurveyed participants in their 1987 survey to determine the success of U.S. Department of Agriculture outreach efforts. Since the time of the first survey, CRP eligibility requirements had been expanded in two important respects for riparian buffers. Before the sixth CRP sign-up, two-thirds of a field had to be considered highly erodible to be eligible for CRP per-acre rental payments. Starting with the sixth

sign-up, fields that were only one-third highly erodible could be included, as long as the applicant intended to plant trees. In addition, grass or forest filter strips (buffers) were included, even if that land was not highly erodible, as long as the filter strips promised to "reduce sediment substantially." Depending on the sample site, the authors found that from 39% to 58% were unaware of the filter strip option, and even bigger proportions (69% to 80%) were unaware of the liberalized conditions for tree planting. The authors found that there was increased awareness of CRP eligibility since the initial survey, and they concluded that awareness of CRP eligibility is related to the number of visits by a landowner to a USDA office. This relationship did not hold for awareness of the new tree planting or riparian filter strip options, suggesting a need for better outreach materials (Esseks and Kraft 1989).

McLean-Meyinsse, Hui, and Joseph focused on the determinants of small farmers in Louisiana's awareness, participation, and willingness to participate in the Conservation Reserve Program. Their analysis is based on the assumption that a farmer's participation is determined by weighing his or her perceived costs and perceived benefits, and that the expected utility from participating exceeds the expected utility from not participating. The authors surveyed 69 farm operators by mail. They used a binomial logit model to analyze their hypothesis that participation was a function of age, education, income, full- or part-time farming status, race, percentage of acres operated that are owned by the operator, and average return in dollars per acre of land farmed. The authors found that participation depends on whether payments per acre were comparable to the opportunity costs of removing cropland from production. In addition, farmers with higher incomes and more education were more aware of the Conservation Reserve Program (McLean-Meyinsse, Hui, and Joseph 1994).

Olmstead and McCurdy analyzed factors affecting Conservation Reserve Program tree planting in Southern Illinois. The authors surveyed by mail participants in the Conservation Reserve Program. Of the landowners who planted trees, 62% cited conservation and 52% cited wildlife, recreation, and aesthetics as a motivation for planting. The number of participants interested in habitat increased with age. Twenty-four percent cited timber as a motivation, and only 9% cited full reimbursement for stand establishment. CRP participants who did not plant trees cited most often the length of timber rotation between harvest, a lack of information, and insufficient rental rate per acre as the reasons for not planting trees. 43% of tree planting owners believed that the forest land would increase the value of their ownership, while 51% of non-tree planting owners believed that the forest land would decrease the value of their ownership. Only 2% of the tree planting participants listed timber production exclusive of other objectives, however.

The authors found no statistically significant difference in educational levels of tree planting and and non-tree planting participants. The authors also examined information sources, finding that tree planters cited the Forest Service and Illinois Department of Conservation more frequently than non-tree planters, who in turn cited neighbors, friends and relatives as a source of information more often than the tree planters (Olmstead and McCurdy 1989).

Lant conducted a contingent choice survey of farmers in Fayette County, Illinois and found that farmers were less likely to enroll streamside land in the Conservation Reserve Program if tree planting were required and if the contracts were extended to 20 years. Lant found that farmers were constrained by the economic trade-offs they would have to make between crop production and conservation on their riparian land. At the same time, he found that farmers use non-economic factors when deciding the use of their riparian lands, with soil conservation, water quality, and wildlife habitat benefits being important considerations. In addition, farmers wished to avoid government control over management of their farms (Lant 1991).

CHAPTER 3

ANALYTICAL FRAMEWORK: THE ADOPTION PROCESS

This research project attempts to answer the following questions: Why do people participate or decline to participate in voluntary riparian buffer programs, and what are the factors driving this behavior? Empirical research will test the hypothesis that a combination of attitudinal and "pure" economic factors determine this behavior, with the relative importance of each factor varying with age, size of farm, percentage of income from farming, and other independent variables.

For this project, an adoption-of-innovation model for riparian buffers is developed and tested by examining one state-wide initiative, Maryland's Buffer Incentive Program, an undertaking focused exclusively on voluntary implementation of forest buffers. Data gathered from interviews with more than 500 landowners in Maryland provides an empirical test of the model. This research project is designed to gain some understanding of what it might take to get various types of landowners in various land uses to implement riparian buffers on their land. While Maryland differs from other states in many environmental, economic, sociological, and institutional respects, this project is designed to provide a framework for analysis that might be useful for riparian buffer policy-makers in other parts of the country as well.

The central premise of this research project is that three steps take place for a landowner to participate in a voluntary riparian buffer program:

1) The landowner is made aware of the concept of riparian buffers and of the existence of cost-share or grant-making programs like the Buffer Incentive Program.

2) The landowner perceives that the benefits of riparian buffers outweigh the costs. Perceived benefits may include environmental functions and values occurring on the owner's land, those accruing to the community at large, possible tax or financial advantages, and psychological rewards of conducting environmental restoration. Perceived costs may include opportunity costs of other land uses, planting and maintenance costs, and transactions costs.

3) The landowner makes "the buffer deal" with or without the help of cost-share funds, grants, technical assistance, and other programs and policies designed to encourage implementation of buffers.

This thesis focuses only on the first two steps in this adoption process, through which conclusions and subsequent recommendations will be made for policies to facilitate the third step.

The theoretical framework used to determine the factors determining participation in Maryland's Buffer Incentive Program was developed with guidance from previous analyses of participation in other land set-aside or agricultural conservation programs, as discussed in the previous chapter.

The landowner participation in the Buffer Incentive Program can be seen as a function of the following factors:

A. land parcel features (including current land use and size)

B. personal characteristics of the landowner (including educational level, age, percentage income from farming, gross income from farming, and commitment to conservation)

C. the landowner's awareness of the concept of buffers and of the Buffer Incentive Program

D. perceived benefits from the landowner's point-of-view, including incentive payments, on-site benefits, and community benefits

E. perceived costs to the landowner, which can be broken down into three subcategories:

    1. opportunity costs, including loss of income from the current land use and in the future from reduced development potential

    2. planting and maintenance costs, including up-front costs for planting and subsequent costs for maintaining the buffer in forest or grass

    3. transactions costs, or "who bears the brunt of the 'hassle factor'?"

This study has been undertaken with the recognition that decisions about adoption of an innovation are made over a period of time, and that an individual's perceptions and attitudes are not cast in concrete forever. This empirical analysis takes a snapshot of the motivations of farmers from November 1995 to January 1996. For policy-making purposes, how those motivations might change over time is perhaps the more important question, requiring a dynamic model, as discussed in the next chapter.

CHAPTER 4

GENERAL APPROACH

The following steps were taken in the development of this research project and are described in greater detail in this chapter:

1. Defined scope of project
2. Limited scale of investigation
3. Identified research questions
4. Evaluated models and analytical techniques
5. Designed survey instrument
6. Implemented survey
7. Analyzed data

Project Scope

The first task in this project was a review of literature on the determinants of participation in voluntary riparian buffer programs. Because forest buffers in particular have received emphasis only in the past several years, there is very little peer-reviewed, published research on this topic. Three steps were taken as next-best alternatives. First, the literature on adoption of agricultural innovations and conservation practices was reviewed. This literature describes research on many factors that might also play a role in a landowner's decision to set aside riparian land for forest or grass buffers. Second, interviews with people from the public and private sector who are knowledgeable about riparian buffers highlighted additional concerns that farmers have voiced in various forums addressing the issue. Third, government reports, testimony, and other grey literature were reviewed, especially for guidance on the current riparian buffer policy debates. The dearth of published research on riparian buffer adoption, as well as insights provided through telephone and personal interviews, pointed to the need for original data collection in this project.

Narrowing the Scale of Investigation

Interviews and a review of peer-reviewed and grey literature pointed to a need to narrow the scale of investigation by focusing on a program that met the following criteria.

First, the program had to address riparian buffers, preferably without the confusion of having other land eligible for planting that lies outside the riparian area. Second, the program had to be voluntary, not regulatory, because such voluntary approaches are at the heart of current policy debates on riparian buffers. Third, the program should address agricultural land uses, because of agriculture's predominance as a nonpoint source of water pollution. Because riparian zones in different regions of the country offer significantly different ecological and economic values, it is difficult to generalize on a nationwide scale about the costs and benefits a landowner might perceive from buffer implementation. Thus the program being analyzed should be statewide, which should provide a manageable scale for comparison.

Maryland's Buffer Incentive Program fit the bill as the focus of study for several reasons. First, its sole purpose is to provide a voluntary incentive only for planting riparian forest buffers. Unlike other programs that include a tree-planting component, such as the Conservation Reserve Program or Forestry Incentive Program, land outside the riparian zone is ineligible for grants from the Buffer Incentive Program. In addition, the program focuses only on planting trees, not grass. Grass buffers are an important alternative or complement to forest buffers, however, so landowner perceptions about grass buffers are included as part of this research. The number of participants appeared to be large enough to provide some insight on determinants of participation, yet conducting interviews with all the participants appears to be a feasible goal. The program is statewide, with participants in 16 counties. A review of public records indicated that previous land uses of buffered areas in this program were primarily for row crops or pasture, so the study provides an opportunity for insight into determinants of riparian buffer adoption on agricultural land.

Adoption behavior for other best management practices has been shown to vary because of economic, institutional, and cultural differences in different regions (Feder, Just and Zilberman 1985). Agriculture in Maryland, while different in many respects from other states, offers a reasonable scale for comparison of determinants of participation in a riparian buffer program. The counties of the Eastern Shore of Maryland (the peninsula east of the Chesapeake Bay) lead the state in production of corn, soybeans, barley, and wheat, while western counties lead the state's dairy, hay, and tobacco production (Maryland Department of Agriculture 1995). Institutional factors also vary across the state. For example, the easternmost 16 counties are subject to stricter riparian zone regulation because of Maryland's Chesapeake Bay Critical Areas Act. Culturally, the Chesapeake Bay can be seen as the literal great divide for Maryland. The state was founded three centuries before construction of the Chesapeake Bay Bridge, which now

provides easy access between the eastern and western parts of the state. It may take longer to bridge the cultural differences that developed in those three centuries, and this may be reflected in different attitudes from east to west about private property rights or government programs in general.

Maryland's Buffer Incentive Program

Maryland's Buffer Incentive Program is a voluntary initiative coordinated by the state's Department of Natural Resources to awards grants for successful planting and maintenance of riparian forested buffers. The program's stated goal is to serve as an incentive for the planting of these buffers on private land and to help defray the landowner's costs of establishing and maintaining them.

The Buffer Incentive Program helped establish a total of 665 acres in forest buffers during the period of 1992 to 1994, the three years included in this study. Twenty-six landowners participated in 1992, 22 in 1993, and 34 in 1994. Some landowners planted buffers in more than one year, so the working total for this study is 80 landowners. During that time the program helped establish riparian forest buffers in 16 of Maryland's 23 counties.

The previous use of the riparian land converted to forest buffers through the Buffer Incentive Program has been primarily agricultural: of 82 buffers established through the program in 1992 to 1994, 21 were on land previously used as pasture and 48 as row cropland or for some other agricultural use. Guidance to DNR foresters notes that one of the groups DNR is most interested in reaching through the program is the agricultural community, and suggests that the best way to reach farmers is through the local Soil Conservation District manager.

Buffer Incentive Program eligibility requirements include the following:

- any area of privately owned land of at least one acre and not more than 50 acres which is a crop field, pasture field, other open area of bare ground, or early successional vegetation
- in addition to meeting one of the qualifications above, eligible lands must meet one of the following criteria: be within 300 feet of a stream, river, pond, tidal or non-tidal wetland, or other open water. The water must appear on a U.S. Geological Survey 7.5 minute quad map (a "blue line" stream) or have flowing water for any one-month period during the year. Wetlands must appear on a U.S. Fish and Wildlife Service wetlands map or be otherwise classifiable as a wetland based on current State of Maryland criteria. Land within a 100-year floodplain is also eligible.

Policies and conditions of Buffer Incentive Program requirements include the following:

- the minimum proposed buffer width is 50 feet, although existing forest can be incorporated into the buffer. For example, if a 20-foot buffer already exists, a 30-foot buffer may be planted to create the minimum 50-foot buffer.

- one acre is the minimum planting size; there is no minimum length along the stream

- grant awards were $200 per acre in 1992, $500 per acre in 1993 and 1994, and are currently $300 per acre.

- to receive full grant payment, 65% of the planted trees must survive until the fall or winter following planting, based on an inspection by the local forester. Survival rates of 50% to 65% are eligible for a 50% grant, with the remainder paid upon successful replanting that brings survival up to the 65% rate.

- Landowners must comply with the terms of the approved planting plan for at least ten years, or DNR may bring an action to require restoration of the practice or payment of the money received.

- The program does not apply to recently cleared forestland, nor to any planting required by law or regulation, nor to establishment of orchard or Christmas trees

- Landowners are also eligible for cost-share funding from programs such as the Agricultural Conservation Program, the Forestry Incentive Program, the Stewardship Incentive Program, and the Conservation Reserve Program.

- Grass buffers are not eligible for grants under the Buffer Incentive Program guidelines.

Identification of Research Questions

Once a suitable program had been identified as a case study, a group of testable hyphotheses was developed with regard to the determinants of participation in this program. Development of these hypotheses was guided by the findings of similar adoption studies for other best management or agricultural technology practices and by farmer concerns about buffers reflected in the grey literature and in interviews with knowledgeable parties. Hypotheses relate to land parcel features, landowner personal characteristics, awareness of the concept, perceived benefits, and perceived costs.

Stated Hypotheses:

1. Land parcel features

   A) current land use: landowners with row crops in riparian area will be less likely to participate than landowners with pasture or other land uses in riparian area

   B) size: landowners with larger properties will be more likely to participate than landowners with smaller properties

2. Landowner personal characteristics

   A) gross revenue: the higher the gross revenue, the more likely the landowner will be to participate

   B) age: younger landowners will be more likely to participate than older farmers

   C) education: landowners with education beyond high school will be more likely to participate than landowners with less education

   D) percent net income from farming: landowners who earn less than 50% of their income from farming will be more likely to participate than landowners who earn more than 50% of their income from farming

   E) commitment to conservation: landowners who indicate that water quality and other environmental benefits to the community were important in their decision will be more likely to participate than landowners who did not indicate that this was a factor

3. Landowner's awareness of riparian buffers and the program :

   A) landowners who were initially approached personally by a Maryland Department of Natural Resources Forester are more likely to participate than landowners who were not

   B) landowners who had contacts with more than one source of information (neighbor, DNR, NRCS, etc.) about buffers were more likely to participate than those who did not

4. Perceived benefits

A) cost-share: landowners are more likely to participate as cost share payment increases

B) cost-share: non-participants are more likely to participate if grass buffers are also eligible for BIP cost-share

C) on-site benefits: landowners who said that creation of fish and wildlife habitat was important in their decision will be more likely to participate than landowners who did not

D) on-site benefits: landowners who said that erosion was an important factor in their decision will be more likely to participate than landowners who did not

E) on-site benefits: landowners who said that aesthetic factors such as a scenic view were important in their decision are less likely to participate than landowners who did not

F) community benefits: landowners who indicate that water quality and other environmental benefits to the community were important in their decision will be more likely to participate than landowners who did not indicate that this was a factor

G) community benefits: the higher the gross revenue,the more likely the landowner will be to indicate that environmental benefits to the community were important in his decision

H) community benefits: landowners with education beyond high school will be more likely to indicate that environmental benefits to the community were important in his or her decision

5. Perceived costs

A) opportunity costs (current income): landowners with row crops in riparian area will be less likely to participate than landowners with pasture or other agricultural land uses in riparian area

B) opportunity costs (current income): landowners with row crops will be more likely to cite deer population and loss of moisture to adjacent fields as a factor in their decision

C) opportunity costs (future development potential): landowners who said that aesthetic factors such as a scenic view were important are less likely to participate than landowners who did not

D) opportunity costs (future development potential): landowners who said that aesthetic factors such as a scenic view were important are less likely to have very small order streams

E) planting and maintenance costs: non-participants will be more likely to cite length of time for planting and maintenance as a factor in their decision than participants.

F) planting and maintenance costs: non-participants will be more likely to cite time of year of planting and maintenance as a factor in their decision than participants

G) planting and maintenance costs: non-row crop farmers will be less likely to indicate that timing is a factor than row-crop farmers

H) planting and maintenance costs: landowners will be less willing to accept 20, 30, or permanent maintenance requirements or easements than they are for a 10 year maintenance requirement

I) planting and maintenance costs: landowners are willing to accept longer-term easements for a higher cost-share

J) transactions costs: non-participants are more likely than participants to cite time spent on the application process as a critical factor in their decision

Evaluation of Models and Analytical Techniques

Once hypotheses specific to riparian buffer adoption had been developed, an adoption framework was developed, based on similar analyses described in the literature on the adoption and diffusion of environmental innovations on agricultural land. T-tests and Mann-Whitney U-tests were used to compare the means of responses by adopters and non-adopters to the survey questions.

The framework, outlined in Chapter 3, hypothesizes that a landowner decision to participate or not participate in the Buffer Incentive Program can be seen as a function of land parcel features, personal characteristics of the landowner, the landowner's awareness of the concept and program, and the landowner's perceived costs and benefits from participation in the program.

This framework was chosen with a recognition that it nonetheless has analytical limitations. Feder, Just and Zilberman discussed some of those limitations with regard to other dichotomous choice analyses. One is that describing the adoption choices as simply "adoption" or "non-adoption," not taking into account the percentage of eligible land for which the innovation is adopted, may not tell the complete story. Also, there may be a problem of simultaneous equations bias since buffers may be just one of a set of complementary innovations (including other best management practices) that are introduced simultaneously (Feder, Just and Zilberman 1985). Finally, the process-oriented nature of adoption of innovations may not lead itself to the static, "snapshot" approach of landowner behavior used in this model. The model developed for this study was guided especially by approaches used by Bell, et al. (1994) and D'Souza, Cyphers and Phipps (1993) in part because of the snapshot approach taken in those studies. Testing a dynamic model through empirical research would require a period of years, following perhaps the approach used by Esseks and

Kraft (1988; 1989) or Nowak (1987). Such a project by researchers with the resources to do so would be a valuable contribution to furthering the understanding adoption of riparian buffers.

Design of the Survey Instrument

Once the model had been constructed, empirical data collection was necessary to test it. The difficulty in gathering farm level economic level about riparian areas, as well as the subtleties of attitudinal factors and perceived benefits and costs, suggested that a survey would be the most effective method of gathering data.

Two survey instruments were developed. The first was designed for participants in the Buffer Incentive Program; the second was developed as a follow-up to a survey in the fall of 1995 of a random sample of farm operators in Maryland with regard to best management practices. The earlier survey had asked questions concerning the use of best management practices by these operators and gathered data about the farm operator's age, gross income from farming, and other demographic characteristics. Many of these questions were similar to questions planned for the Buffer Incentive Program participant survey, so wording and format of the participant survey was adjusted to match the already-completed best management practices survey.

The survey follows the Total Design Method, an approach commonly used in the agricultural economics and rural sociology literature (Dillman 1979; Salant and Dillman 1994), to the extent that time and financial resources allowed.

Survey questions were developed with input from faculty committee members and others involved in riparian forest buffer policies or programs in Maryland, most notably from the Maryland Department of Natural Resources Forestry and Coastal Zone Management Divisions, Maryland's Agricultural Extension Service, the Chesapeake Bay Program, and the Chesapeake Bay Commission. Beth Webb of the University of Maryland's Survey Research Center provided particularly helpful changes in question wording and ordering. Additional wording changes were made after test interviews with three participants in the Buffer Incentive Program and training sessions for paid callers from the Maryland Agricultural Statistics Service. Needless to say, any errors of omission or commission in the survey instruments are the author's responsibility and should not be a reflection on the many people who provided valuable guidance as it was developed.

The questions were arranged as much as possible to follow the adoption process proposed in this thesis. Questions about initial awareness were asked first, followed by factors considered when evaluating the costs and benefits of participation in a forest buffer program. Hypothetical and more sensitive questions were left to the end of the interview, after rapport between interviewer and respondent and a clearer understanding of the issue were likely to have been established, as suggested by Dillman.

Buffer Incentive Program Participants Interview Description

The first two questions in the interview protocol for Buffer Incentive Program participants attempted to elicit responses about the first step in the adoption process: awareness. Following an approach suggested by Dillman, the first question is multiple choice, followed by an open-ended question to moderate the pace of the interview. This open-ended question was also designed to address a particularly difficult but important issue in streamside buffer adoption: the ability of agents on the ground to sell the idea of buffers to a landowner. While this may be difficult to measure in a rigorous statistical fashion, the responses to this open-ended question may nonetheless offer useful insights about the importance of one-on-one or other outreach methods. From a policy and funding perspective, this may be particularly relevant. Also, the question design recognizes that many people may learn about buffers from more than one source and over a period of time, as described in the adoption-of-innovation literature (see literature reviews in Rogers 1983; Feder, Just and Zilberman 1985).

Questions 3 through 5 address physical properties of the stream and riparian area, including the width of the stream, slope of the land, and possible limitations the land might present for further implementation of buffers.

Question 6 is the heart of the interview. In this multi-part question, the respondent is asked to rate on a four-point scale the extent to which 13 factors played a role in his or her decision to put a buffer on his or her land. The survey was developed with the recognition that it would be impossible to query landowners about every conceivable factor in a decision. The 13 factors included in this question cover a range of possible perceived costs, benefits, and attitudinal influences and may lead to identification of other possible factors worth examination in future research projects.

Landowners were then asked to recall their actual planting and maintenance costs, which may differ from what they originally perceived those costs to be when deciding to participate.

The next section of the interview (Questions 14 and 15) includes two multi-part hypothetical questions about willingness to accept payments for various length land use restrictions for both forest and grass buffers. The questions are based on similar questions asked in a 1993 survey of a nationwide sample of Conservation Reserve Program participants (Osborn, Schnepf and Keim 1993). As with Question 6, the desire to keep interviews to a reasonable length precluded inclusion of a longer introduction that might have strengthened these questions and provoked more concise responses. These questions were included despite these limitations, with the expectation that many landowners would offer comments about compensation or various term easements that might provide a useful starting point for more in-depth research.

Questions 16 to 21 requested information about the farm and farm owner. Following Dillman, these questions were left until the end because they addressed income, age, educational level, and other possibly sensitive issues.

The question about the landowner's education was asked differently in the two surveys. Following Dillman, the BIP landowner survey asked the respondent to choose among four categories (high school or less, some college, college degree, some graduate school). Answers in the best management practices survey were compiled showing the number of years beyond high school that a landowner attended school. These answers were adjusted to show that 4 years of additional schooling earned a bachelor's degree, and any additional years of schooling indicated work toward a graduate degree.

The interview ended with an open-ended question to elicit opinions about forest and grass buffers and the Buffer Incentive Program.

Random Sample of Maryland Farm Operators Interview Description

Because of funding and timing constraints, the survey was kept to four 8 1/2 by 11 pages, thus limiting the time devoted to definitions and other elaboration that might have strengthened the interview process.

The interview began with a screening question to establish whether or not the operator owned any riparian land. Since the survey of Buffer Incentive Program participants dealt with landowners, not operators, it was necessary to weed out of the comparison survey any operators who do not own any land. Of those operators in the sample who do own land, it was also necessary to establish whether or not they owned any riparian land. If the farmer indicated that he or she does not own any riparian land,

the interview was terminated. Respondents were asked to address only land they owned in the interview, not any other land that they might rent.

The definition of "riparian" used in the survey instrument is the same as the one used in the Buffer Incentive Program guidelines ("within 300 feet of a stream, river, pond, tidal or non-tidal wetland, or other open water"). There are a number of definitions of "riparian land" that have been offered, as discussed in Chapter 1. However, to ensure that the respondent was discussing land that is actually eligible for the Buffer Incentive Program, that program's definition was used. At least one other study, of farmers in Dickinson County, Kansas, has recognized that a landowner's perception of streamland importance is influenced to some degree by his or her perception of what constitutes streamland (Schrader 1995); this study in Maryland also recognizes the potential of this problem occurring. Callers were given the full Buffer Incentive Program guidelines to help respondents if there was some confusion about whether or not their land is eligible for the program. Without consulting a U.S. Geological Survey map or visiting the site, it is difficult to determine all eligible lands with precision. However, the wording of the question and the background materials provided to callers should have given a reasonable definition as a basis for conducting the interview.

Question 2 established the farmer's awareness of the concepts of forest or grass buffers. The survey was designed with the expectation that most farmers in Maryland have at least a rudimentary awareness of forest and grass buffers. If not, the interview was terminated, since its focus is on the reasons a farmer decided to participate or not participate in a forest or grass buffer program.

Questions 3 and 4 were designed to elicit responses about the physical characteristics of the land and stream, as well as the current land use of the riparian area. They follow the wording of questions 3 and 17 in the survey of Buffer Incentive Program participants. Another BIP participant survey question about physical characteristics, concerning land slope, had already been asked of the BIP non-participants in the earlier best management practice survey. Again following Buffer Incentive Program guidelines, 300 feet was used as the width of the riparian zone. Interviewers were instructed to check off multiple categories for riparian land use, if necessary, recognizing that the area within 300 feet of a stream could include both cropland and pasture, or even some forest or grass buffers. Question 4, with regard to stream width, poses a problem in cases where more than one stream or other water body is on the property. Callers were instructed to emphasize that the question relates to the width of the stream on average. This should at least give a reasonable approximation of stream order to help determine the relative

importance of the value of a view and, possibly, of the opportunities for buffer implementation along different order streams.

Questions 5 and 6 are the same as Questions 1 and 2 in the BIP participant survey. One possible problem for data analysis was the inclusion of grass buffers as an option. While Buffer Incentive Program participants were asked only about their motivations for participating in that forest buffer program, the non-participants were asked at the same time about their motivations for participating in a forest or grass buffer program.

Question 7 established whether or not the farmer had planted a forest or grass buffer on his or her land since 1990. That cut-off point was used as an approximate time-frame for the current interest in promoting forest buffers and of the availability of grants from the Buffer Incentive Program. If respondents answered yes, interviewers were instructed to follow up by asking if the buffer planted was of grass or trees.

In Question 9, interviewers asked the same 13 questions of non-participants as were asked of BIP participants in Question 6 of that survey. There are a number of possible problems with this question that were addressed as the survey instrument was developed. First, the inclusion of the grass buffers option posed an opportunity for some confusion. If the respondent indicated in Question 7 that he or she had planted a grass buffer, then he or she was asked to answer Question 9 with regard to his or her motivations for establishing the grass buffer. If the respondent noted in Question 7 that he or she had planted a forest buffer, then Question 9 addressed that forest buffer. All other respondents were asked Question 9 with regard to forest and grass buffers together. This wording may weaken the question's ability to elicit information about motivations for both forest and grass buffers. The survey included both the grass and forest buffer options because of the potential in some cases for grass buffers to provide environmental benefits in a more palatable way for farmers. Since, ultimately, this study is about opportunities for environmental benefits, not about forest buffers for forest buffers' sake, inclusion of both the forest and grass buffer options was important in the survey.

Another possible problem with Question 9 is that it was immediately preceded by the question about awareness of Maryland's Buffer Incentive Program. Since part of question 9 refers to that program, it was necessary to include the Buffer Incentive Program awareness question earlier in the interview. To avoid the perception by respondents that Question 9 referred only to the Buffer Incentive Program (and thus, tree planting), callers were instructed to make it clear to respondents that Question 9 referred to any forest or grass buffer program, not just the Buffer Incentive Program.

As with the BIP participant survey, this survey was developed with the recognition that it would be impossible to query landowners about every conceivable

factor in a decision. Follow-up surveys might also want to address factors including possible loss of yield to adjacent fields because of nutrient loss, noxious weeds, or difficulty in operating farm machinery; question 9E, about loss of moisture to agricultural fields, should, however, provide some insight on this possible perceived problem for adjacent land. In addition, loss of base acreage for establishment of support through farm commodity programs might have been a useful addition, particularly in states other that Maryland which have much larger scale agriculture. However, with Farm Bill developments that have occurred since the surveys were conducted, the loss of base acreage may now be a moot point.

Question 9 also did not address the relative importance of up-front, out-of-pocket expenses for the farmer as a consideration in planting a buffer. This would have been useful information in addition to knowing the relative importance of Buffer Incentive Program grants and other cost-share and technical assistance (Questions 9K and 9L), especially since there had been a year's lead time from planting to receiving Buffer Incentive Program grants.

Finally, Question 9 does not ask the farmer point-blank if unwillingness to participate in government programs was a factor in his or her decision. Questions 9H (about compliance with current or future land-use regulation) and 9M (about the amount of time spent on application for cost-share funds) were designed, however, to shed some light on this attitudinal question.

Questions 10 and 11 address the landowner's willingness to accept lump-sum payments for planting forest and grass buffers for 10-year, 20-year, 30-year, or permanent terms. They are identical to Questions 14 and 15 of the BIP participant survey. Callers were given background materials to clear up any misunderstandings about the meaning of these questions.

The interview ended with an open-ended question to elicit information about the farmer's motivation that was not covered elsewhere in the interview. This open-ended question is seen as even more important in the non-participants survey than in the BIP participants survey, mainly because of the possible problems described for Question 9.

Survey Implementation

The participant survey contacted everyone who signed a contract with Maryland's Buffer Incentive Program in 1992, 1993, and 1994, a total of 80 landowners. Although there were some participants in the program before 1991, the records for those years at the Department of Natural Resources were not as thorough as those for subsequent years.

Also, landowners were considered less likely to remember the details of their participation in the program. 1995 participants were not included because the landowners would not have had enough time in the program to answer questions about the success or failure of planting and maintenance.

An introductory letter signed by the author on University of Maryland letterhead was sent on November 3rd to let the Buffer Incentive Program landowners know the purpose of the survey (see Appendix 3). An introductory letter was not sent to the non-participants because it would have delayed considerably the data collection. Survey instruments were under development in November 1995 at the same time that interviews were still being conducted for the best management practices survey. Only farmers who completed this survey were to be interviewed for the subsequent riparian buffers survey. At that time, an opening existed in the Maryland Agricultural Statistics Service survey schedule for mid-December, with other surveys already scheduled for future months. Thus there was not enough lead time to send a letter to the farmers who replied to the best management practices survey. Since these landowners had been contacted recently by the Maryland Agricultural Statistics Service (MASS) for the best management practice survey and in many cases knew the callers personally, it was believed at the time that an introductory letter was not absolutely necessary. However, a letter similar to the one sent to Buffer Incentive Program participants might have provided a better understanding and response from landowners contacted.

According to Bruce West, state statistician for MASS, the initial population from which the best management practice sample was drawn consisted of a list of farm operations in Maryland compiled continuously by MASS. Because of changes in farm ownership and operation, the list typically records current data for about 85% of farm operations in Maryland. An initial sample of approximately 1,000 names was drawn from this population in 1990 for a best management practice survey. That sample was compared to the list of current Maryland farm operators in 1995 for the best management practice survey conducted in the fall of 1995. Additional operators were selected randomly from the current population of farm operators in Maryland to make up for any attrition of operators from the first list.

A comparison of the Buffer Incentive Program participants and the best management practices sample found one landowner who appeared on each list. That landowner was surveyed as part of the participant survey. An additional screening question in the non-participant survey determined if those operators owned any riparian land. If not, they were considered ineligible for the Buffer Incentive Program or other riparian buffer programs, and thus not interviewed. The farm operators sample is

representative of farms in Maryland, a state in which 88% of operators own at least some of the land they farm (Lichtenberg, Howar, Strand, and Lessley 1989). Landowners in the participants survey were also asked if they rent land to others; if so, they were asked to provide the operator's name to avoid possible duplication of effort with the non-participant survey.

Two two-hour training sessions were held for MASS telephone interviewers, resulting in additional wording changes suggested by the interviewers attending those sessions. The first of these sessions was held in Easton on November 28th, the second in Frederick on November 29th. While it would have been valuable to have conducted test interviews of the survey instrument for nonparticipants, the lead time needed for distribution of the questionnaires to the interviewers precluded doing so. Training sessions highlighted possible problems, including confusion over land eligibility for riparian buffers and confusion over the difference between Maryland's Buffer Incentive Program and other programs. Also, a farmer could already have a forest or grass buffer on some, but not all, of his eligible land. While the survey instrument attempts to elicit this information, this nonetheless may present difficulties for analyzing the true obstacles and opportunities for maximum benefits from buffers. The multi-part question about the relative importance of various factors in the farmer's decision-making process posed a particular challenge in the non-participant survey, since the farmer could be answering about establishment of a forest or grass buffer. The respondents in the participant survey were only responding with regard to forest buffer establishment. Because of funding limitations, the survey was kept to four 8 1/2 x 11 pages. Thus additional skip pattern questions that might have clarified certain answers were not included in the survey instrument.

Table 2. Telephone Survey Disposition Table

Buffer Incentive Program Interviews

- 53 of 80 landowners who participated in the Buffer Incentive Program in 1992, 1993, or 1994 were interviewed by telephone between November 15, 1995 and January 15, 1996
- of the remaining 27 landowners:

  13 were contacted at least 3 times but were inaccessible
  6 were companies or organizations with insufficient contact information
  5 introductory letters were returned for insufficient address
  2 interviews were refused
  1 landowner ended up not participating in the program

Survey of Random Sample of Farm Owners in Maryland

590 landowners were interviewed by telephone between July 1995 and November 1995 by the Maryland Agriculture Statistics Service (MASS) for a study of the use of best management practices in Maryland. Demographic data including age, educational level, gross income from farming, and net percentage income from farming were gathered as part of the survey.

Participants in the best management practices survey were called again between November 28th and December 22, 1995 by MASS to elicit additional information about riparian buffers. The 590 attempted follow-up interviews break down as follows:

284	own riparian land (but 19 did not provide data on acres owned)
140	own land but do do not own riparian land
23	own no land
143	(follow-up interview not conducted):
	45 refused
	98 inaccessible (at least 3 attempted calls or unable to obtain current working telephone number)

Data Analysis

Data from the best management practices survey, the follow-up survey on riparian buffers, and the survey of Buffer Incentive Program participants were combined and entered into SPSS, a statistical software package. Additional comments made by respondents were cross-referenced with identification numbers for easy reference to demographic data and recorded separately in a Microsoft Word file.

Farmers with less gross income from farming were undersampled in the MASS survey, and farmers with higher levels of gross income were oversampled. To provide a better representation of farm owners in Maryland, the data from the survey carried out by the Maryland Agricultural Statistics Service were weighted for statistical analyses, using the "weight" function in SPSS. A weighting variable was developed, based on gross income from farming. Fifty-seven farm owners did not provide gross income data and so were dropped from statistical tests, leaving 348 cases of Buffer Incentive Program non-adopters for means comparisons with Buffer Incentive Program adopters. Stratified data on gross income from farming was obtained from the 1992 Agricultural Census, and weights were developed as outlined in Table 3.

Table 3. Weights for Sample of Maryland Farmers

Value of Sales	Farms in Maryland	(%)	Farms in MASS Sample	(%)	(%1/%2)	Weight
Less than $1,000	1691	12.98	19	5.46	12.98/5.46	2.38
$1,000-$19,999	6231	47.79	127	36.49	47.79/36.49	1.31
$20,000-$30,999	1148	8.81	45	12.93	8.81/12.93	0.68
$40,000-$99,999	1257	9.64	39	11.21	9.64/11.21	0.86
$100,000-$249,999	1436	11.01	65	18.68	11.01/18.68	0.59
$250,000 or more	1274	9.77	53	15.23	9.77/15.23	0.64
Total	13037	100.00	348	100.00		

Four of the 53 Buffer Incentive Program participants interviewed were dropped from the analysis because their property did not have a recent agricultural land use. One of these land parcels was owned by a quarry, two were in established housing developments, and one was owned by a land trust that did not provide gross income data.

A review of Department of Natural Resources records revealed that of the 85 buffers planted through the Buffer Incentive Program from 1992 to 1994, 69 were in an agricultural land use before planting. Participation in the Buffer Incentive Program by some landowners represents part of an effort to get out of farming altogether, but these landowners were included in the analysis.

Because of the categorical recording of most of the variables in the survey data, some of the assumptions of parametric tests are not met, so nonparametric tests were used to analyze correlation between variables and to compare distributions (SPSS Inc.1993 and 1994; Daniel 1978; Gibbons 1993). Spearman rank correlation coefficients for all variables are listed in Appendix 9. T-tests were used for variables not recorded in categorical form, and thus appropriate for parametric means comparisons. These variables include acres owned, years farming, years managing a farm, number of animals per acre on the property, and willingness to accept payment for various term buffer programs. Mann-Whitney U-tests are used for non-parametric comparisons of distributions for categorical data. For a more detailed description of the Mann-Whitney U-tests, see Appendix 6.

Results of both weighted and unweighted tests are described in Chapter 5 and are listed in Appendices 5 to 7. The use of weights did not change the results appreciably; of 38 T-tests or U-tests conducted, in only 2 instances did the weighted test fail to reject a null hypothesis at the .05 level that was rejected in an unweighted test, and in only one instance did a weighted test fail to reject when an unweighted test rejected the null hypothesis.

CHAPTER 5
INTERPRETATION OF RESULTS

Results of the surveys are discussed in the same order as the analytical framework described in Chapter 3. Differences in land parcel and landowner characteristics between Buffer Incentive Program participants and non-participants are discussed first, followed by awareness of the concept and the relative importance of perceived benefits and perceived costs for the landowner when making the decision to participate or not participate in a riparian buffer program. This is followed by a discussion of the landowners' willingness to accept payment for various length programs for forest or grass buffers. Other comments that landowners made in response to an open-ended question at the end of the interview are also described. Descriptive statistical data are unweighted throughout this chapter and include 57 Buffer Incentive Program non-adopters who did not provide gross income data.

Land Parcel Features

For the farmers interviewed in the Maryland Agricultural Statistics Service survey, it was necessary first to determine whether or not they owned any riparian land at all. Thus an initial screening question was included:

> Question 1: "Do you own any riparian land, in other words, land that borders a stream, river, pond, tidal or non-tidal wetland, or other open water?"

The responses of the 140 individuals who said they own land but do not own riparian land are separated by county in the following table. This is worth noting, because on the Eastern Shore, where one could expect most if not all landowners to own some riparian land, many of the landowners said they did not. One landowner from Dorchester County went so far as to say that this initial screening question was "stupid, because anyone knows that if you live in lower Dorchester County, you have to be on a marsh or some waterway." Yet five of the eight landowners contacted in Dorchester County said that they did not own any riparian land. Perhaps the word "riparian" triggers

a negative reaction in a landowner making him decline to participate in the interview; perhaps an individual owns land that is eligible for riparian buffer programs but he does not perceive that it is. Both of these explanations need closer examination, as they might have important implications for development of effective outreach and incentive programs.

Table 4. Perceived Riparian Land Ownership, by County

County	N	Do Not Own Own Riparian Land (%)	Own Riparian Land (%)
Allegany	14	28.6	71.4
Anne Arundel**	12	33.3	66.6
Baltimore**	24	8.3	91.7
Calvert**	9	22.2	77.8
Caroline*	19	47.4	52.6
Carroll	53	24.5	75.5
Cecil*	14	28.6	71.4
Charles**	7	14.3	85.7
Dorchester*	8	62.5	37.5
Frederick	67	17.9	82.1
Garrett	24	29.2	70.8
Harford**	29	41.4	58.6
Howard	10	10.0	90.0
Kent*	14	57.1	42.9
Montgomery	16	25.0	75.0
Prince George's (no data)**	-	-	
Queen Anne's*	8	50.0	50.0
St. Mary's**	8	37.5	62.5
Somerset*	10	30.0	70.0
Talbot*	7	28.6	71.4
Washington	44	43.2	56.8
Wicomico*	10	80.0	20.0
Worcester*	18	72.2	27.8
Total	140		

*Eastern Shore
**Western Shore but county in Chesapeake Bay Critical Area

The following hypotheses were stated with regard to land parcel features:

- landowners with row crops in the riparian area will be less likely to participate than landowners with pasture or other land uses in the riparian area
- landowners with larger properties will be more likely to participate than smaller properties

How does the land of the 284 farmers who said they own riparian land compare with the land parcels of the 49 Buffer Incentive Program participants interviewed? Tables 5 through 8 provide a basis for discussion of possible difference in type of farm operation and in farm size.

Table 5. Width of Stream or Body of Water on the Property, in Feet

Width of stream (average)	BIP Participants (%) (N=48)	All Other Riparian Landowners (%) (N=191)	Other Riparian Landowners Who Have Not Planted Buffers (%) (N=73)
1-10 feet	37.5	63.9	84.9
11-20 feet	16.7	9.9	4.1
21-50 feet	8.3	6.3	2.8
51 feet or greater	37.5	19.9	8.2

Lowrance et al. and Bohlen and King emphasize the added benefits that forest buffers can provide when planted by small streams. These streams provide an opportunity for full shade from a forest buffer, for leaf litter, and eventually for input of woody debris that is important for habitat. The difference in stream sizes reported by landowners in interviews in Table 5 is quite dramatic, particularly when looking separately at those properties without any buffered riparian land. The overwhelming majority of farm owners interviewed who are not in the Buffer Incentive Program have streams of less than 10 feet in width on their property. Mann-Whitney U-tests (see Appendix 6) rejected at the .05 level the null hypothesis of no difference in distribution between the stream sizes on farms participating in the Buffer Incentive Program and those not participating in the program.

Table 6. Previous Riparian Land Use

	BIP Participants (%) (N=49)	All Other Riparian Landowners (%) (N=265)	Other Riparian Landowners Who Have Not Planted Buffers (%) (N=78)
All Row Crops	30.6	2.3	5.1
Partially in Row Crops	10.2	21.9	9.0
All Pasture	14.3	14.3	37.2
Partially Pasture	8.2	39.6	44.9
Grass Lawn or Field Not Used as Pasture	41.5	15.5	20.5
Idle Row Crop Field	4.1	2.3	1.3
Forest Buffer	-	47.5	29.5
Grass Buffer or Filter Strip	-	43.4	21.8
Other Use	2.0	0.8	1.3

Note: totals do not equal 100%, because landowners could choose more than one category if there were multiple riparian land uses on their property.

The survey results reported in Table 6 do not support the working hypothesis that landowners with row crops in the riparian area will be less likely to participate than landowners with pasture or other land uses in the riparian area. In fact, 41% of Buffer Incentive Program participants indicated that the land now buffered was previously all or partly in row crops; 82% of the farmers with unbuffered riparian land indicated that the current riparian land use is for pasture, at least in part. These findings may suggest that participation in the Buffer Incentive Program represents part of an effort to get out of farming, as discussed previously in this paper. This point is discussed again during the examination of the importance of lost agricultural income from farming in the adoption decision (See Table 16).

The type of farm operation was examined further by collecting data on type of row crops in the riparian area and the type and number of animals per acre on the farm. Of the 19 Buffer Incentive Program adopters who provided information about row crops previously grown in the now-buffered area, 14 indicated that the riparian land was previously in a corn/wheat/beans rotation, three said that land was all in soybeans, and the remainder said the land was in corn and hay, respectively. Of the 58 non-adopters who provided crop type information, 31 said their riparian land is in a corn/beans/wheat

rotation, 14 said the riparian land is in hay, six in corn, and three in vegetables. Of the six Buffer Incentive Program participants who provided information about type of animals in riparian pasture land that is now buffered, five said they had beef cattle there before, two had horses, and one had sheep. Of the 96 non-adopters who have pasture on their riparian land, 64 have beef cattle, 34 have dairy cattle, 11 have horses, and four have sheep. Landowners could choose more than one category. The weighted mean of animals per acre was 1.7 for Buffer Incentive Program adopters and 2.5 for non-adopters. Weighted and unweighted t-tests failed to reject at the .05 level the null hypothesis that the population variances of animals per acre for adopters and non-adopters are the same.

Table 7. Land Ownership, in Acres

	N	Mean	Std. Dev.	Min.	Max.
BIP Participants	49	138.47	265.91	3	1480
All Other Riparian Landowners Interviewed	265	197.73	208.19	2	1200
Other Riparian Landowners Without Buffers	78	175.87	142.41	10	700

Table 8. Land Ownership by Property Size, in Acres

Acres Owned	BIP Participants N=53 (%)	All Other Riparian Landowners N=265 (%)	No Buffer Planted N=78 (%)	Planted Grass Buffer N=55 (%)
1-10	18.9	2.3	1.3	1.8
11-20	13.2	3.8	5.1	5.5
21-30	5.6	5.7	6.4	3.6
31-40	7.5	4.9	7.7	0.0
41-50	7.5	4.2	7.7	1.8
51-60	3.8	4.2	1.3	5.5
61-70	3.8	1.9	1.3	1.8
71-80	1.9	3.4	3.8	0.0
81-90	1.9	1.9	0.0	3.6
91-100	1.9	7.2	3.8	3.6
101-110	0.0	3.0	3.8	3.6
111-120	0.0	2.3	3.8	0.0
121-130	3.8	2.6	0.0	0.0
131-140	0.0	3.8	9.0	5.5
141-150	1.9	4.5	6.4	1.8
151-160	5.6	4.5	2.6	5.5
161-200	5.6	11.7	9.0	14.5
201-300	5.6	11.3	14.1	9.1
301-400	7.5	6.4	5.1	9.1
401-500	0.0	3.4	6.4	3.6
501-700	0.0	3.8	2.6	1.8
701 or more	3.8	4.2	0.0	12.7

Feder, Just and Zilberman refer to a literature which suggests that smaller farms are less likely to adopt agricultural innovations because of fixed costs. One would suspect that landowners with very large parcels would be more willing to give up the minimum of one acre required by the Buffer Incentive Program than would landowners with relatively small properties.

T-tests for acres owned by Buffer Incentive Program adopters and non-adopters failed to reject at the .05 level the null hypothesis that the population variances of acres owned for adopters and non-adopters are the same (see Appendix 5). The alternative hypothesis stated that adopters have larger properties than non-adopters. In fact, an initial look at the survey data provides some evidence that the mean size of properties for Buffer Incentive Program participants may be smaller than for the population of non-adopters. Nineteen percent of the Buffer Incentive Program participants interviewed own ten acres or less. Of the riparian landowners interviewed by MASS who do not have a buffer, only one of the 78 who provided acreage ownership data indicated that he owned ten acres or

less, although this may be because smaller farms are underrepresented in the sample. Table 7 illustrates the acres owned by Buffer Incentive Program participants, all the riparian landowners in the MASS sample, and those landowners in that sample who do not have a buffer on their riparian land.

At first glance, this does not make a lot of sense. Why would a landowner concede a significant portion of his or her land for a minimum of ten years? Is the grant provided by the Buffer Incentive Program so appealing that a landowner would be willing to give up the income that land could provide? The next section provides some answers for landowner motivations by examining their personal characteristics including age, education, and income from farming.

Landowner personal characteristics

How do the landowners participating in the Buffer Incentive Program differ from the farm owners interviewed by MASS with regard to demographic variables such as age, education, gross revenue from farming, percentage of net income from farming, years farming, and commitment to conservation? The short answer: most Buffer Incentive Program participants are not farmers.

While the Buffer Incentive Program is not targetted solely at agricultural land, information on previous riparian land use for properties now in the Buffer Incentive Program indicates that most riparian properties were previously in some agricultural land use. The Maryland Department of Natural Resources has not collected data on the level of farm effort by these landowners.

The following hypotheses were stated with regard to landowner personal characteristics:

- age: younger landowners will be more likely to participate in BIP than older landowners
- education: landowners with education beyond high school will be more likely to participate in BIP than landowners with less education
- gross revenue from farming: the higher the gross revenue from farming, the more likely the landowner will be to participate
- net percent income from farming: landowners who earn less than 50% of their income from farming will be more likely to participate in BIP than landowners who earn more than 50% of their income from farming

Table 9. Age of Landowners

	BIP Participants N=49 (%)	All Other Riparian Landowners N=277 (%)	No Buffer N=80 (%)
60 or more	30.6	43.0	41.3
50-59	28.6	29.6	30.0
40-49	28.6	17.3	18.7
30-39	12.2	9.0	10.0
20-29	0.0	1.1	0.0

Table 10. Educational Level of Landowners

	BIP Participants N=49 (%)	All Other Riparian Landowners N=181 (%)	No Buffer N=44 (%)
High school or less	18.4	47.5	47.7
Some college, business school, or vocational training	14.3	12.7	15.9
Bachelor's degree	30.6	26.5	20.5
Master's or doctorate	36.7	13.3	15.9

Table 11. Gross Revenue from Farming

	BIP Participants N=49 (%)	All Other Riparian Landowners N=243 (%)	No Buffer N=74 (%)
Less than $1,000	55.1	5.8	5.4
$1,000-$19,999	26.5	36.6	27.0
$20,000-$39,999	6.2	11.9	10.8
$40,000-$99,999	10.2	11.1	12.2
$100,000-$249,999	0.0	20.6	21.6
$250,000 or more	2.0	14.0	23.0

Table 12. Percent Net Income from Farming

	BIP Participants N=49 (%)	All Other Riparian Landowners N=222 (%)	No Buffer N=67 (%)
Zero	51.0	0.0	0.0
1% to 24%	36.7	26.6	20.9
25% to 49%	8.2	5.9	3.0
50% to 99%	4.1	13.5	14.9
100%	0.0	54.0	61.2

Mann-Whitney U-tests between BIP adopters and non-adopters rejected at the .05 level null hypotheses of no difference in population distributions for age, education, gross income from farming, and net percentage income from farming between BIP adopters and non-adopters (see Appendix 6). The survey results present a somewhat different profile of the Buffer Incentive Program participant than the one presented in the alternative hypotheses.

Of the six landowners under the age of forty participating in BIP who were interviewed, two indicated that they planned to harvest the trees at some point after the ten year term of the program. One of these landowners noted that he viewed the trees as a retirement fund: "I don't want to sound anti-environmental, but I'm in it for the money." This does not support the working hypothesis that younger landowners are apt to participate more because of stronger environmental awareness. There are very few landowners under the age of 40 in both surveys, however, so it would have been difficult to draw very strong conclusions about these individuals in any case.

Data was also collected on the number of years farming and the number of years managing a farm. The unweighted mean of years farming for 48 Buffer Incentive Program participants interviewed is 13.6, compared to 38.6 for 154 non-adopters providing this information. The unweighted mean of years managing a farm for adopters is 7.6, compared to 25.6 for non-adopters responding to this question. Weighted and unweighted t-tests rejected at the .05 level the null hypotheses that the population variances for years farming and years managing a farm are the same for adopters and non-adopters (see Appendix 5).

The Buffer Incentive Program participants are a highly-educated group of people, with 36.7% of those participants interviewed holding master's or doctoral degrees. This

may also be an indicator of the level of farming effort and total income: these individuals in most case earn little income from farming their land. As one BIP participant put it, "I'm a gentleman farmer: this is a hobby." Since most of the BIP participants receive little or no net income from farming, it is understandable that many of them have set aside land for buffers on properties that are relatively small. Of these "hobby" farmers, several indicated that planting trees was an excellent way to reduce the commitment needed to maintain the property. Two of these landowners learned of the program because of their interest in tax breaks for keeping the land in an agricultural or forestry use, one of whom said that he "originally wanted to keep his land agricultural in a tax break program, but didn't want the hassle of animals or crops." Five landowners indicated that their whole property is now wooded. In one instance, the landowners inherited the farm and could not manage it from another state. The assistance from the Department of Natural Resources helped them reduce their maintenance commitment while keeping the property in the family. With the average age of farm owners in Maryland increasing, such inheritances may provide an excellent opportunity for implementation of buffers on agricultural land in Maryland. Spearman rank correlation coefficients listed in Appendix 9 show the same sign as the one hypothesized, with a negative correlation between BIP adoption and net percentage of income from farming; there is a somewhat weaker negative correlation between education level and net percentage of income from farming.

Unlike the net-income-from-farming hypothesis, the survey results suggest that the alternative gross-income-from-farming hypothesis would be rejected. The sign of the Spearman rank correlation coefficient between GROSFARM and BIPADOPT in Appendix 9 does not agree with the stated alternative hypothesis. The stated hypotheses with regard to net income from farming and gross income from farming might seem contradictory, yet there is support in the literature for both hypotheses: individuals with higher gross income and off-farm income are thought to have more resources to experiment with innovations like riparian buffers. But it is clear from the survey results that most Buffer Incentive Program participants generate very little in farm sales, while the riparian landowners surveyed by MASS and Maryland farmers overall surveyed by the Agricultural Census tend to have much more significant farm operations. The survey findings suggest that the "orientation to farming as a way of life" hypothesis that the Pampel and Van Es study supported for other environmental innovations on farmland (Pampel and Van Es 1977) may have some merit with regard to riparian forest buffers.

Step One in the Adoption Process: Awareness

The demographic characteristics described in the previous two sections provide an initial explanation about what type of landowner would or would not be willing to plant a buffer on his or her land. But they don't tell the whole story of how a landowner progresses from learning about the concept to weighing the benefits and costs of participation to deciding to take part in a buffer program. The first step in this adoption process, as described by Rogers and others, is awareness of the concept and of the particular buffer program (Rogers 1983). If a landowner is not aware of the innovation, it follows that he or she will not adopt it. Following the screening question about riparian land ownership in the survey conducted by MASS, riparian landowners were then asked:

Are you familiar with the concept of forest or grass buffers on riparian land to control nutrient and sediment runoff into waterbodies and to provide other environmental benefits?

N	Aware of Concept (%)	Not Aware of Concept (%)
283	85.2	14.8

These responses are summarized by age, educational level, and county in Table 13. Younger farmers and those with more years of formal education were hypothesized to have a greater awareness of the riparian buffer concept. Farmers in this sample, across all educational and age groups, are aware of the buffer concept. This is not a surprising finding for Maryland, where agricultural nonpoint source pollution controls to reduce nutrients in the Chesapeake Bay have received a great deal of attention in recent years.

Mann-Whitney U-tests (see Appendix 7) were conducted of awareness of the concept of riparian buffers by age, educational level, gross income from farming, and net percentage income from farming. The null hypothesis that the populations of landowners who are aware and who are not aware of the concept have the same distribution was rejected at the .05 level for the net percentage income from farming variable. The U-tests failed to reject the same null hypotheses for age, educational level, and gross income from farming. In an unweighted analysis, the U-test rejected the null hypothesis for the gross income from farming variable. These tests were also conducted for awareness of the Buffer Incentive Program. The null hypothesis that the populations of landowners who are aware and those who are not aware of the program have the same distribution was rejected for the age, education, and net income from farming variables in weighted analyses. U-tests failed to reject at the .05 level the same null hypothesis with regard to gross income from farming.

Table 13. Awareness of the Concept of Riparian Buffers by Riparian Landowners not in the Buffer Incentive Program, by Educational Level, Age, and County

	N	Aware of Concept (%)	Not Aware of Concept (%)
Educational Level			
High School diploma or less	86	82.6	17.4
Some college, business, or vocational school	23	91.3	8.7
Bachelor's degree	48	85.4	14.6
Graduate degree	24	87.5	12.5
Age			
60 or above	119	81.5	18.5
50-59	82	92.7	7.3
40-49	48	83.3	16.7
30-39	25	88.0	12.0
20-29	3	66.7	33.3
County			
Allegany	10	90.0	10.0
Anne Arundel**	8	87.5	12.5
Baltimore**	22	100.0	0.0
Calvert**	7	71.4	28.6
Caroline*	10	100.0	0.0
Carroll	40	80.0	20.0
Cecil*	11	81.8	18.2
Charles**	6	83.3	16.7
Dorchester*	3	100.0	0.0
Frederick	55	76.4	23.6
Garrett	17	100.0	0.0
Harford**	17	100.0	0.0
Howard	8	75.0	25.0
Kent*	6	100.0	0.0
Montgomery	12	75.0	25.0
Prince George's (no data)**	-	-	
Queen Anne's*	4	100.0	0.0
St. Mary's**	5	100.0	0.0
Somerset*	7	100.0	0.0
Talbot*	5	100.0	0.0
Washington	24	70.8	29.2
Wicomico*	2	0.0	100.0
Worcester*	4	100.0	0.0
Total	283	85.2	14.8

*Eastern Shore **Western Shore but county in Chesapeake Bay Critical Area

How a landowner learns about the concept might also affect his or her willingness to adopt the innovation. Does the landowner learn from a respected neighbor? From a representative of a government agency who might be seen as a regulatory adversary? From an environmental group whose views the landowner may or may not espouse?

Buffer Incentive Program participants and other riparian landowners were asked to describe how they learned about the concept and about buffer programs, as illustrated in Table 14.

Table 14. Sources of Information About Riparian Buffers

How did you first learn about the concept of putting forest or grass buffers along rivers or streams? Was it through...

	BIP Participants (N=47) (%)	Other Riparian Landowners (N=174) (%)
Written materials received in the mail	14.9	21.8
Telephone call	4.3	2.9
Personal meeting or conversation	42.6	40.8
Public meeting	4.3	11.5
Information in the media	17.0	33.3
Literature picked up at a USDA office	0.0	1.2
Other	21.3	13.2

Could you talk briefly about who had the first contact with you about putting a buffer along the river or stream, and how that contact came about?

	BIP Participants (N=47) (%)	Other Riparian Landowners (N=265) (%)
MD Department of Natural Resources	70.0	3.4
USDA Natural Resources Conservation Service	23.4	14.0
Neighbor, family member or peer	12.8	11.3
USDA Consolidated Farm Services Agency	6.4	10.6
University of MD Cooperative Extension Service	2.1	7.5
MD soil district conservationist	0.0	19.2
University of MD Agricultural Experiment Station	0.0	7.8
agricultural chemical company representative	0.0	0.8
Farm Bureau	0.0	0.4
environmental or land conservation organization	2.0	0.0
other	10.6	4.9
no contact with anyone	0.0	15.5

More than one category could be checked for both of these questions, since in some cases landowners recalled more than one source of information or described a sequence of contacts, which might reflect the importance of interagency cooperation or multiple methods of outreach.

Nine farmers interviewed through the MASS survey noted that they learned about riparian buffers because they were a part of the way they were raised to farm. Learning about buffers "from caring for the land," "tradition," "because it was always done that way," and "from my father or grandfather" were among the comments farmers offered. An additional 7 farmers noted that buffers were just common sense. Five farmers noted that the Soil Conservation Service (now NRCS) visited their property to discuss best management practices, including forest or grass buffers. One farmer said he learned about buffers in college, another in high school, and another in elementary school. One farmer noted that he became aware of buffers because they were mentioned as a requirement for other cost-share programs; another farmer mentioned U.S. Environmental Protection Agency regulations.

Of the 47 Buffer Incentive Program participants who answered the question, six indicated that a forester from Maryland's Department of Natural Resources initiated contact about participation in the program, which DNR administers. Thirty-four of the 47 BIP participants made the initial contact with a government agency after learning about the concept of riparian buffers:

22 called DNR
8 called NRCS
1 called CFSA
1 called his state senator
1 called Maryland's Critical Areas Commission
1 called the Maryland Department of Agriculture

Clearly the Buffer Incentive Program participants and the random sample of farmers are gathering information about buffers from different sources. The use of the Department of Natural Resources as the point-of-contact is understandable for Buffer Incentive Program participants, since the program is, of course, coordinated by DNR. There is also some indication that cooperation between other agencies and DNR helped steer landowners toward the program, as the eight landowner contacts with the Natural Resources Conservation Service suggest.

The random sample of farmers, however, points to the important role of the Soil Conservation District and state and federal agricultural agencies in improving awareness of buffers, as guidance to foresters from DNR has suggested. For grass buffers, the efforts of these agricultural agencies appears to have paid off: of the 55 landowners who

had planted a grass buffer since 1991, 20 cited the soil conservation district as their point of contact, 15 cited NRCS or CFSA, and only three cited DNR. In addition, six of those landowners made comments about the efforts of NRCS or CFSA to help them implement their grass buffers. For those farmers who had planted a forest buffer, one mentioned ASCS assistance and four noted help from the district soil conservationist. Of all riparian landowners surveyed, only nine cited DNR as a point of contact, and one commented that DNR "just has no common sense." Since DNR might be seen as a regulator by some farmers, the suggestion by DNR of the need for cooperation with other agencies appears to have some merit.

One Buffer Incentive Program landowner noted this difference in the communication channels described by Rogers and others in the diffusion-of-innovations literature, suggesting that "there might be more people like us who know nothing about the Soil Conservation District, etc. DNR should use that angle, should try to find a way to get to people who are environmentally oriented, like Sierra Club members." Another described himself in terms Rogers might have used for an innovator. He expected that the interviewer would "find a distinct gap in opinions between 'white forehead farmers' and farmers like myself. I was one of the first in Harford County to do this--one reason was as a demonstration for other farms."

Once awareness of the concept had been established in the MASS interviews, the next step was to determine whether or not a farmer had already planted a buffer on his property, and, if not, why he had not done so. These questions were necessary to determine which of the 241 farmers who were aware of the concept were in a position to make a decision to participate in Maryland's Buffer Incentive Program or another forest or grass buffer program. As with the previous questions, some farmers gave more than one reason for their decision to plant or not plant a buffer. Riparian landowners were asked the following questions:

> Have you planted a forest or grass buffer on any of your riparian land since 1991?
> IF NO: Why haven't you done so?

Of the 241 riparian landowners asked this question, 70 said that they had planted a forest or grass riparian buffer since 1991. Fifteen of those buffers are forest buffers planted without Buffer Incentive Program support; fifty-five are grass buffers. The remaining 171 landowners indicated that they had not planted a riparian buffer since 1991. They gave the following reasons for not doing so:

- No, because a natural buffer was already there 68
- No, I planted it before 1991 15
- No, I have not planted a buffer and I refuse to participate in government programs 2
- No, I have not planted a buffer and I have unbuffered riparian land 81

Of those farmers in the last category, the following reasons for not planting a buffer were given as additional comments. Again, some farmers gave more than one reason.

- No need, cattle not near the stream, they have another water source 9
- No need, land not steep or erodible 3
- No, I need a crossing and water source for cattle 3
- No, it's pasture 3
- No, not enough land to spare 4
- No, the land is fenced off 7
- No need, "not much of a stream" 4

General comments noted in more than one interview included variations on "It -I need cattle crossings." planted itself, just didn't mow, " "more trouble than it's worth-fence!" and "inconvenient- Of those who had planted grass buffers, four commented that they had done so to combat erosion problems.

Awareness of the Buffer Incentive Program

The next step in the MASS interviews was a determination of which farmers were aware of Maryland's Buffer Incentive Program. The landowners who are aware of the program, have unbuffered riparian land, and who have not planted a buffer would make the ideal comparison for an analysis of determinants of participation in the program. Of the 284 riparian landowners in the survey, only 67 were aware of Maryland's Buffer Incentive Program. Of the 81 landowners who have unbuffered riparian land and who have not planted a buffer, only 21 were aware of BIP, 58 said they were not aware of the program, and two did not give an answer.

Eleven of the 49 Buffer Incentive Program participants interviewed commented that they thought one of the main barriers to participation in the program was simply that people weren't aware of it; six of those people suggested that farmers in particular need to be educated about the concept.

Perceived Benefits, Perceived Costs, and Attitudinal Factors

Recognizing that many, if not most, of the landowners in the survey would not be aware of the Buffer Incentive Program or that they would have already planted a forest or grass buffer, the next, 13-part question was worded to elicit responses about any of those choices, yet still be compatible with the Buffer Incentive Program interviews for comparison purposes. Tables 15 to 29 summarize the answers to this 13-part question. It was asked as follows of all landowners surveyed:

I am interested in learning why you decided whether or not to participate in a riparian forest or grass buffer program. Please indicate whether each of the following was

- a critical factor in your decision to plant a buffer on your land
- somewhat important
- not a very important factor
- or was not a factor

Table 15. Aesthetic Factors

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	16.3	51.0	10.2	22.4
All other riparian landowners:	162	8.6	29.6	9.9	51.9
Planted forest buffer	14	0.0	21.4	14.3	64.3
Planted grass buffer	44	13.6	31.8	11.4	43.2
Has not planted a buffer	72	9.7	32.0	5.5	52.8
Planted buffer before '91	7	14.3	28.6	14.3	42.8
Aware of BIP	54	7.4	37.0	9.2	44.4

The majority of BIP landowners considered aesthetic factors critical or somewhat important in their decision to participate in the program; a majority of the other riparian landowners surveyed who responded to this question indicated that aesthetic factors were not very important or not a factor in their decision. Three BIP participants noted that they cannot see the buffer, two like the privacy it affords, including not seeing neighbors' lights, and three "like trees." One of these landowners noted that he "deliberately made his buffer aesthetically pleasing." He commented further that the buffer is "a great source of satisfaction and beauty" for him and that it is "just gorgeous: one of the prettiest things

you've ever seen." On the other hand, four BIP landowners noted that their buffer hinders their view. One landowner who participated in BIP because of insistence on a forest buffer by the Critical Areas Commission noted that his buffer now blocks his view of a 350-foot wide river and asked, "Why have waterfront property if you can't have the view?"

Of the other riparian landowners, two who indicated that aesthetic factors such as a scenic view were critical to their decision noted that their riparian land is very close to their house. Another farmer planted a grass buffer around his pond more for aesthetic reasons than any others.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of aesthetic factors in the buffer adoption decision. Spearman correlation coefficients (see Appendix 9) did not indicate a strong correlation between width of stream and importance of aesthetic factors.

Table 16. Lost Agricultural Income from Land Along the Stream

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	6.1	12.2	10.2	71.4
All other riparian landowners:	166	18.0	19.9	19.3	42.8
Planted forest buffer	14	14.3	21.4	14.3	50.0
Planted grass buffer	44	18.2	20.5	18.2	43.1
Has not planted a buffer	76	21.1	21.1	17.1	40.7
Planted buffer before '91	7	14.3	28.6	14.3	42.8
Aware of BIP	55	14.5	14.5	16.4	54.6

Thirty-five of the 49 Buffer Incentive Program participants interviewed indicated that lost agricultural income from the land along the stream was not a factor in their decision; only three indicated this factor was critical. This is not surprising, since the majority of these landowners earn little or no income from farming sources. Somewhat more surprising is the finding that less than half of the riparian landowners interviewed by

MASS, including those who had not planted a buffer, said that lost agricultural income was critical or somewhat important in their adoption decision.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of lost agricultural income from the land along the stream in the buffer adoption decision. Spearman correlation coefficients (see Appendix 9) did not indicate a strong correlation between the importance of lost agricultural income and gross income from farming, net percentage of income from farming, or type of previous riparian land use. These results suggest a need for further research that examines more closely the importance of the riparian area to the overall farm operation, and how that might change from farm to farm.

Table 17. The Creation of Fish and Wildlife Habitat

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	40.8	40.8	2.0	16.4
All other riparian landowners:	162	8.0	34.0	19.1	38.9
Planted forest buffer	14	7.1	35.7	14.3	42.9
Planted grass buffer	43	14.0	30.2	16.3	39.5
Has not planted a buffer	73	4.1	31.5	23.3	41.1
Planted buffer before '91	7	42.8	42.8	14.3	0.0
Aware of BIP	55	9.1	32.7	29.1	29.1

It is striking that 40 of the 49 Buffer Incentive Program participants indicated that creation of fish and wildlife habitat was critical or somewhat important in their decision to participate, while the majority of the riparian landowners interviewed by MASS, including those who had not planted a buffer and those who had planted grass buffers, indicated that habitat was not very important or was not a factor. Nine of the 49 Buffer Incentive Program participants made additional comments related to this question. Three of these landowners indicated that it was the primary reason or one of the primary reasons for planting the buffer. Another landowner, a dedicated birdwatcher, was excited that,

since the buffer had been planted, they had seen the first pheasant on their property in quite some time.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of fish and wildlife habitat creation in the buffer adoption decision.

Table 18. Erosion

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	44.9	28.6	4.1	22.4
All other riparian landowners:	167	40.7	31.1	8.4	19.8
Planted forest buffer	14	50.0	28.6	0.0	21.4
Planted grass buffer	45	51.1	24.4	8.9	15.6
Has not planted a buffer	76	27.6	36.8	13.2	22.4
Planted buffer before '91	7	85.7	14.3	0.0	0.0
Aware of BIP	55	41.8	36.4	54.4	16.4

People do not like erosion. That is the short explanation of these numbers. The numbers also show that there are many landowners who believe that grass buffers are more effective than forest buffers in controlling erosion: 34 of the 45 farmers who planted a grass buffer and answered this question indicated that erosion control was critical or somewhat important in their decision to do so. Three of the Buffer Incentive Program participants, however, commented that erosion control was the principal reason for planting the buffer, with one noting that a previous grass buffer could not handle the volume of water coming down a steep hill. The grass-versus-forest debate with regard to erosion control was the most common comment from the 113 farmers who made general comments at the end of the interview, with nine farmers offering their view that grass buffers outperform forest buffers.

Mann-Whitney U-tests (see Appendix 8) failed to reject at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of erosion in the buffer adoption decision.

Table 19. Possible Loss of Moisture to Adjacent Agricultural Fields

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	0.0	10.2	0.0	89.8
All other riparian landowners:	164	8.5	12.8	14.7	64.0
Planted forest buffer	14	21.4	7.1	7.1	64.4
Planted grass buffer	44	9.1	15.9	15.9	59.1
Has not planted a buffer	75	6.7	9.3	14.7	69.3
Planted buffer before '91	7	14.3	28.6	0.0	57.1
Aware of BIP	55	5.4	10.9	16.4	67.3

This question was asked to gain some understanding of the perceived opportunity costs from reduced productivity in adjacent fields caused by a buffer. Loss of moisture is only one of the ways that the possible effects of forest buffers on adjacent fields have been cited, with loss of nutrients, as well as shading or limbs on adjacent fields, also possible sources of concern that have been raised in various forums. Loss of moisture does not appear to be on the radar screen for any of the categories of landowners interviewed, regardless of whether or not they have planted a buffer of any kind. This question does not really apply for people who planted a grass buffer, as two farmers who had planted grass pointed out. One noted that this was a "dumb question." One of the Buffer Incentive Program participants, however, noted that this was an "interesting question," which the author finds to be a much better answer. The landowner noted his father-in-law's experience in Illinois, where a windbreak helped with erosion but decimated yields from twenty to thirty rows adjacent to the trees, possibly from nutrient loss in his opinion. Another Buffer Incentive Program participant used this question as an opportunity to complain that most of his peers "are farming right up to the ditch banks. It's ridiculous. There will always be some lost revenue (from the buffer), but those perimeter crops don't do that well anyway."

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution for attitudes about the importance of loss of moisture to adjacent agricultural fields in the adoption decision. Spearman correlation coefficients (see Appendix 9) did not indicate a strong correlation between type of riparian land use and importance of loss of moisture.

Table 20. Possible Increased Deer Population

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	10.2	30.6	8.2	51.0
All other riparian landowners:	164	17.1	15.2	22.6	45.1
Planted forest buffer	14	7.1	21.4	7.1	64.4
Planted grass buffer	43	16.3	9.3	16.3	58.1
Has not planted a buffer	75	22.7	20.0	20.0	37.3
Planted buffer before '91	7	14.3	14.3	42.8	28.6
Aware of BIP	55	16.4	9.1	25.4	49.1

This question was included because of the possible perception that establishment of forest buffers could lead to an increased deer population that would damage adjacent crops. This did not prove to be a concern for most of the landowners surveyed. But this question proved to be one of the most interesting in the survey: 14 of the 49 Buffer Incentive Program participants interviewed commented that increased deer population was not a major factor when deciding to participate, but buffer maintenance problems caused by deer are a major consideration for them now. Several discussed the benefits and costs of deer protectors for the trees, but three noted that at $1.25 to $3 apiece, they are cost-prohibitive when 1,000 or more trees are planted. Another landowner expressed concern about the use of deer protectors, calling them "bluebird death traps." One property in the program is owned by a land trust and is in a conservation easement that prohibits hunting deer. The deer have decimated the buffer, and the land trust will not consider extending its commitment beyond the ten year requirement for the program. What is the solution to this problem? "Louisiana Hot Sauce, " according to one Buffer Incentive Program participant, "but not Tabasco."

Mann-Whitney U-tests (see Appendix 8) failed to reject at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about increased deer population in the buffer adoption decision.

Table 21. Water Quality and Other Environmental Benefits to the Landowner's Community

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	48	54.2	29.2	4.1	12.5
All other riparian landowners:	166	28.3	47.0	9.6	15.1
Planted forest buffer	14	28.6	42.9	21.4	7.1
Planted grass buffer	44	38.6	41.0	13.6	6.8
Has not planted a buffer	76	25.0	51.3	9.2	14.5
Planted buffer before '91	7	28.6	42.8	0.0	28.6
Aware of BIP	55	25.5	54.5	9.1	10.9

This question was asked to gain some understanding of the relative importance of on-site, private benefits versus off-site, public benefits. Since the benefits of buffers may accrue largely to the community, not on the landowner's property, the relative weight which the landowner gives these benefits in his or her decision is important to understand. Somewhat surprisingly, in each category, including those who have not planted a buffer, a majority of landowners said that these community benefits were critical or somewhat important in their decision. Twelve Buffer Incentive Program participants elaborated on the benefits to the community of the buffer, with four saying that such benefits were the primary motivation for participating in the program. Five Buffer Incentive Program participants and two other landowners with natural buffers noted their desire to protect a specific stream. Two BIP participants also noted that on-site water quality benefits were a major factor in their decision to plant a buffer, with one of these landowners particularly concerned for his cattle about contamination from upstream development.

Mann-Whitney U-tests (see Appendix 8) failed to reject at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of water quality and other environmental benefits to the community in the buffer adoption decision. Spearman correlation coefficients indicate some correlation between education and importance of water quality and other environmental benefits, one of the alternate hypotheses stated earlier.

Table 22. Compliance with Current or Future Land Use Regulations

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	24.5	16.3	8.2	51.0
All other riparian landowners:	168	25.6	37.5	11.3	25.6
Planted forest buffer	14	35.7	14.3	14.3	35.7
Planted grass buffer	42	45.2	31.0	11.9	11.9
Has not planted a buffer	74	18.9	48.6	10.8	21.6
Planted buffer before '91	7	14.3	28.6	14.3	42.8
Aware of BIP	53	30.2	43.4	9.4	17.0

This question was asked to understand the extent to which landowners are concerned about the potential for increased regulation that participation in a riparian buffer program might bring. Will planting the buffer provide habitat that might subject the landowner to endangered species regulation? Will the land use be changed so that the buffered property could be considered wetlands and thus restricted from future development or farming uses?

Not surprisingly, a majority of the riparian landowners surveyed by MASS said that compliance with current or future land use regulations was critical or somewhat important in their decision to plant or not plant a buffer. Five made additional comments that there are too many regulations already, and two expressed concern about the potential for more control of their land and restrictions on cutting down the trees in the future if they participated in a program. Somewhat surprisingly, 20 of the 49 Buffer Incentive Program participants interviewed said that compliance with current or future land use regulations was critical or somewhat important in their decision. Two of these landowners noted that tree replacement laws or other regulations concerning subdivision of their land played a role in their decision.

The Mann-Whitney U-test unweighted by gross income level (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of current or future land use regulation in the buffer adoption decision. When weighted by gross income, the Mann-Whitney test fails to reject the null hypothesis at a 5% significance level.

Table 23. The Time of Year That a Buffer Would Need to be Planted or Maintained

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	6.1	12.2	4.1	77.6
All other riparian landowners:	160	15.6	27.5	19.4	37.5
Planted forest buffer	14	28.6	21.4	14.3	35.7
Planted grass buffer	42	16.7	23.8	30.9	28.6
Has not planted a buffer	72	15.3	36.1	13.9	34.7
Planted buffer before '91	7	14.3	14.3	0.0	71.4
Aware of BIP	55	16.4	30.9	20.0	32.7

This question was asked to gain some understanding of the extent to which conflicts with row crop-planting or other activities might influence a farmer's willingness to participate in a riparian buffer program. Just over half of those landowners interviewed who had not planted a buffer indicated that the time of year for planting and maintenance was critical or somewhat important to their decision. Thirty-eight of the 49 Buffer Incentive Program participants interviewed indicated that it was not a factor at all.

Several BIP participants commented further about timing factors. One landowner who said that he was knowledgeable about forestry practices in the southeast United States questioned the Department of Natural Resources emphasis on springtime planting for the program, saying that he believes springtime planting leads to greater mortality than fall planting, which is more common in the southeast. He called this requirement a major negative factor and believes that the spring plantings lead also to greater costs and delayed tax advantages.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of time of year of planting in the buffer adoption decision. Spearman correlation coefficients (see Appendix 9) did not indicate a strong correlation between type of riparian land use and the importance of the time of year of planting. As was the case with the loss-of-moisture question, there is a somewhat surprising slightly negative correlation between importance of time of year of planting and riparian land that is all in row crops.

Table 24. The Length of Time Needed for Planting and Maintenance

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	2.0	20.4	14.3	63.3
All other riparian landowners:	158	14.6	30.0	13.3	42.4
Planted forest buffer	15	20.0	26.7	20.0	33.3
Planted grass buffer	39	18.0	20.5	17.9	43.6
Has not planted a buffer	72	15.3	37.5	9.7	37.5
Planted buffer before '91	7	0.0	14.3	14.3	71.4
Aware of BIP	53	20.8	24.5	15.1	39.6

Is the perceived time commitment from planting and maintaining a riparian buffer a major concern for landowners when deciding whether or not to participate in a program? For riparian landowners interviewed by MASS, the answer is "yes," with the majority of landowners in each category saying this factor was critical or somewhat important in their decision. This is particularly noteworthy for landowners who have not planted a buffer, with 38 of 72 landowners saying this was critical or somewhat important in their decision not to plant.

For Buffer Incentive Program participants interviewed, the answer is "no," with 31 of the 49 landowners interviewed saying that the time commitment was not a factor in their decision. In hindsight, should it have been a factor for these landowners? In retrospect, 11 landowners said yes. Two landowners noted that maintenance has turned out to be "a pain in the neck." One landowner, a university professor, said that initial planting and maintenance turned out to be so time consuming that she would not have been able to take part in the program if she had not been on sabbatical that semester. Maintaining the buffer through mowing, herbicide application, replanting to replace trees that died, and other activities has proved to be a major task for some landowners and suggests that this aspect of their participation has been played down somewhat by foresters promoting the program. One noted that, "even with the forester doing most of the work, the landowner can't anticipate that time commitment." One landowner called first-year maintenance "a terrible ordeal," another said that weeding was required almost

every night the first summer, and another noted that his family did not go anywhere that summer because weekends were tied up by buffer maintenance due to drought conditions.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of length of time needed for planting in the buffer adoption decision. Spearman correlation coefficients (see Appendix 9) did not indicate a strong correlation between type of riparian land use and the importance of the time of year of planting. As was the case with the loss-of-moisture question, there is a somewhat surprising slightly negative correlation between importance of length of time needed for planting and riparian land that is all in row crops.

Buffer Incentive Program participants were asked if they hired out planting or maintenance. Twenty-eight of the 49 landowners interviewed said that someone else planted the buffer, but only six said that maintenance was performed by paid contractors.. Buffer Incentive Program participants were also asked to recall how many hours it took to plant the buffer and how many hours per month were spent on maintenance during the first and second year, assuming that in many cases maintenance requirements would drop off after the first year. That assumption did not hold for some landowners who noted that after about two years of tree growth, deer arrived, presenting a new maintenance requirement. These findings (summarized in Table 25) and comments present a wide range of estimates for planting and maintenance time. This suggests the need for further research. It may also point to the need for a planting and maintenance program similar to the approach being used by the Ohio TREES program, whereby landowners contract out planting and maintenance activities, with that expenditure possibly covered by other cost-share programs.

Table 25. Planting and Maintenance Time for Buffer Incentive Program Participants

Buffer (acres)	Planting Time (hrs.)	Planting Time (hrs./acre)	Maintenance First Year (hrs./mo.)	Maintenance First Year (hrs./mo./acre)	Maintenance After First Year (hrs/mo.)	Maintenance After First Year (hrs/mo./acre)
1.0	45	45.0	2	2.0	2	2.0
1.0	*-	-	5	5.0	5	5.0
1.0	100	100.0	15	15.0	4	4.0
1.0	20	20.0	0	0.0	0	0.0
1.0	8	8.0	3	3.0	3	3.0
1.0	72	72.0	3	3.0	3	3.0
1.0	60	60.0	12	12.0	0	0.0
1.0	18	18.0	9	9.0	9	9.0
1.0	*8	8.0	8	8.0	8	8.0
1.0	30	30.0	-	-	4	4.0
1.1	40	36.4	11	10.0	11	10.0
1.2	125	104.2	8	6.7	8	6.7
1.5	*100	66.7	5	3.3	3	2.0
1.5	60	40.0	20	13.3	20	13.3
1.6	*20	12.5	8	5.0	4	2.5
2.0	-	-	1	0.5	1	0.5
2.1	300	142.9	80	38.1	48	22.9
2.5	16	6.4	3	1.2	3	1.2
2.5	*3	1.2	5	2.0	2	0.8
2.6	85	32.7	2	0.8	1	0.4
3.0	40	13.3	16	5.3	24	8.0
3.0	*4	1.3	1	0.3	0	0.0
3.0	16	5.3	4	1.3	2	0.7
3.0	20	6.7	1	0.3	1	0.3
3.5	*16	4.6	*3	0.9	*3	0.9
4.0	*-	-	3	0.8	3	0.8
4.1	50	12.2	3	0.7	3	0.7
4.4	60	13.6	15	3.4	6	1.4
4.8	*-	-	-	-	-	-
5.0	*24	4.8	8	1.6	8	1.6
5.1	*160	31.4	10	2.0	10	2.0
5.1	100	19.6	0	0.0	0	0.0
5.2	*250	48.1	4	0.8	4	0.8
5.5	*20	36.4	16	2.9	10	1.8
6.0	*10	16.7	*4	0.7	*4	0.7
6.0	*8	13.3	75	12.5	75	12.5
6.0	80	13.3	40	6.7	40	6.7
6.0	4	1.5	30	5.0	8	1.3
7.0	*12	1.7	2	0.3	2	0.3
7.0	*8	1.1	2	0.3	1	0.1
8.0	35	4.4	3	0.4	1	0.1
9.5	*100	10.5	3	0.3	3	0.3

*planting or maintenance hired out

Table 25 (continued). Planting and Maintenance Time for Buffer Incentive Program Participants

Buffer (acres)	Planting Time (hrs.)	Planting Time (hrs./acre)	Maintenance First Year (hrs./mo.)	Maintenance First Year (hrs./mo./acre)	Maintenance After First Year (hrs/mo.)	Maintenance After First Year (hrs/mo./acre)
9.6	*-	-	2	0.2	2	0.2
11.5	*-	-	*4	0.3	0	0.0
11.7	*-	-	7	0.6	7	0.6
12.6	*280	22.2	20	1.6	1	0.1
14.0	*8	0.6	3	0.2	3	0.2
16.5	*40	2.4	3	0.2	3	0.2
19.4	*15	0.8	0	0.0	0	0.0
20.1	16	0.8	15	0.7	10	0.5
27.2	*8	0.3	3	0.1	3	0.1
35.0	*32	0.9	*1	0.0	*1	0.0
50.0	*-	-	*-	-	*-	-
Mean		24.3		3.8		2.8

*planting or maintenance hired out

Table 26. The Cost-share Payment from Maryland's Buffer Incentive Program

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	26.5	42.9	14.3	16.3
Other riparian landowners who are aware of BIP:	53	13.2	45.3	7.5	33.4
and who have...					
Planted forest buffer	5	20.0	60.0	0.0	20.0
Planted grass buffer*	18	11.1	5.6	11.1	72.2
Not planted a buffer	21	19.0	71.4	4.8	4.8

*grass buffers are not eligible for BIP grant

This question, and a more in-depth question on willingness to accept payment for various term programs, addresses the relative importance of a financial incentive for participation in a riparian buffer program. If in fact lost income from riparian land is an important factor for a landowner, one would expect that such incentive payments would be very important in the decision to adopt or not adopt a riparian buffer. Thirty-four of the 49 Buffer Incentive Program participants interviewed said that the BIP grant was critical or somewhat important to their decision. Seven landowners made additional comments about how important it was to have that financial incentive, with one noting that it was his main reason for participating. Four others commented that the grant was a bonus that they really appreciated, even if it was not crucial to their decision. One landowner said that he planted more trees than he would have without the incentive, and another indicated that it was particularly helpful in offsetting buffer fence-building expenses. Two landowners commented that it was the technical assistance from the forester, not the money, that was the biggest incentive. While these comments point to the need for continued grants through the program, it should also be noted that 12 of the 49 landowners commented that they would have participated in the program even if no cost share was provided.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of the Buffer Incentive Program grant in the buffer adoption decision.

Of the 21 riparian landowners in the survey conducted by MASS who are aware of the Buffer Incentive Program and decided not to plant a buffer, 19 said that the cost share payment was critical or somewhat important to their decision not to participate. Mann-Whitney U-tests (see Appendix 8) failed to reject at the .05 level the null hypothesis that the populations of adopters and of non-adopters who are aware of the program and have not planted a buffer have the same distribution with regard to attitudes about the importance of the Buffer Incentive Program grant in the buffer adoption decision. The number of responses to this question may be too small to draw any strong conclusions, but it does suggest that a bigger grant payment would influence these landowners to participate. Perhaps the bigger determinant of participation in this case is that only 21 of the 81 landowners who had not planted a buffer had heard of the program at all. The issue of the level of grant payment that landowners would be willing to accept to participate in the program is addressed in greater detail later in this chapter.

Table 27. Other Cost-share Programs or Technical Assistance, for Instance, to Purchase Seedlings

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	48	29.2	35.4	4.2	31.2
All other riparian landowners:	154	11.0	42.9	8.4	37.7
Planted forest buffer	14	28.6	42.9	7.1	21.4
Planted grass buffer	40	12.5	37.5	10.0	40.0
Has not planted a buffer	70	8.6	51.4	5.7	34.3
Planted buffer before '91	7	14.3	0.0	28.6	57.1
Aware of BIP	51	11.8	47.1	5.9	35.2

The third step in the adoption process suggested in this thesis concerns the ability of a "change agent" like the Department of Natural Resources forester to coordinate a package of other incentives or technical assistance to make participation in the program more attractive. For an illustration of a technical assistance and cost share package, see Table 1.

The majority of Buffer Incentive Program participants and other riparian landowners interviewed said that other cost-share programs or technical assistance were critical or somewhat important in their adoption decision. Eight participants noted the importance of the availability of low-cost seedlings, with one hoping that this research would reach a conclusion suggesting that the state provide seedlings free of charge. Two landowners said that they could not have undertaken the project without the forester's assistance. Another landowner, however, said that lack of technical assistance and follow-up by the forester prevented him from getting other cost-share and caused problems for the survival rate of the buffer. This comment was the exception to generally high marks by Buffer Incentive Program participants for the technical assistance provided by the foresters.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of other cost-share or technical assistance in the buffer adoption decision.

Table 28. Time Spent on the Application Process for Cost-share Funds

	N	Critical (%)	Somewhat Important (%)	Not Very Important (%)	Not a Factor (%)
BIP participants	49	0.0	8.2	16.3	75.5
All other riparian landowners:	158	10.8	35.4	12.7	41.1
Planted forest buffer	14	28.6	21.4	0.0	50.0
Planted grass buffer	38	10.5	31.6	18.4	39.5
Has not planted a buffer	73	11.0	39.7	12.3	37.0
Planted buffer before '91	7	0.0	14.3	14.3	71.4
Aware of BIP	53	13.2	39.6	9.4	37.8

The reason this question was asked can be summed up by the comment of one riparian landowner interviewed by MASS: "Paperwork? Forget it!" To what extent are landowners turned off by perceived transactions costs to receive the grant payment, in other words, by the "hassle factor"? This was not a perceived problem for the Buffer Incentive Program participants, with 43 of the 49 landowners interviewed saying it was not very important or not a factor in their decision to participate. Only two BIP participants had negative comments about the amount of paperwork, while two others noted that the forester and extension personnel did almost all the paperwork for them.

While the time that they would have to spend on the application process was of somewhat more concern for other riparian landowners interviewed, only just over half of those who have not planted a buffer said that this factor was critical or somewhat important in their decision not to participate. Four riparian landowners commented, however, about their unpleasant experiences with other best management practices, with one noting that "farmers are disgusted" with the delays in reimbursement.

Mann-Whitney U-tests (see Appendix 8) rejected at the .05 level the null hypothesis that the populations of adopters and non-adopters have the same distribution with regard to attitudes about the importance of the time commitment to obtain grant funds in the buffer adoption decision.

Table 29 provides a summary of the comparison of perceived costs and benefits between Buffer Incentive Program adopters and non-adopters discussed in this section. Water quality and other environmental benefits to the community were the most important factor in the adoption decision for Buffer Incentive Program participants, followed by creation of fish and wildlife habitat, control of erosion, and the grant from the Buffer Incentive Program. For non-adopters, using both weighted and unweighted data, erosion control was the most important factor in the adoption decision, followed by water quality and other environmental benefits to the community, compliance with current or future land use regulations, and the grant payment from the Buffer Incentive Program.

Table 29. Means of Responses to Perceived Cost and Benefit Questions

BIP Adopters			BIP Non-Adopters (unweighted)			BIP Non-Adopters (weighted by gross income from farming)		
Variable*	Mean	N	Variable	Mean	N	Variable	Mean	N
WATERQUL	3.25	49	EROSION	2.93	138	EROSION	2.91	131
HABITAT	3.06	49	WATERQUL	2.88	137	WATERQUL	2.84	130
EROSION	2.96	49	LAWS	2.65	133	LAWS	2.60	125
SHAREBIP	2.80	49	SHAREBIP	2.31	131	SHAREBIP	2.26	126
SHAREOTH	2.63	49	SHAREOTH	2.21	126	SEASON	2.14	126
AESTHETC	2.61	49	SEASON	2.18	132	SHAREOTH	2.14	120
LAWS	2.14	49	SHARETIM	2.17	129	HABITAT	2.12	128
DEER	2.00	49	INCOMLOS	2.13	137	INCOMLOS	2.10	130
PLANTTIM	1.61	49	HABITAT	2.08	134	SHARETIM	2.08	124
INCOMLOS	1.53	49	PLANTTIM	2.05	129	PLANTTIM	1.98	125
SEASON	1.47	49	DEER	2.03	135	DEER	1.98	129
SHARETIM	1.33	49	AESTHETC	1.88	133	AESTHETC	1.90	128
MOISTURE	1.20	49	MOISTURE	1.62	135	MOISTURE	1.64	129

*Data are coded on a four-point scale, with 1 representing "not a factor" in the adoption decision, 2 "not very important," 3 "somewhat important," and 4 "critical" in the adoption decision. For a description of codes, see Appendix 4.

Attitudes About Longer Term Programs

The samples of adopters and non-adopters cited the Buffer Incentive Program grant payment as one of the four most important factors in the adoption decision. The final section of the interviews was a series of questions to gain a better understanding of the amount that a landowner would accept for a 10-year, 20-year, 30-year, or permanent maintenance requirement for forest and grass buffers, in a lump-sum payment. The Buffer Incentive Program grant was $200 per acre in 1992, $500 per acre in 1993 and 1994, and is now $300 per acre. Because of the time delay for some environmental benefits from forest buffers, longer-term commitments are an important policy consideration. The option to secure at least some environmental benefits from grass buffers makes the grass option an important consideration as well.

Table 30. Willingness to Accept Payment for Various Term Forest or Grass Buffer Programs

	mean	standard dev.	minimum	maximum	number
Forest Buffer					
49 BIP participants					
20 years	661.5	395.4	100	1500	13
30 years	663.6	508.4	100	2000	11
permanent	757.1	559.3	500	2000	7
241 riparian landowners					
10 years	730	1994	60	15000	56
20 years	2760	7402	0	30000	16
30 years	6820	18692	300	60000	10
permanent	8560	21642	300	70000	10
Grass Buffers					
49 BIP participants					
10 years	366.4	349.6	50	1000	11
20 years	870.0	1004.2	50	3000	9
30 years	871.4	816.4	50	2000	7
permanent	1060.0	894.0	50	2000	5
241 riparian landowners					
10 years	1121	1994	60	15000	34
20 years	3133	6531	300	25000	15
30 years	6360	12636	300	40000	10
permanent	2120	2311	300	7500	10

These questions test two hypotheses:

- that landowners will participate in longer-term programs, but will require a higher grant payment to do so
- that landowners will require a lower grant payment for participation in grass buffer programs than for forest buffer programs

Most landowners declined in telephone interviews to give dollars-and-cents answers to these admittedly difficult questions. Appendix 5 summarizes t-tests using both weighted and unweighted data that compared the variances of responses by adopters and non-adopters to these questions. In all cases, the t-tests fail to reject at the .05 level the null hypothesis of no difference between population variances with regard to lowest acceptable lump-sum payment for various terms for forest and grass buffer programs. The following comments suggest that these questions are worth continued consideration:

- Eleven of the 49 Buffer Incentive Program participants surveyed plan to keep their buffer permanently, regardless of additional financial incentives
- Nine of the 49 BIP participants surveyed indicated that they would not commit for longer than the current 10 year commitment
- Four of the 49 BIP participants surveyed indicated that they would consider a longer commitment but would not commit on a permanent basis
- of 113 other riparian landowners who commented on various term programs, 14 indicated that they would not commit beyond 10 years for forest or grass.
- Nine of the 113 riparian landowners who commented indicated that they would not participate in a forest or grass buffer program at any price, with six of those landowners further commenting on their unwillingness to participate in government programs
- of those comments on buffers in general, the most common was that grass is viewed as a better buffer than forest, with 10 farmers emphasizing this point in their comments.

There is a mixed bag of messages included in these bullet points. While interviews suggest that there is an opportunity to secure longer-term commitments from some Buffer Incentive Program participants, there still may need to be flexibility in the program for shorter commitments. For landowners not in the program, there is some evidence that grass is a preferred option. But there is also some evidence that for some landowners, the issue is not forest versus grass; rather, the concerns are tieing up or taking that land out of production for any reason or participation in government programs.

General Comments from Surveys

Each survey instrument was designed to include a combination of closed- and open-ended questions. While closed ended questions would provide data for statistical analysis, several open-ended questions were seen as necessary because of the subtleties of adoption determinants that might not have been captured in closed-ended questions. These comments offer additional insights into the awareness of the concept and the perceived costs and benefits of adoption. Each interview ended with the following open-ended question:

> I would be grateful for your comments about buffers and the Buffer Incentive Program, including any barriers to participation that you see in your case, and any ways that a buffer incentive program could be made more attractive for someone like yourself. Is there anything more you would like to say about riparian buffers?

Awareness

The Buffer Incentive Program participants interviewed overwhelmingly expressed support for the program: 18 of the 49 landowners interviewed offered additional comments about how pleased they are with the program. Twelve landowners also singled out their county forester for praise. The forester's assistance in obtaining other cost-share or low-price seedlings, as well as planting and maintenance advice and assistance, were noted by several landowners. Only one Buffer Incentive Program participant expressed dissatisfaction with the program or the level of effort by the county forester. This landowner also happened to be the only participant from his county in the three-year period under study. These comments offer strong evidence of the importance of the forester as a "change agent" for this innovation. Several of the landowners fit the mold of the innovator or community leader that Rogers and other diffusion researchers have cited in the adoption process, with eleven landowners noting that the biggest barrier to participation in general is that more people should know about the program. Several indicated that they have either participated as a model for the community or that they have spread the word about riparian buffers to neighbors or business acquaintances.

The riparian landowners interviewed by the Maryland Agricultural Statistics Service offered many perspectives on buffers, ranging from one farmer whose general comments were recorded simply as "not printable" to four landowners who expressed interest in talking to the county forester about their eligibility for the program. Seven

landowners said that they think forest buffers are a good idea, with two more landowners offering further that the idea needs more publicity.

Perceived Costs and Benefits

Replies to open-ended questions also yielded insights into the range of perceived costs and benefits of participation in buffer programs. Effects on both the land that would be buffered and land adjacent to the buffer were addressed. Two riparian landowners in the MASS survey thought that riparian buffers were a good idea if not too wide. Ten landowners, however, believed that grass is a better option. This was the most commonly-heard general comment. Stream or pond access is a concern for many farmers. One farmer expressed interest in grass, but only if cattle had access to the buffer. Others expressed concerns about the maneuverability of farm machinery and the effects of shading on adjacent fields. No one commented on loss of moisture or nutrients to adjacent fields. The issue of passive versus active restoration was addressed by several farmers; two said that planting buffers was more trouble than it is worth, and that streambank fencing is a better solution.

Attitudes About Government Programs

Not surprisingly, many farmers offered opinions about government programs. Eight of the 113 farmers who offered additional comments said that they want nothing to do with government programs; three of these farmers refused to participate in the survey for that reason. Five farmers noted that government programs are too demanding, three said that the "government messes things up," and four expressed concern about allowing more government control on their land. One farmer noted that he refuses to deal with the Department of Natural Resources, a contrast to the positive interaction that Buffer Incentive Program participants have had with their county foresters. Two farmers expressed disappointment with the permitting and reimbursement process. While one farmer believed that the government should not be paying for these programs, three others said that there should simply be a tax credit for planting a buffer.

In the following chapter, conclusions are presented about the determinants of participation in this government program, based on the data presented in this chapter. These conclusions are followed by recommendations for development of public policy and future research programs.

CHAPTER 6

CONCLUSIONS

This research project was undertaken to address the following question: Why would someone plant a riparian buffer if he or she were not required to do so? Empirical research was conducted to test hypotheses about the extent to which attitudinal and "pure" economic factors drive the behavior of farmers with regard to voluntary riparian buffer programs.

Conclusions outlined in this chapter follow the adoption process analytical framework used in this study. Landowner and farm characteristics are discussed first, followed by awareness of the concept and program, and the landowner's evaluation of perceived costs and benefits of participation. The chapter ends with recommendations for the Buffer Incentive Program, riparian buffer policy, and future research.

The Landowners

Who are these people? In short, the typical farmer in the Buffer Incentive Program is not really a farmer. Survey results suggest that Buffer Incentive Program participants earn less gross income from farming and less percentage net income from farming than do farm owners in Maryland who are not participating in the program. Buffer Incentive Program participants are also younger, have more years of formal education, and less years of experience working on and managing farms than farm owners not in the program. In contrast to results from some studies of other agricultural best management practices, and to one of the working hypotheses of this study, the survey results suggest that farmers with higher gross income from farming are less likely to participate in the Buffer Incentive Program than those with a lower gross income from farming. Forty-nine of 69 Buffer Incentive Program participants from 1992 to 1994 who had a recent agricultural land use on their property were interviewed for this study. Over half of those 49 participants interviewed earn less than $1,000 per year from farming, and 82% earn under $20,000 per year.

Physical Characteristics of the Farm

What about the streams and riparian land being buffered or not being buffered? Ultimately, this is the reason for the interest in buffers in the first place. Is the land being set aside through the Buffer Incentive Program in areas where it will have the most impact from the eight environmental functions of buffers described by Bohlen and King? Both Bohlen and King and Lowrance, et al. recognize the difficulty in answering that question across watersheds and different land uses. Nonetheless, however delicate it is to raise this point in policy forums, it is pretty obvious what is driving the riparian buffer debate, especially in the Chesapeake Bay watershed: there is a 40% nutrient reduction goal for the Chesapeake Bay on the table, great strides have been made in reducing point-source discharges to the Bay, the focus now is on non-point sources, and agriculture accounts for 69% of those non-point source discharges. Is the Buffer Incentive Program getting through to those large-scale farm operations that are apt to generate more non-point source discharges? No. Although 42% of Buffer Incentive Program participants indicated that the previous riparian land use was for row crops (a higher percentage than for other riparian landowners interviewed), the level of farming effort on that land, as indicated by gross revenue from farming, suggests that these are not the farms generating the most non-point source discharges. Statistical tests failed to reject the null hypothesis that the distributions of farm sizes for adopters and non-adopters is the same. There is some evidence, however, that the stated alternate hypothesis that landowners with larger properties will be more likely to adopt is not supported: the mean size of properties of Buffer Incentive Program participants interviewed is less than the size of farms owned by non-participants interviewed. It is important to note that while analysis in this study was limited to riparian properties on agricultural land, the farming community is not the sole target of the Buffer Incentive Program, nor is reduction of sediment, nitrogen, and phosphorus loads into streams.

Bohlen and King outline these and other environmental functions of buffers, such as thermal effects on streams and wildlife habitat. Lowrance et al. emphasize the importance of forest buffers on smaller, first and second order streams, where the trees can provide full shade and other benefits for fish and wildlife habitat in particular. Is there any evidence that these smaller streams are being protected through the Buffer Incentive Program? While 38% of Buffer Incentive Program participants have streams of 10 feet or less on the property, 85% of the riparian landowners interviewed who have properties without forest or grass buffers have streams of 10 feet or less. Statistical tests rejected the null hypothesis of no difference in distribution between stream sizes for

adopters and non-adopters. The prevalence of smaller order streams on the land of individuals who have no buffers whatsoever provides a convenient transition to the next section of these conclusions: awareness of the riparian buffer concept and the Buffer Incentive Program.

Awareness

How important is the "awareness stage" in the hypothesized adoption process? Interviews with non-participating landowners suggest that there is a real lack of awareness of the Buffer Incentive Program. Of the 81 landowners interviewed who have unbuffered land and have not planted a buffer, only 21 were aware of the Buffer Incentive Program, thus ruling out adoption of the innovation before they can mull over perceived costs and benefits of participation.

How do adopters and non-adopters differ with regard to their awareness of the concept and program, and of the means through which they became aware of them?

Eighty-five percent of riparian landowners interviewed who are not in the Buffer Incentive Program stated that they are aware of the concept of riparian buffers. This is not surprising, given the emphasis on best management practices in Maryland in recent years. What is somewhat surprising is the number of farm owners who said that they do not own any riparian land. The negative responses from Maryland's Eastern Shore were especially interesting, with the comment from one farmer in Dorchester County particularly telling: "The question is stupid, because anyone knows that if you live in lower Dorchester County, you have to be on a marsh or some waterway." Yet five of eight landowners interviewed in Dorchester County who are not in the Buffer Incentive Program said that they do not own riparian land. Perhaps, as may be the case with small streams, land may be unbuffered because the landowner does not perceive that it is eligible for support through grants, cost-share, or technical assistance. Perhaps the word "riparian" signals "government regulation" and thus these landowners declined to provide information through an interview.

Participants and non-participants differ in the way in which they become aware of the concept of riparian buffers. Participants learn about riparian buffers from the Department of Natural Resources foresters; non-participants cite the soil district conservationist and the Natural Resources Conservation Service most often. This is no great surprise, and perhaps just another indication that Buffer Incentive Program participants are not really farmers. But it does point to the need for close collaboration between the different agencies at the very least. It also suggests that the most cost-

effective social and economic improvements from buffers would be gained by establishing a program similar to BIP run by an agencies or agencies more trusted by farmers. This would be a better strategy to buffer the intensive farming operations where there is the most capacity and opportunity for environmental improvements.

Twelve of the 49 Buffer Incentive Program participants interviewed made additional comments praising their county forester, offering strong evidence of the importance for these landowners of the forester as the change agent cited in adoption research. It should also be noted that, historically, the Buffer Incentive Program has spent its annual budget for buffer implementation grants. Without increased funding for more grants, as discussed later, it makes little sense to focus on increased outreach by foresters or other change agents from the soil conservation district or another agency to promote the program.

Perceived Costs and Benefits

How do landowners' motivations differ between the Buffer Incentive Program participants and non-participants? Water quality or other environmental benefits to the community was the most important factor in the adoption decision for Buffer Incentive Program participants interviewed, followed by creation of fish and wildlife habitat, control of erosion, the grant from the Buffer Incentive Program, and other cost-share or technical assistance. For non-adopters, erosion control was the most important factor, followed by water quality or other environmental benefits to the community, compliance with current or future land use regulations, the grant payment from the Buffer Incentive Program, and a tie between other cost-share or technical assistance and the time of year that a buffer would need to be planted.

The responses to questions about perceived costs and benefits in the adoption decision highlight the widespread concerns that Maryland farmowners have about water quality and erosion. They also point to the important role that the grant payment from the Buffer Incentive Program plays, as well as technical assistance. The concern by non-adopters about compliance with current or future land use regulation may suggest the need for increased outreach by individuals not seen by farmers as regulatory adversaries.

Surprisingly, lost agricultural income from the land along the stream was not one of the top reasons cited by both Buffer Incentive Program participants and non-participants in the adoption decision. Non-participants did have a higher mean score for this question than did participants, and the null hypothesis for this question of no difference in distributions between the two groups was rejected. Nonetheless, the relative

mean ranking (eighth out of thirteen) of this factor for non-adopting landowners was unexpected. The difficulty in generalizing across farms and watersheds about the agricultural viability of riparian land suggests that this question is best asked during on-site interviews of farm owners to gain a better understanding of that farm's characteristics.

Recommendations for the Buffer Incentive Program and Riparian Buffer Policy

The results of this study suggest several areas worthy of consideration by policy-makers involved with the Buffer Incentive Program and riparian buffers issues. First, the level of grant payment by the Buffer Incentive Program needs further examination. Nineteen of 21 non-adopters who have unbuffered land, are aware of the Buffer Incentive Program, and have not planted a buffer indicated that the grant from the Buffer Incentive Program was critical or somewhat important in their decision not to participate, suggesting that it is too low. Follow-up questions about the amount farmers would be willing to accept for participation in various term buffer programs were inconclusive. But there is some weak evidence that non-adopters would participate in a ten-year program if the grant payment were increased. If the governors of Maryland, Pennsylvania, and Virginia produce a policy in the coming year setting a mileage or acreage goal for riparian forest buffers, they may have to put their money where their mouths are and increase grant payments to reach non-adopting farmers. Whether those costs exceed the program's benefits is another question altogether.

Further study is also needed on the question of what farmers would be willing to accept for longer-term obligations for buffer maintenance, because buffers cut down after ten years may never provide the full range of benefits for which they are being promoted. Eleven of the 49 BIP participants interviewed indicated that they never plan to cut down their buffer. A government agency or land conservation organization should seize this opportunity and work with BIP participants to put their land in permanent conservation easements, which may also provide federal and state tax benefits to the landowner.

Neither the Buffer Incentive Program nor the Chesapeake Executive Council's Riparian Forest Buffer Panel is charged with promoting the notion of grass buffers. Yet there is evidence that some farmers prefer the grass option: the most frequent comment from non-adopting farmers interviewed was that grass is better than forest as a buffer. If the literature cited by Lowrance et al. and Bohlen and King is correct about the effectiveness of grass buffers for sediment, nitrogen, and phosphorus control, then farmers should be given that option when forest buffers are promoted.

The Department of Natural Resources foresters were singled out for praise by BIP participants, and the landowners themselves deserve some recognition as well for being guinea pigs of sorts in this endeavor. Rogers describes the adoption process as having five steps: initial knowledge, the formation of a favorable or unfavorable attitude about the innovation through persuasion, the decision to adopt or reject the innovation, implementation of the innovation, and confirmation, whereby the individual may reverse the earlier decision to adopt or not adopt. The BIP participants from 1992 to 1994, whom Rogers might call "innovators" and Morris and Potter might call "active adopters," may now be in the "confirmation" stage and in a position to influence Morris and Potter's passive adopters, conditional non-adopters, and resistant non-adopters down the road. Many participants commented about the time commitments for planting and maintenance, as well as the problems for buffer survival caused by deer. These comments suggest a need for more technical assistance, reduced-cost wildlife protectors, and other resources to ensure the long-term viability of the investment in these buffers. Success in cultivating these initial buffers will also help cultivate a corps of successful voluntary buffer planters to sell the idea to neighbors and peers. Ohio's TREES programs should be examined for adaptation in Maryland to help ease the planting and maintenance burden on landowners.

There is also some evidence that it is not the type of buffer planted, but the commitment to tie up the land for a period of time or participate in a government program that is of most concern to some farmers. These concerns are difficult ones to address. Perhaps the best approach is to focus on the passive adopters and conditional non-adopters, and let the attitudes of the resistant non-adopters change over time.

Recommendations for Further Research

This last policy recommendation suggests an area for further research. A sample of landowners in Maryland should be tracked over a several-year period to understand how adoption behavior changes over time. If the adoption process proposed by Rogers and others holds, then eventually the resistant non-adopters will become adopters. Ideally, this research would include on-site interviews to gain a more thorough understanding of a farm's physical characteristics, the scale of the farm operation, the type of stream, and the adjacent land uses upstream and downstream. This would also help answer questions that arose in this study about landowner perceptions of riparian land and about the extent to which the operation had already experimented with these innovations on parts of his or her land. Focusing on one or two counties might provide the most workable scale for such a study.

Esseks and Kraft (1988; 1989) used soil maps to compare farmers' eligibility for the Conservation Reserve Program with actual soil conditions. Zube and Sheehan (1994) focused on desert riparian area landscape perceptions and attitudes in Arizona, noting differences between resource managers and other interest groups such as farmers. Both approaches would be useful supplements to this study.

Appendix 1. Buffer Incentive Program Survey Instrument

ID#_____
Call #1_____
Call #2_____
Call #3_____

77=NO OPINION
88=DOES NOT APPLY
99=REFUSED

My name is Pat Hagan. I am a graduate student at the University of Maryland College Park conducting research for my master's thesis on forest and grass buffers along rivers and streams. Have you received the letter I sent you about the study?

I understand that you are participating in Maryland's Buffer Incentive Program. I would be grateful if you were to spend 10 to 15 minutes discussing the program and answering a few questions about your interest in buffers. This interview is completely voluntary and confidential.

Is now a good time for us to talk?

IF NO: When would be a better time to call you back?

DATE/TIME:

To help my analysis, many of these questions are in a multiple choice format.

First, I would like to get some sense of how you became interested in putting a forest buffer on your land.

Q1) **How did you first learn about the concept of riparian buffers? Was it through:**

written materials received in the mail	__	1
a telephone call	__	2
a personal meeting or conversation	__	3
a public meeting	__	4
information in the media	__	5

Q2) **Could you talk briefly about who had the first personal contact with you about putting a riparian buffer on your land, and how that contact came about?**

CATEGORIES NOT READ ALOUD

forester from Maryland Department of Natural Resources .. __ 1
USDA Consolidated Farm Service Agency ..... __ 2
USDA Natural Resources Conservation Service ..... __ 3
Maryland soil district conservationist ..... __ 4
University of Maryland Cooperative Extension Service .... __ 5
University of Maryland Agricultural Experiment Station ... __ 6
an agricultural chemical company or other company ..... __ 7
a non-profit conservation organization or land trust ..... __ 8
a neighbor who has put a buffer on his or her land ..... __ 9
another source (SPECIFY)_____ ..... __ 10

COMMENTS:

Q3) **I am trying to get some sense of the width of the stream at the point where you have planted a forest buffer. On average, how wide is the stream where it is now buffered on your property?**

_____ feet

Q4) **What percentage of your land is**
moderately sloped, with a 2-8% slope) ..... _____ %
highly sloped, with a greater than 8% slope)..... _____ %

Q5) **Have you considered putting additional forest or grass buffers elsewhere on your property?**

no.... __ 0
yes... __ 1

Why haven't you done so? (OR) Why not?

Q6) **I am interested in the extent to which the following factors played a role in your decision to put a riparian buffer on your land. I will read a list of 13 possible factors. Please indicate whether each was**

a critical factor in your decision to put a buffer on your land
was somewhat important
was not a very important factor
or was not a factor

Q6A) **The cost-share payment from the Buffer Incentive Program?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6B) **Other cost-share programs or technical assistance, for instance, to purchase seedlings?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6C) **Aesthetic factors such as a scenic view?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6D) **Lost agricultural income previously generated from your land along the stream?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6E) **The creation of fish and wildlife habitat?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6F) **Erosion?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6G) **Time spent on the application process to receive cost-share funds?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6H) **The time of year that a buffer would need to be planted or maintained?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6I) **The length of time needed for planting and maintenance of a buffer?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6J) **Possible loss of moisture to adjacent agricultural fields?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6K) **Possible increased deer population?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6L) **Water quality and other environmental benefits to your community?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q6M) **Compliance with current or future land use regulations?**

critical __ 1
somewhat important __ 2
not very important __ 3
not a factor __ 4

Q7) **About how much out-of-pocket did it cost you to plant the buffer?**

$_____

Q8) **About how much was cost-shared by programs other than the Buffer Incentive Program?**

$_____

Q9) **Have you ever received cost sharing funds for other best management practices?**

no.... __ 0
yes... __ 1

Q10) **Did you do the planting and maintenance yourself, or did someone else?**

myself ..... __ 0
someone else __ 1

Q11) **Can you give me an estimate of how many hours were spent planting the buffer?**

_____ hours

Q12) **Can you give me an estimate of how many hours per month were spent on maintenance of the buffer during the first year?**

_____ hours per month

Q13) **Subsequent to the first year, can you give me an estimate of how many hours per month have been spent on maintaining the buffer as forest?**

_____ hours per month

The terms of your contract with the Buffer Incentive Program state that your buffer must be maintained as forest for 10 years. A one-time cost share payment of ($_____ per acre) would be provided once the buffer had been successfully established.

Q14) **What is the lowest total price per acre that you would accept for a <u>20-year</u> maintenance requirement, in a lump-sum payment?**

$_____ per acre

for a 30-year maintenance requirement?..... $_____ per acre

for a permanent maintenance requirement?..... $_____ per acre

Q15) **What is the lowest total price per acre that you would accept for a 10-year maintenance requirement for a grass buffer, in a lump-sum payment?**

$_____ per acre

for a 20-year maintenance requirement?..... $_____ per acre

for a 30-year maintenance requirement?..... $_____ per acre

for a permanent maintenance requirement?..... $_____ per acre

Q16) **As of June 1st, how many acres did you own?**..... _____ acres

use free from others? _____ acres

rent to others?..... _____ acres

17) **Before you planted a buffer along the river or stream on your property, how was that portion of your land used? Was it**

all in row crops	__	1
partially in row crops	__	2
all pasture	__	3
partially pasture	__	4
a grass lawn or field not used as pasture ..	__	5
an idle row crop field	__	6
in another use (specify)_____	__	7

(IF ROW CROPS)
Could you specify the crop or crops previously grown on the area that is now buffered?

(IF PASTURE)
What
animals?_____

How many animals per acre? ..... _____ animals/acre

Q18) **Of your total net income (from both off-farm and on-farm sources), which of the following categories best represents the percentage of your total income that came from farming?**

zero __ 1
1% to 24% __ 2
25% to 49% __ 3
50% to 99% __ 4
all of my income is from farming __ 5

The following information will help my analysis and, again, it will be kept strictly confidential:

(IF APPLICABLE):

Q18) **How many years have you been working on a farm?**....._____ years

managed a farm? ....._____ years

Q19) **In which of the following categories would you estimate your gross revenue from farming sources to be in 1994?**

less than $1,000 __ 1
$1,000 - $19,999 __ 2
$20,000-$39,999 __ 3
$40,000-$99,999 __ 4
$100,000-$249,999 __ 5
$250,000 or more __ 6

Q20) **In what age range are you?**

20-29 years old __ 1
30-39 __ 2
40-49 __ 3
50-59 __ 4
60 or more __ 5

Q21) **What is the highest grade you completed in school?**

high school or less ..... __ 1
some college, business school, or vocational training..... __ 2
bachelor's degree..... ..... __ 3
master's or doctorate degree..... __ 4

That covers all the specific questions I wanted to ask you in this interview. I would be grateful for your comments about buffers and the Buffer Incentive Program, including any barriers to participation that you ran across in your case, and any ways that a buffer incentive program could be made more attractive for someone like yourself.

Is there anything more you would like to say about the Buffer Incentive Program or buffers?

I plan to visit _____ County later this month as part of my research. If it is convenient for you, would you mind if I paid you a brief visit to see your buffer?

Thank you for spending some time with me. The information you have provided will be valuable for my research and, I hope, may someday help improve buffer programs and policies in Maryland.

Appendix 2. Farm Operators Survey Instrument

I am calling from the Maryland Agricultural Statistics Office to follow up our recent survey on best management practices.

Q1) **Do you own any riparian land, in other words, land that borders a stream, river, pond, tidal or non-tidal wetland, or other open water?**

no... __
yes... __

IF NO, TERMINATE INTERVIEW

Q2) **Are you familiar with the concept of putting forest or grass buffers on riparian land to control nutrient and sediment run-off into waterbodies and to provide other environmental benefits?**

no... __
yes... __

IF NO, TERMINATE INTERVIEW

Q3) **How is the land along the river or stream on your property used? Is it**

all in row crops..... __
partially in row crops..... __
all pasture..... __
partially pasture..... __
a grass lawn or field not used as pasture... __
an idle row crop field..... __
forest buffer ..... __
grass buffer or filter strip ..... __
in another use (specify)..... __

(IF ROW CROPS)
Could you specify the crop or crops currently grown on the area along the river or stream on your property? _____

(IF PASTURE)
What animals? _____

How many animals per acre? ..... _____ animals/acre

(IF FOREST OR GRASS BUFFER)
Q3E: What is the width of your buffer, width _____ feet
Q3F: and the length of the buffer along the stream? length _____ feet

Q4) **I am trying to get some sense of the width of body of water on your property. On average, how wide is the stream or other water body on your property?**

one to ten feet ___
11 to 20 feet ___
21 to 50 feet ___
greater than 50 feet ___

Q5) **How did you first learn about the concept of putting forest or grass buffers along rivers or streams? Was it through:**

written materials received in the mail..... ___
a telephone call..... ___
a personal meeting or conversation..... ___
a public meeting..... ___
information in the media..... ___

Q6) **Could you talk briefly about who had the first contact with you about putting a riparian buffer on your land, and how that contact came about?**

CATEGORIES NOT READ ALOUD
forester from Maryland Department of Natural Resources.... ___
USDA Consolidated Farm Service Agency..... ___
USDA Natural Resources Conservation Service..... ___
Maryland soil district conservationist..... ___
University of Maryland Cooperative Extension Service..... ___
University of Maryland Agricultural Experiment Station..... ___
agricultural chemical company or other company..... ___
non-profit conservation organization or land trust..... ___
neighbor who has put a buffer on his or her land..... ___
another source (SPECIFY)_____ ..... ___

COMMENTS:

Q7A) **Have you planted a forest or grass buffer on any of your riparian land since 1991?**

no.... __
yes.... __

IF NO:
Q7B: Why haven't you done so? OR Why not?

Q8) **Are you aware of Maryland's Buffer Incentive Program, which provides cost-share funds of $300 per acre for implementation of riparian forest buffers?**

no.... __
yes.... __

Q9) **I am interested in learning why you decided whether or not to participate in a riparian forest or grass buffer program. Please indicate whether each of the following was**

- **a critical factor in your decision not to put a buffer on your land**
- **somewhat important**
- **not a very important factor**
- **or was not a factor**

Q9A) **The cost-share payment from the Buffer Incentive Program?**

critical ___ not very important __
somewhat important __ not a factor __

Q9B) **Other cost-share programs or technical assistance, for instance, to purchase seedlings?**

critical ___ not very important __
somewhat important __ not a factor __

Q9C) **Aesthetic factors such as a scenic view?**

critical ___ not very important __
somewhat important __ not a factor __

Q9D) **Lost agricultural income previously generated from your land along the stream?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9E) **The creation of fish and wildlife habitat?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9F) **Erosion?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9G) **Time spent on the application process?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9H) **The time of year that a buffer would need to be planted or maintained?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9I) **The length of time needed for planting and maintenance of a buffer?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9J) **Possible loss of moisture to adjacent agricultural fields?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9K) **Possible increased deer population?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9L) **Water quality and other environmental benefits to your community?**

critical ___ not very important ___
somewhat important ___ not a factor ___

Q9M) **Compliance with current or future land use regulations?**

critical ___ not very important ___
somewhat important ___ not a factor ___

As I mentioned before, a one-time cost-share payment of $300 per acre is provided by Maryland's Buffer Incentive Program once a forest buffer has been successfully established. The terms of contracts in the Buffer Incentive Program state that the buffers must be maintained as forest for 10 years.

Q10) **What is the lowest total price per acre that you would accept for a 10-year maintenance requirement for a forest buffer, in a lump-sum payment?**

$_____ per acre

for a <u>20-year</u> maintenance requirement?.....$_____ per acre

for a <u>30-year</u> maintenance requirement?.....$_____ per acre

for a <u>permanent</u> maintenance requirement?.....$_____ per acre

Q11) **What is the lowest total price per acre that you would accept for a 10-year maintenance requirement for a <u>grass</u> buffer, in a lump-sum payment?**

$_____ per acre

for a <u>20-year</u> maintenance requirement?.....$_____ per acre

for a <u>30-year</u> maintenance requirement?.....$_____ per acre

for a <u>permanent</u> maintenance requirement?.....$_____ per acre

That covers all the specific questions I wanted to ask you in this interview. I would be grateful for your comments about buffers and the Buffer Incentive Program, including any barriers to participation that you see in your case, and any ways that a buffer incentive program could be made more attractive for someone like yourself. Is there anything more you would like to say about riparian buffers?

COMMENTS:

Appendix 3. Letter of introduction to Buffer Incentive Program participants

(on letterhead of Chesapeake Biological Laboratory)

November 3, 1995

Name
Address
Address

Dear (name):

I am a graduate student at the University of Maryland and am currently doing research for my master's thesis on forest buffers along rivers and streams. As part of my research, I am talking to landowners, government representatives, and other people interested in buffers in the State of Maryland.

A review of public records at Maryland's Department of Natural Resources showed that you are participating in Maryland's Buffer Incentive Program. A key element of my thesis research is discussions with participants in this program from 1992-1994, a total of 85 landowners. I would be grateful if you were to spend ten to fifteen minutes discussing the program with me by telephone and answering a few questions about your interest in riparian forest buffers.

This interview is voluntary and confidential. If you are interested, the results of my research can be sent to you.

I will call the week of November 6th to see if there is a convenient time for our conversation. Your participation is important to the success of my research project, and I would appreciate any assistance you can provide.

Sincerely,

Patrick Hagan

Appendix 4. Explanation of Variable Codes

BIPADOPT	1=participating in program 0=not participating in program
RIPARYES	1=landowner says he owns some riparian land
AWAREYES	1=riparian landowner aware of concept
AWARENO	1=riparian landowner not aware of the concept of riparian buffers
BIPAWYES	1=riparian landowner aware of Buffer Incentive Program
BIPAWNO	1=riparian landowner not aware of Buffer Incentive Program
OWNACRES	number of acres owned
YRSFARM	number of years farming
YRSMANAG	number of years managing a farm
AGE	1=20-29 years old 2=30-39 years old 3=40-49 years old 4=50-59 years old 5=60 or more years old
EDUCATE	1=high school or less 2=some college or trade school 3=bachelor's degree 4=graduate degree
GROSFARM	1=less than $1,000 in gross income from farming in 1994 2=$1,000-$19,999 3=$20,000-$39,999 4=$40,000-$99,999 5=$100,000-$249,999 6=$250,000 or more
NETPFARM	1=zero net percentage income from farming in 1994 2=1-24% net percentage income from farming 3=25-49% 4=50-99% 5=100%
ROWALL	1=landowner says all his riparian land is in row crops
ROWPART	1=riparian land (within 300 feet of stream) partially in row crops (more
than	one answer possible)
PASTALL	1=riparian land all in pasture
PASTPART	1=riparian land partially in pasture
LAWN	1=grass lawn or field not used as pasture
ROWIDLE	1=riparian land is an idle row crop field
BUFFORES	1=riparian land has forest buffer
BUFGRASS	1=riparian land has grass buffer
BUFFWIDE	width of the buffer (repeated as BUFWIDTH a few columns later)
OTHERUSE	1=riparian land is/was in some other use
ANIMACRE	# of animals per acre on the property
BUFWIDTH	width of the buffer, on average
BUFLENGT	length of the buffer along the stream
STRMWIDE	1=stream width, on average is 1-10 feet 2=11-20 feet 3=21-50 feet 4=51 feet or greater, on average

AWMAIL	1=became aware of the concept initially by mail
AWPHONE	1=by phone
AWPERMTG	1=in a personal meeting
AWPUBMTG	1=in a public meeting (farm bureau, for instance)
AWMEDIA	1=through the media
AWOTHER	1=through another source
CONTDNR	1=DNR had first personal contact with landowner about buffer planting
CONTCFSA	1=Consolidated Farm Service Agency (formerly ASCS)
CONTNRCS	1=Natural Resources Conservation Service (formerly SCS)
CONTSOIL	1=soil district conservationist
CONTCES	1=Cooperative Extension Service
CONTAES	1=U. of M. Agricultural Experiment Station
CONTCHEM	1=an agricultural chemical or other company
CONTNEIG	1=a neighbor
CONTOTHE	1=some other contact about buffers
CONTNONE	1=didn't talk to anyone about buffers
PLANTNO	1=has not planted a buffer since 1991 of any kind
PLANTNAT	1=already had a natural buffer there, so didn't plant one
PLANTNOR	1=hasn't planted and no reason like natural buffer that would have precluded doing so given
PLANTGOV	1=hasn't planted a buffer and won't through any government program because opposed to government programs
PLANT91	1=planted a forest or grass buffer before 1991
PLANTGRA	1=planted a grass buffer since 1991
PLANTFOR	1=planted a forest buffer since 1991, but not with BIP grant
TREES10	lowest lump-sum payment they would be willing to accept for planting and maintaining forest buffer for 10 years
TREES20	forest for 20 years
TREES30	forest for 30 years
TREESPER	willingness to accept for keeping as forest permanently
GRASS10	lowest lump-sum payment for a grass buffer for 10 years
GRASS20	grass for 20 years
GRASS30	grass for 30 years
GRASSPER	willingness to accept for keeping buffer as grass permanently

the following questions use this format:

1=was not a factor in the decision to adopt or not adopt a forest or grass buffer
2=not very important in the decision
3=somewhat important in the decision
4=critical in the decision

AESTHETC	aesthetic factors such as a scenic view
DEER	increased deer population
EROSION	erosion
HABITAT	creation of fish and wildlife habitat
INCOMLOS	lost agricultural income from the land along the stream
LAWS	current or future land use regulation
MOISTURE	loss of moisture from adjacent agricultural fields
PLANTTIM	the length of time for planting and maintenance
SEASON	the time of year that a buffer would have to be planted or maintained
SHAREBIP	the grant from the Buffer Incentive Program
SHAREOTH	other cost share or technical assistance, for instance, seedlings
SHARETIM	the length of time for application for grants, cost share, etc.
WATERQUL	water quality and other environmental benefits to the community

Appendix 5. T-Tests

Variable		N	Mean	Std. Dev.	SE of Mean	Mean Difference	Levene's Test for Equal Variance[5] F	p	T-test T	DF	2-tail sig.
OWNACRES	(unweighted)										
	BIPADOPT 1	49	138.47	265.91	37.99						
	BIPADOPT 0	226	197.87	199.11	13.24						
						59.41	.04	.834	1.78	273	.077
OWNACRES	(weighted)										
	BIPADOPT 1	49	138.47	265.91	37.99						
	BIPADOPT 0	230	166.56	179.18	11.81						
						28.09	1.02	.314	.91	277	.365
ANIMACRE	(unweighted)										
	BIPADOPT 1	6	1.67	1.75	.72						
	BIPADOPT 0	96	2.73	6.39	.65						
						1.07	.16	.69	.41	100	.685
ANIMACRE	(weighted)										
	BIPADOPT 1	6	1.67	1.75	.72						
	BIPADOPT 0	94	2.47	5.30	.72						
						.80	.09	.760	.37	98	.713

5. Levene's test is used to test the hypothesis that the two population variances are equal. It is obtained by computing for each case the absolute difference from its group mean and then performing a one-way analysis of variance on these differences. If the observed significance level is small, the hypothesis that the population variances are equal is rejected, and a separate variance t-test for means is used. If the significance level for the Levene statistic is large, a pooled variance t-test is used, since using the separate variance t-test when the population variances are equal may result in an observed significance level somewhat larger than it should be. The pooled variance t-test is based on the assumption that the population variances in the two groups are equal; it is obtained by using a pooled estimate of that common variance (SPSS 1993).

Variable		N	Mean	Std. Dev.	SE of Mean	Mean Difference	Levene's Test for Equal Variance F	Levene's Test for Equal Variance p	T-test T	T-test DF	T-test 2-tail sig.
YRSFARM	(unweighted)										
	BIPADOPT 1	48	13.63	15.31	2.21						
	BIPADOPT 0	195	38.66	15.37	1.10	25.03	.19	.663	10.12	241	.000
YRSFARM	(weighted)										
	BIPADOPT 1	48	13.63	15.31	2.21						
	BIPADOPT 0	194	38.65	15.73	1.13	25.02	.44	.507	9.92	240	.000
YRSMANAG	(unweighted)										
	BIPADOPT 1	48	7.65	11.07	1.60						
	BIPADOPT 0	141	25.56	12.56	1.06	17.91	2.17	.143	8.79	187	.000
YRSMANAG	(weighted)										
	BIPADOPT 1	48	7.65	11.07	1.60						
	BIPADOPT 0	154	25.62	13.07	1.05	17.97	3.30	.071	8.61	200	.000

Variable		N	Mean	Std. Dev.	SE of Mean	Mean Difference	Levene's Test for Equal Variance F	Levene's Test for Equal Variance p	T-test T	T-test DF	T-test 2-tail sig.
TREES20	(unweighted)										
	BIPADOPT 1	13	661.54	395.36	109.66						
	BIPADOPT 0	11	3741.82	8875.02	2675.92						
						3080.28	6.33	.020	1.15	10	.277
TREES20	(weighted)										
	BIPADOPT 1	13	661.54	395.36	109.66						
	BIPADOPT 0	9	5172.64	10996.80	3671.73						
						4511.10	11.02	.003	1.23	8	.254
TREES30	(unweighted)										
	BIPADOPT 1	11	663.64	508.47	153.31						
	BIPADOPT 0	4	15525.00	29260.34	14825.17						
						14861.36	27.68	.000	1.00	3	.390
TREES30	(weighted)										
	BIPADOPT 1	11	663.64	508.47	153.31						
	BIPADOPT 0	4	21123.95	32849.88	16851.63						
						20460.31	86.52	.000	1.21	3	.317
TREESPER	(unweighted)										
	BIPADOPT 1	7	757.14	559.34	211.41						
	BIPADOPT 0	6	13133.33	27882.73	11383.08						
						12376.19	7.09	.022	1.09	5	.327
TREESPER	(weighted)										
	BIPADOPT 1	7	757.14	559.34	211.41						
	BIPADOPT 0	5	19571.89	33718.06	15109.42						
						18814.74	19.48	.001	1.25	4	.281
GRASS10	(unweighted)										
	BIPADOPT 1	11	366.36	349.64	105.42						
	BIPADOPT 0	25	1132.00	2160.77	432.15						
						765.63	3.62	.066	1.16	34	.254
GRASS10	(weighted)										
	BIPADOPT 1	11	366.36	349.64	105.42						
	BIPADOPT 0	23	1141.30	2407.76	499.67						
						774.94	3.39	.075	1.05	32	.300

Variable		N	Mean	Std. Dev.	SE of Mean	Mean Difference	Levene's Test for Equal Variance F	p	T-test T	DF	2-tail sig.
GRASS20	(unweighted)										
	BIPADOPT 1	9	870.00	1004.17	334.72						
	BIPADOPT 0	9	4655.56	8228.32	2742.77	3785.56	7.04	.017	1.37	8	.207
GRASS20	(weighted)										
	BIPADOPT 1	9	870.00	1004.17	334.72						
	BIPADOPT 0	7	6187.13	10100.75	37948.78	5317.13	12.83	.003	1.39	6	.211
GRASS30	(unweighted)										
	BIPADOPT 1	7	871.43	816.42	308.58						
	BIPADOPT 0	5	11440.00	17119.81	7656.21	10568.57	12.48	.005	1.38	4	.240
GRASS30	(weighted)										
	BIPADOPT 1	7	871.43	816.42	308.58						
	BIPADOPT 0	4	14353.60	19637.11	9319.36	13482.18	19.34	.002	1.45	3	.233
GRASSPER	(unweighted)										
	BIPADOPT 1	5	1060.00	894.01	399.81						
	BIPADOPT 0	6	1983.33	1539.37	628.45	923.33	.271	.615	1.18	9	..268
GRASSPER	(weighted)										
	BIPADOPT 1	5	1060.00	894.01	399.81						
	BIPADOPT 0	5	2248.39	1888.94	846.45	1188.39	2.33	.165	1.27	8	.239

Appendix 6. Mann-Whitney U-Tests[6] : Adoption, by Landowner and Land Parcel Characteristics

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
AGE	BIPADOPT1	49	3.78	114.24	-	5598.0		
(unweighted)	BIPADOPT0	228	4.11	144.32	4373.0	-		
							-2.5421	.0110
AGE	BIPADOPT1	49	3.78	108.61	-	5322.0		
(weighted)	BIPADOPT0	228	4.21	145.53	4097.0	-		
							-3.1565	.0016
EDUCATE	BIPADOPT1	49	2.86	129.69	-	14555.0		
(unweighted)	BIPADOPT0	155	2.08	93.90	2465.0	-		
							-3.8994	.0001
EDUCATE	BIPADOPT1	49	2.86	129.21	-	14171.5		
(weighted)	BIPADOPT0	153	2.10	92.62	2390.5	-		
							-4.0205	.0001
GROSFARM	BIPADOPT1	49	1.80	87.00	-	4263.0		
(unweighted)	BIPADOPT0	232	3.42	152.41	3038.0	-		
							-5.3833	.0000
GROSFARM	BIPADOPT1	49	1.80	89.14	-	4368.0		
(weighted)	BIPADOPT0	228	2.81	150.83	3143.0	-		
							-5.1172	.0000

6. The Mann-Whitney U-test is a non-parametric version of the T-test that two independent samples come from populations having the same distribution. The test is computed by combining the two samples, then ranking them from smallest to largest value. A mean rank is determined, then a U score for the group with the larger number of observations and a W score for the group with the smaller number of observations. This is converted into a standard normal deviate, or "z" score of the number of standard deviations between a given measurement and the mean of the normal distribution (SPSS 1993; Schefler 1988). In all U-Tests in this table, larger means and mean ranks indicate a higher value for that variable because of the way ordinal numbers were assigned during data input. Thus a value of "1" for age indicates someone in the 20-29 age group, while "5" indicates someone who is over 60; "4" indicates an answer of "critical," while "1' indicates an answer of "not a factor." For a complete explanation of data codes, see Appendix 4.

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
NETPFARM	BIPADOPT1	49	1.65	46.63	-	2285.0		
(unweighted)	BIPADOPT0	185	3.88	136.27	1060.0	-		
							-8.6514	.0000
NETPFARM	BIPADOPT1	49	1.65	47.04	-	2305.0		
(weighted)	BIPADOPT0	175	3.58	130.83	1080.0	-		
							-8.3903	.0000
STRMWIDE[7]	BIPADOPT1	48	2.46	146.04	-	21670.0		
(unweighted)	BIPADOPT0	191	1.82	113.46	3334.0	-		
							-3.2930	.0010
STRMWIDE	BIPADOPT1	48	2.46	152.31	-	23814.0		
(weighted)	BIPADOPT0	191	1.93	118.48	3513.0	-		
							-3.2916	.0010

7. Following the approach used in the Total Design Method (Dillman 1978), survey participants were given a choice of ranges for stream width, instead of being asked to estimate a specific width. This made the question somewhat easier to answer. As noted in Appendix 4, an answer of "1" equals a stream of 1-10 feet in width; "2" equals a stream of 11-20 feet in width; "3" equals 21-50 feet in width; and "4" 51 feet or greater. Thus the mean of 2.46 does not indicate that the mean stream width is 2.46 feet; rather, it indicates that the mean width is between the second and third categories. Since the stream widths are categorical variables, Mann Whitney U-Tests are used to analyze the data

Appendix 7. Mann-Whitney U-Tests: Awareness, by Landowner Characteristics

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
AGE	AWAREYES	241	4.04	135.25	3434.5	-		
(unweighted)	AWARENO	31	4.10	146.21	-	32595.5		
							-.7738	.4390
AGE	AWAREYES	37	3.78	133,64	-	31272.0		
(weighted)	AWARENO	234	4.18	150.92	3770.0	-		
							-1.3376	.1810
AGE	BIPAWYES	102	3.78	107.39	-	10953.5		
(unweighted)	BIPAWNO	130	4.15	123.65	5700.5	-		
							-1.9382	.0526
AGE	BIPAWYES	93	3.78	108.61	-	5322.0		
(weighted)	BIPAWNO	142	4.24	145.53	4097.0	-		
							-3.1565	.0016
EDUCATE	AWAREYES	172	2.31	97.99	1464.0	-		
(unweighted)	AWARENO	20	2.00	83.70	-	1674.0		
							-1.1456	.2520
EDUCATE	AWAREYES	173	2.31	102.40	2006.0	-		
(weighted)	AWARENO	27	2.07	88.30	-	2384.0		
							-1.2331	.2175
EDUCATE	BIPAWYES	81	2.58	73.21	-	6223.0		
(unweighted)	BIPAWNO	85	2.04	94.30	2568.0	-		
							-2.9637	.0030
EDUCATE	BIPAWYES	79	2.61	86.94	-	7047.5		
(weighted)	BIPAWNO	52	2.03	76.60	2769.5	-		
							-2.7972	.0052

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
GROSFARM	AWAREYES	244	3.18	139.56	2046.5	-		
(unweighted)	AWARENO	31	2.81	125.73	-	25482.5		
							-2.3765	.0175
GROSFARM	AWAREYES	237	2.68	139.99	3795.5	-		
(weighted)	AWARENO	37	2.33	121.58	-	44948.5		
							-1.3882	.1651
GROSFARM	BIPAWYES	103	3.01	109.98	-	11328.0		
(unweighted)	BIPAWNO	132	3.25	124.26	5972.0	-		
							-1.6395	.1011
GROSFARM	BIPAWYES	94	2.61	110.31	-	10369.0		
(weighted)	BIPAWNO	144	2.68	125.50	5904.0	-		
							-1.7528	.0796
NETPFARM	AWAREYES	216	3.35	117.97	2046.5	-		
(unweighted)	AWARENO	26	4.08	150.97	-	25482.5		
							-2.3765	.0175
NETPFARM	AWAREYES	193	3.06	144.73	1606.0	-		
(weighted)	AWARENO	26	3.94	105.32	-	20327.0		
							-3.1261	.0018
NETPFARM	BIPAWYES	96	2.88	86.98	-	8350.5		
(unweighted)	BIPAWNO	112	3.72	119.51	3694.5	-		
							-4.0716	.0000
NETPFARM	BIPAWYES	82	2.63	78.91	-	6471.0		
(weighted)	BIPAWNO	111	3.40	110.36	3068.0	-		
							-4.0547	.0001

Appendix 8. Mann-Whitney U-Tests[8] : Perceived Costs and Benefits

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
AESTHETC	BIPADOPT1	49	2.61	82.77	-	11008.0		
(unweighted)	BIPADOPT0	133	1.88	115.20	2097.0	-		
							-3.9885	.0001
AESTHETC	BIPADOPT1	49	2.61	118.70	-	12138.5		
(weighted)	BIPADOPT0	140	1.90	86.70	2268.5	-		
							-3.8041	.0001
INCOMLOS	BIPADOPT1	49	1.53	72.47	-	3551.0		
(unweighted)	BIPADOPT0	137	2.13	101.42	2326.0	-		
							-3.4276	.0006
INCOMLOS	BIPADOPT1	49	1.53	75.68	-	3708.5		
(weighted)	BIPADOPT0	142	2.10	103.01	2483.5	-		
							-3.2263	.0013
HABITAT	BIPADOPT1	49	3.06	125.09	-	10706.5		
(unweighted)	BIPADOPT0	134	2.88	79.90	1661.5	-		
							-5.3419	.0000
HABITAT	BIPADOPT1	49	3.06	127.65	-	11700.0		
(weighted)	BIPADOPT0	140	2.12	83.57	1830.0	-		
							-5.0639	.0000
EROSION	BIPADOPT1	49	2.96	95.92	-	12878.0		
(unweighted)	BIPADOPT0	138	2.93	93.32	3287.0	-		
							-.3060	.7596
EROSION	BIPADOPT1	49	2.96	99.39	-	13658.0		
(weighted)	BIPADOPT0	143	2.91	95.51	3362.0	-		
							-.4465	.6552

8. For an explanation of Mann-Whitney U-Tests, see Appendix 6. For an explanation of variable codes, see Appendix 4. All variables in Appendix 7 were recorded on a four-point scale according to the following answers: 4=critical, 3=somewhat important, 2=not very important, and 1=not a factor in the decision to adopt or not adopt.

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
MOISTURE	BIPADOPT1	49	1.20	76.00	-	3724.0		
(unweighted)	BIPADOPT0	135	1.62	98.49	2499.0	-	-3.1757	.0015
MOISTURE	BIPADOPT1	49	1.20	79.31	-	3886.0		
(weighted)	BIPADOPT0	140	1.64	100.49	2661.0	-	-2.9732	.0029
DEER	BIPADOPT1	49	2.00	90.93	-	4455.5		
(unweighted)	BIPADOPT0	135	2.03	93.07	3230.5	-	-.2574	.7969
DEER	BIPADOPT1	49	2.00	95.02	-	4656.0		
(weighted)	BIPADOPT0	141	1.98	95.67	3431.0	-	-.0756	.9397
WATERQUL	BIPADOPT1	48	3.25	109.94	-	11928.0		
(unweighted)	BIPADOPT0	137	2.88	87.07	2475.0	-	-2.7130	.0067
WATERQUL	BIPADOPT1	48	3.25	113.54	-	12695.0		
(weighted)	BIPADOPT0	142	2.84	89.40	2542	-	-2.7794	.0054
LAWS	BIPADOPT1	49	2.14	76.87	-	3766.5		
(unweighted)	BIPADOPT0	133	2.65	96.89	2541.5	-	-2.3713	.0177
LAWS	BIPADOPT1	49	2.14	81.05	-	3971.5		
(weighted)	BIPADOPT0	136	2.60	97.31	2746.5	-	-1.9054	.0567
SEASON	BIPADOPT1	49	1.47	66.43	-	3255.0		
(unweighted)	BIPADOPT0	132	2.14	100.12	2030.0	-	-4.1362	.0000
SEASON	BIPADOPT1	49	1.47	69.35	-	3398.0		
(weighted)	BIPADOPT0	138	2.18	102.75	2173.0	-	-4.0090	.0001

Variable		N	Mean	Mean Rank	U	W	Z	2-tailed P
PLANTTIM	BIPADOPT1	49	1.61	75.73	-	3711.0		
(unweighted)	BIPADOPT0	129	2.05	94.73	2486.0	-	-2.3898	.0169
PLANTTIM	BIPADOPT1	49	1.61	79.35	-	3888.0		
(weighted)	BIPADOPT0	136	1.98	97.92	2663.0	-	-2.2691	.0233
SHAREBIP	BIPADOPT1	49	2.80	107.00	-	11047.0		
(unweighted)	BIPADOPT0	131	2.31	84.33	2401.0	-	-2.7575	.0058
SHAREBIP	BIPADOPT1	49	2.80	111.38	-	11747.5		
(weighted)	BIPADOPT0	136	2.26	86.38	2431.5	-	-2.9604	.0031
SHAREBIP[9]	BIPADOPT1	49	2.80	33.45	414.00	-		
(unweighted)	BIPADOPT0	19	3.05	37.21	-	1639.0	-.7610	.4467
SHAREBIP[9]	BIPADOPT1	49	2.80	33.99	440.5	-		
(weighted)	BIPADOPT0	20	3.04	37.47	-	1665.5	-.7185	.4724
SHAREOTH	BIPADOPT1	48	2.63	100.76	-	10388.5		
(unweighted)	BIPADOPT0	126	2.21	82.45	2387.5	-	-2.2862	.0222
SHAREOTH	BIPADOPT1	49	2.63	103.28	-	10973.5		
(weighted)	BIPADOPT0	130	2.14	84.41	2458.5	-	-2.3028	.0213
SHARETIM	BIPADOPT1	49	1.33	61.60	-	3018.5		
(unweighted)	BIPADOPT0	129	2.17	100.10	1793.5	-	-4.8226	.0000
SHARETIM	BIPADOPT1	49	1.33	63.54	-	3113.5		
(weighted)	BIPADOPT0	134	2.08	102.41	1888.5	-	-4.7571	.0000

9. The second unweighted and weighted U-Tests for SHAREBIP analyze means differences between Buffer Incentive Program adopters and only those non-adopters who are aware of the program and have unbuffered riparian land.

- - - - - - - - - - - S P E A R M A N C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - -

AGE	-.0043							
	N(87)							
	Sig .969							
ANIMACRE	.0286	-.0533						
	N(70)	N(100)						
	Sig .814	Sig .598						
AWAREYES	.	-.0894	.					
	N(87)	N(123)	N(102)					
	Sig .	Sig .326	Sig .					
AWMAIL	.2154	.0006	.0523	.				
	N(72)	N(92)	N(76)	N(94)				
	Sig .069	Sig .996	Sig .654	Sig .				
AWMEDIA	-.0540	.1241	.1584	.	.0167			
	N(72)	N(92)	N(76)	N(94)	N(94)			
	Sig .652	Sig .239	Sig .172	Sig .	Sig .873			
AWOTHER	.0296	-.1003	-.1079	.	-.2204	-.3488		
	N(72)	N(92)	N(76)	N(94)	N(94)	N(94)		
	Sig .805	Sig .341	Sig .354	Sig .	Sig .033	Sig .001		
AWPERMTG	.0839	-.0068	-.0062	.	-.0393	-.5022	-.3488	
	N(72)	N(92)	N(76)	N(94)	N(94)	N(94)	N(94)	
	Sig .483	Sig .948	Sig .958	Sig .	Sig .707	Sig .000	Sig .001	
AWPHONE	-.1876	-.0548	-.0839	.	-.0884	-.1398	-.0822	-.1398
	N(72)	N(92)	N(76)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .115	Sig .604	Sig .471	Sig .	Sig .397	Sig .179	Sig .431	Sig .179
	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG

(Coefficient / (Cases) / 2-tailed Significance)

" . " is printed if a coefficient cannot be computed

- - - - - - - - - - - S P E A R M A N C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - -

	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE
AWPUBMTG	.0467 N(72) Sig .697	-.0736 N(92) Sig .486	.0081 N(76) Sig .945	. N(94) Sig .	.0752 N(94) Sig .472	-.1435 N(94) Sig .168	-.1649 N(94) Sig .112	.0619 N(94) Sig .553	-.0661 N(94) Sig .527
BIPADOPT	.2893 N(87) Sig .007	.0074 N(123) Sig .936	-.0920 N(102) Sig .358	.0279 N(125) Sig .757	-.0802 N(94) Sig .442	-.1230 N(94) Sig .238	.2110 N(94) Sig .041	.0197 N(94) Sig .850	-.0626 N(94) Sig .549
BIPAWYES	.1644 N(86) Sig .130	.0417 N(120) Sig .651	-.0327 N(100) Sig .747	.0659 N(122) Sig .471	.0917 N(93) Sig .382	.0437 N(93) Sig .678	.0788 N(93) Sig .453	-.0195 N(93) Sig .853	-.1354 N(93) Sig .196
BUFFORES	-.0352 N(87) Sig .746	.0701 N(123) Sig .441	.0656 N(102) Sig .512	.0733 N(125) Sig .416	.0506 N(94) Sig .628	.0101 N(94) Sig .923	.1566 N(94) Sig .132	-.1251 N(94) Sig .230	-.1463 N(94) Sig .159
BUFGRASS	-.0066 N(87) Sig .952	-.0267 N(123) Sig .770	.0303 N(102) Sig .763	-.1177 N(125) Sig .191	-.0181 N(94) Sig .863	.0790 N(94) Sig .449	.0227 N(94) Sig .828	.0329 N(94) Sig .753	-.1335 N(94) Sig .199
CONTAES	-.0700 N(74) Sig .553	.1857 N(92) Sig .076	.0016 N(77) Sig .989	. N(94) Sig .	.1158 N(75) Sig .322	.0433 N(75) Sig .712	.1936 N(75) Sig .096	-.1507 N(75) Sig .197	. N(75) Sig .
CONTCES	.2154 N(74) Sig .065	-.0549 N(92) Sig .604	.2617 N(77) Sig .022	. N(94) Sig .	.0601 N(75) Sig .608	-.0862 N(75) Sig .462	.0789 N(75) Sig .501	.0010 N(75) Sig .993	. N(75) Sig .
CONTCFSA	-.0732 N(73) Sig .538	-.2654 N(91) Sig .011	.1440 N(76) Sig .215	. N(93) Sig .	-.0366 N(74) Sig .757	-.0037 N(74) Sig .975	-.0950 N(74) Sig .421	.0571 N(74) Sig .629	. N(74) Sig .

(Coefficient / (Cases) / 2-tailed Significance)

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	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE
CONTCHEM	.1017 N(74) Sig .389	-.1421 N(92) Sig .177	-.0980 N(77) Sig .397	. N(94) Sig .	.2232 N(75) Sig .054	-.0897 N(75) Sig .444	-.0429 N(75) Sig .715	.1277 N(75) Sig .275	. N(75) Sig .
CONTDNR	.3390 N(74) Sig .003	-.0742 N(92) Sig .482	-.0485 N(77) Sig .675	. N(94) Sig .	-.1671 N(75) Sig .152	-.1529 N(75) Sig .190	.3047 N(75) Sig .008	-.0160 N(75) Sig .892	. N(75) Sig .
CONTNEIG	.0426 N(74) Sig .718	-.0805 N(92) Sig .445	-.1719 N(77) Sig .135	. N(94) Sig .	-.1392 N(75) Sig .234	-.2063 N(75) Sig .076	.2303 N(75) Sig .047	.0787 N(75) Sig .502	. N(75) Sig .
CONTNONE	-.2987 N(74) Sig .010	.0461 N(92) Sig .663	-.0349 N(77) Sig .763	. N(94) Sig .	-.1537 N(75) Sig .188	.1842 N(75) Sig .114	.0679 N(75) Sig .563	-.2225 N(75) Sig .055	. N(75) Sig .
CONTNRCS	.0976 N(73) Sig .412	-.1599 N(91) Sig .130	-.0351 N(76) Sig .763	. N(93) Sig .	.1613 N(74) Sig .170	-.0527 N(74) Sig .656	-.1146 N(74) Sig .331	.1250 N(74) Sig .289	. N(74) Sig .
CONTOTHE	.1512 N(74) Sig .198	.1998 N(92) Sig .056	.1028 N(77) Sig .374	. N(94) Sig .	-.0745 N(75) Sig .525	.0905 N(75) Sig .440	-.1276 N(75) Sig .275	-.0544 N(75) Sig .643	. N(75) Sig .
CONTSOIL	-.1331 N(74) Sig .258	.0571 N(92) Sig .589	-.0708 N(77) Sig .541	. N(94) Sig .	.0708 N(75) Sig .546	-.1327 N(75) Sig .256	-.2151 N(75) Sig .064	.2701 N(75) Sig .019	. N(75) Sig .
DEER	.0716 N(85) Sig .515	.0304 N(88) Sig .778	.1846 N(71) Sig .123	. N(88) Sig .	.0166 N(73) Sig .889	.2489 N(73) Sig .034	-.0566 N(73) Sig .634	-.1193 N(73) Sig .315	-.2128 N(73) Sig .071

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EDUCATE	.2126	-.1213	.1409	.0993	.0641	.0615	-.0900	.1341	-.2110
	N(53)	N(79)	N(68)	N(81)	N(62)	N(62)	N(62)	N(62)	N(62)
	Sig .126	Sig .287	Sig .252	Sig .378	Sig .621	Sig .635	Sig .487	Sig .299	Sig .100
EROSION	.2650	-.0724	.0675	.	.0589	-.0746	.0727	.0866	-.2871
	N(87)	N(91)	N(74)	N(91)	N(76)	N(76)	N(76)	N(76)	N(76)
	Sig .013	Sig .495	Sig .568	Sig .	Sig .613	Sig .522	Sig .533	Sig .457	Sig .012
GRASS10	-.0486	-.3649	.1543	.	.2505	.1125	-.2925	.0739	.
	N(14)	N(16)	N(15)	N(16)	N(14)	N(14)	N(14)	N(14)	N(14)
	Sig .869	Sig .165	Sig .583	Sig .	Sig .388	Sig .702	Sig .310	Sig .802	Sig .
GRASS20	.2185	-.3477	.3704	.	.5941	.6642	-.5941	.3985	.
	N(7)	N(8)	N(7)	N(8)	N(6)	N(6)	N(6)	N(6)	N(6)
	Sig .638	Sig .399	Sig .413	Sig .	Sig .214	Sig .150	Sig .214	Sig .434	Sig .
GRASS30	.0000	-.4867	.5526	.	.7071	.8165	-.7071	.	.
	N(4)	N(5)	N(5)	N(5)	N(4)	N(4)	N(4)	N(4)	N(4)
	Sig1.000	Sig .406	Sig .334	Sig .	Sig .293	Sig .184	Sig .293	Sig .	Sig .
GRASSPER	.4472	-.6325	.1539	.	.2582	.	-.2582	.	.
	N(4)	N(5)	N(5)	N(5)	N(4)	N(4)	N(4)	N(4)	N(4)
	Sig .553	Sig .252	Sig .805	Sig .	Sig .742	Sig .	Sig .742	Sig .	Sig .
GROSFARM	-.1800	-.1773	.1058	.0792	.1372	.0904	-.1544	.0817	-.0928
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .095	Sig .050	Sig .290	Sig .380	Sig .187	Sig .386	Sig .137	Sig .434	Sig .373
HABITAT	.5364	.0374	.0464	.	.3701	.0327	.0067	-.0355	-.2316
	N(86)	N(88)	N(71)	N(88)	N(73)	N(73)	N(73)	N(73)	N(73)
	Sig .000	Sig .730	Sig .701	Sig .	Sig .001	Sig .783	Sig .955	Sig .766	Sig .049
	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE

(Coefficient / (Cases) / 2-tailed Significance)

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	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE
INCOMLOS	.0908	.1171	-.0197	.	-.0016	-.0719	-.0074	.0418	-.2009
	N(86)	N(90)	N(73)	N(90)	N(75)	N(75)	N(75)	N(75)	N(75)
	Sig .406	Sig .272	Sig .869	Sig .	Sig .989	Sig .540	Sig .950	Sig .722	Sig .084
LAWN	.3180	-.0125	.2124	.0344	.0242	-.0750	-.0304	.1723	-.0760
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .003	Sig .891	Sig .032	Sig .703	Sig .817	Sig .473	Sig .771	Sig .097	Sig .467
LAWS	.0501	.0111	.1535	.	-.0126	.1907	-.1850	.0684	-.2753
	N(85)	N(89)	N(73)	N(89)	N(74)	N(74)	N(74)	N(74)	N(74)
	Sig .649	Sig .918	Sig .195	Sig .	Sig .915	Sig .104	Sig .115	Sig .563	Sig .018
MOISTURE	-.0001	.1262	.0582	.	-.1334	.0715	.0021	.0471	-.1450
	N(86)	N(90)	N(73)	N(90)	N(75)	N(75)	N(75)	N(75)	N(75)
	Sig .999	Sig .236	Sig .625	Sig .	Sig .254	Sig .542	Sig .986	Sig .688	Sig .215
NETPFARM	-.3177	-.0747	.0760	.1034	.0496	.0986	-.1767	.0515	-.0750
	N(72)	N(104)	N(85)	N(106)	N(80)	N(80)	N(80)	N(80)	N(80)
	Sig .007	Sig .451	Sig .489	Sig .291	Sig .662	Sig .384	Sig .117	Sig .650	Sig .508
OTHERUSE	.	.	.	.	.	.	.	.	.
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
OWNACRES	-.1439	-.0753	.0824	-.0996	.0648	.0276	.1320	-.0860	.0011
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .183	Sig .408	Sig .411	Sig .269	Sig .535	Sig .792	Sig .205	Sig .410	Sig .991
PASTALL	-.1263	.0081	-.0897	-.1385	-.0805	-.1167	-.0474	.0276	.1464
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .244	Sig .929	Sig .370	Sig .123	Sig .441	Sig .263	Sig .650	Sig .791	Sig .159

(Coefficient / (Cases) / 2-tailed Significance)

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PASTPART	.1263	-.0081	.0897	.1385	.0805	.1167	.0474	-.0276	-.1464
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .244	Sig .929	Sig .370	Sig .123	Sig .441	Sig .263	Sig .650	Sig .791	Sig .159
PLANT91	.1283	-.0557	.1697	.0203	.1157	-.1256	-.0638	.2042	-.0301
	N(76)	N(111)	N(96)	N(113)	N(84)	N(84)	N(84)	N(84)	N(84)
	Sig .269	Sig .562	Sig .098	Sig .831	Sig .295	Sig .255	Sig .564	Sig .062	Sig .786
PLANTFOR	-.1166	.0300	-.1080	.0203	.0265	.0491	.0685	-.0552	-.0430
	N(76)	N(111)	N(96)	N(113)	N(84)	N(84)	N(84)	N(84)	N(84)
	Sig .316	Sig .754	Sig .295	Sig .831	Sig .811	Sig .658	Sig .536	Sig .618	Sig .698
PLANTGOV	.	.	-.0911	.0089	.2179	-.0883	-.0448	-.0839	-.0211
	N(76)	N(111)	N(96)	N(113)	N(84)	N(84)	N(84)	N(84)	N(84)
	Sig .	Sig .	Sig .377	Sig .925	Sig .046	Sig .424	Sig .686	Sig .448	Sig .849
PLANTGRA	.1342	-.0948	.1270	.0425	.0746	-.0568	-.1015	.1587	-.0897
	N(76)	N(111)	N(96)	N(113)	N(84)	N(84)	N(84)	N(84)	N(84)
	Sig .248	Sig .322	Sig .218	Sig .655	Sig .500	Sig .608	Sig .358	Sig .149	Sig .417
PLANTNAT	-.0253	-.0055	-.1087	-.1771	-.2349	-.0568	.3426	-.0989	-.0897
	N(75)	N(110)	N(95)	N(112)	N(84)	N(84)	N(84)	N(84)	N(84)
	Sig .829	Sig .954	Sig .294	Sig .062	Sig .032	Sig .608	Sig .001	Sig .371	Sig .417
PLANTNOR	-.0604	.0830	-.0095	.0970	.0291	.1245	-.1860	-.0669	.1708
	N(76)	N(111)	N(96)	N(113)	N(84)	N(84)	N(84)	N(84)	N(84)
	Sig .604	Sig .386	Sig .927	Sig .307	Sig .793	Sig .259	Sig .090	Sig .546	Sig .120
PLANTTIM	-.0012	-.1083	.1212	.	.2058	.1794	.0469	-.0994	-.2273
	N(83)	N(86)	N(69)	N(86)	N(71)	N(71)	N(71)	N(71)	N(71)
	Sig .991	Sig .321	Sig .321	Sig .	Sig .085	Sig .134	Sig .697	Sig .409	Sig .057
	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE

(Coefficient / (Cases) / 2-tailed Significance)

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	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE
RIPARYES	.	.	.	.	.	.	.	.	.
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWALL	.	.	.	. .	.	.	.	.	.
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWIDLE	-.0973	-.0440	.1255	.0081	-.0505	-.0799	.2290	-.0799	-.0188
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .370	Sig .629	Sig .209	Sig .929	Sig .629	Sig .444	Sig .026	Sig .444	Sig .857
ROWPART	.0510	-.1316	.1693	.0392	-.0179	-.0760	.1549	-.0760	.0719
	N(87)	N(123)	N(102)	N(125)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .639	Sig .147	Sig .089	Sig .664	Sig .864	Sig .466	Sig .136	Sig .466	Sig .491
SEASON	-.0640	-.0883	.2024	.	.1584	.2344	.0000	-.1653	-.2314
	N(83)	N(86)	N(70)	N(86)	N(72)	N(72)	N(72)	N(72)	N(72)
	Sig .566	Sig .419	Sig .093	Sig .	Sig .184	Sig .047	Sig1.000	Sig .165	Sig .050
SHAREBIP	.2437	.0650	-.0400	.	.0146	.2289	-.0598	-.0601	-.2826
	N(83)	N(86)	N(70)	N(86)	N(71)	N(71)	N(71)	N(71)	N(71)
	Sig .026	Sig .552	Sig .742	Sig .	Sig .904	Sig .055	Sig .620	Sig .619	Sig .017
SHAREOTH	.2156	-.1091	.0646	.	.1796	-.0089	.0191	.0525	-.2743
	N(80)	N(83)	N(68)	N(83)	N(69)	N(69)	N(69)	N(69)	N(69)
	Sig .055	Sig .326	Sig .601	Sig .	Sig .140	Sig .942	Sig .876	Sig .668	Sig .023
SHARETIM	.0955	-.1320	.1071	.	.0927	.0965	-.0758	.0216	-.2319
	N(82)	N(85)	N(70)	N(85)	N(70)	N(70)	N(70)	N(70)	N(70)
	Sig .394	Sig .229	Sig .377	Sig .	Sig .445	Sig .427	Sig .533	Sig .859	Sig .053

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STRMWIDE	.1843	-.1068	-.0705	.	.0133	-.1846	.1731	.1083	-.1106
	N(87)	N(121)	N(102)	N(123)	N(94)	N(94)	N(94)	N(94)	N(94)
	Sig .087	Sig .244	Sig .481	Sig .	Sig .899	Sig .075	Sig .095	Sig .299	Sig .289
TREES10	.1526	.0180	.0476	.	.3413	-.3573	.0682	.3118	.
	N(25)	N(29)	N(26)	N(29)	N(26)	N(26)	N(26)	N(26)	N(26)
	Sig .467	Sig .926	Sig .817	Sig .	Sig .088	Sig .073	Sig .741	Sig .121	Sig .
TREES20	.2200	-.2108	.4294	.	-.1037	-.6956	.1037	.6956	.
	N(6)	N(8)	N(7)	N(8)	N(6)	N(6)	N(6)	N(6)	N(6)
	Sig .675	Sig .616	Sig .336	Sig .	Sig .845	Sig .125	Sig .845	Sig .125	Sig .
TREES30	.5000	-.5000	.6325	.	.5000	.	-.5000	.	.
	N(3)	N(4)	N(4)	N(4)	N(3)	N(3)	N(3)	N(3)	N(3)
	Sig .667	Sig .500	Sig .368	Sig .	Sig .667	Sig .	Sig .667	Sig .	Sig .
TREESPER	.4472	-.6325	.1539	.	.2582	.	-.2582	.	.
	N(4)	N(5)	N(5)	N(5)	N(4)	N(4)	N(4)	N(4)	N(4)
	Sig .553	Sig .252	Sig .805	Sig .	Sig .742	Sig .	Sig .742	Sig .	Sig .
WATERQUL	.3068	-.0259	.0369	.	-.1263	.1001	.1271	-.0461	-.3322
	N(87)	N(91)	N(74)	N(91)	N(76)	N(76)	N(76)	N(76)	N(76)
	Sig .004	Sig .807	Sig .755	Sig .	Sig .277	Sig .390	Sig .274	Sig .693	Sig .003
YRSFARM	-.2380	.5459	.0418	-.1238	-.1459	.0192	-.0159	.0547	-.0342
	N(80)	N(109)	N(90)	N(111)	N(86)	N(86)	N(86)	N(86)	N(86)
	Sig .033	Sig .000	Sig .696	Sig .196	Sig .180	Sig .861	Sig .885	Sig .617	Sig .754
YRSMANAG	-.0681	.3968	-.0874	-.1815	-.0027	-.0649	-.0141	-.0389	.1180
	N(50)	N(78)	N(66)	N(79)	N(59)	N(59)	N(59)	N(59)	N(59)
	Sig .638	Sig .000	Sig .485	Sig .109	Sig .984	Sig .625	Sig .916	Sig .770	Sig .373
	AESTHETC	AGE	ANIMACRE	AWAREYES	AWMAIL	AWMEDIA	AWOTHER	AWPERMTG	AWPHONE

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BIPADOPT	-.1256							
	N(94)							
	Sig .228							
BIPAWYES	-.2020	.4345						
	N(93)	N(122)						
	Sig .052	Sig .000						
BUFFORES	.0454	-.2536	-.0892					
	N(94)	N(125)	N(122)					
	Sig .664	Sig .004	Sig .329					
BUFGRASS	-.1291	-.2370	-.0533	.0880				
	N(94)	N(125)	N(122)	N(125)				
	Sig .215	Sig .008	Sig .560	Sig .329				
CONTAES	-.0611	-.0661	.1036	.1250	-.0067			
	N(75)	N(94)	N(92)	N(94)	N(94)			
	Sig .602	Sig .527	Sig .326	Sig .230	Sig .949			
CONTCES	.1948	-.0500	-.1334	.1024	-.0364	.1026		
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)		
	Sig .094	Sig .632	Sig .205	Sig .326	Sig .728	Sig .325		
CONTCFSA	.3067	-.1794	.0735	.1035	-.0220	.0646	.1165	
	N(74)	N(93)	N(91)	N(93)	N(93)	N(93)	N(93)	
	Sig .008	Sig .085	Sig .489	Sig .324	Sig .834	Sig .538	Sig .266	
CONTCHEM	.3148	-.0377	-.0840	-.0745	-.0763	-.0188	.2588	-.0511
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)	N(94)	N(93)
	Sig .006	Sig .718	Sig .426	Sig .475	Sig .465	Sig .857	Sig .012	Sig .627
	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA

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	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA	CONTCHEM
CONTDNR	-.1185	.4439	.1858	-.0812	-.0121	-.0591	.0791	-.0683	-.0337
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)	N(94)	N(93)	N(94)
	Sig .311	Sig .000	Sig .076	Sig .437	Sig .908	Sig .572	Sig .449	Sig .515	Sig .747
CONTNEIG	-.0987	.0612	-.0940	.0298	.0243	-.0430	-.0950	-.1168	-.0246
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)	N(94)	N(93)	N(94)
	Sig .400	Sig .558	Sig .373	Sig .776	Sig .816	Sig .680	Sig .363	Sig .265	Sig .814
CONTNONE	-.1208	-.2132	-.1213	-.0088	-.0218	-.1063	-.2346	-.2889	-.0607
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)	N(94)	N(93)	N(94)
	Sig .302	Sig .039	Sig .249	Sig .933	Sig .835	Sig .308	Sig .023	Sig .005	Sig .561
CONTNRCS	.0781	.0411	.1676	-.1205	-.0243	-.0986	.0048	.0609	.1930
	N(74)	N(93)	N(91)	N(93)	N(93)	N(93)	N(93)	N(93)	N(93)
	Sig .508	Sig .696	Sig .112	Sig .250	Sig .817	Sig .347	Sig .964	Sig .562	Sig .064
CONTOTHE	.1382	.2448	.1478	-.0582	-.1445	-.0554	-.1222	.0438	-.0316
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)	N(94)	N(93)	N(94)
	Sig .237	Sig .017	Sig .160	Sig .577	Sig .165	Sig .596	Sig .241	Sig .677	Sig .762
CONTSOIL	-.1208	-.2191	-.0392	.2281	.2130	.1647	-.1017	.0843	-.0624
	N(75)	N(94)	N(92)	N(94)	N(94)	N(94)	N(94)	N(93)	N(94)
	Sig .302	Sig .034	Sig .711	Sig .027	Sig .039	Sig .113	Sig .330	Sig .422	Sig .550
DEER	.1681	-.0799	-.0054	.1853	-.2349	.1959	.2252	.0591	.0844
	N(73)	N(88)	N(87)	N(88)	N(88)	N(75)	N(75)	N(74)	N(75)
	Sig .155	Sig .459	Sig .960	Sig .084	Sig .028	Sig .092	Sig .052	Sig .617	Sig .472
EDUCATE	-.2092	.3033	.1536	-.0357	-.3622	.1990	.0137	-.2485	-.0296
	N(62)	N(81)	N(79)	N(81)	N(81)	N(57)	N(57)	N(56)	N(57)
	Sig .103	Sig .006	Sig .176	Sig .752	Sig .001	Sig .138	Sig .919	Sig .065	Sig .827

(Coefficient / (Cases) / 2-tailed Significance)

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EROSION	.1173	.1417	.0897	.1255	.1945	.0032	-.0085	.0801	-.0518
	N(76)	N(91)	N(90)	N(91)	N(91)	N(78)	N(78)	N(77)	N(78)
	Sig .313	Sig .180	Sig .401	Sig .236	Sig .065	Sig .978	Sig .941	Sig .489	Sig .652
GRASS10	-.1635	-.4389	.0857	-.1558	.3657	-.1463	-.1799	-.1089	-.1463
	N(14)	N(16)	N(16)	N(16)	N(16)	N(16)	N(16)	N(16)	N(16)
	Sig .577	Sig .089	Sig .752	Sig .564	Sig .164	Sig .589	Sig .505	Sig .688	Sig .589
GRASS20	-.2657	-.5808	.3293	-.0549	.6802	-.3319	-.5101	-.5070	.
	N(6)	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)
	Sig .611	Sig .131	Sig .426	Sig .897	Sig .063	Sig .422	Sig .196	Sig .200	Sig .
GRASS30	.0000	-.7255	.2962	-.1814	.7404	-.1814	-.2962	-.2962	.
	N(4)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)
	Sig1.000	Sig .165	Sig .628	Sig .770	Sig .152	Sig .770	Sig .628	Sig .628	Sig .
GRASSPER	.2582	-.7071	.2887	. .0000	.5774	-.3536	-.2887	-.2887	.
	N(4)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)
	Sig .742	Sig .182	Sig .638	Sig1.000	Sig .308	Sig .559	Sig .638	Sig .638	Sig .
GROSFARM	.0320	-.2603	.1075	-.0188	-.0510	-.1163	.0969	.2584	.0195
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .760	Sig .003	Sig .239	Sig .835	Sig .572	Sig .264	Sig .353	Sig .012	Sig .852
HABITAT	.1396	.3533	.3128	.0327	.0010	.1190	.1775	.0000	.1016
	N(73)	N(88)	N(87)	N(88)	N(88)	N(75)	N(75)	N(74)	N(75)
	Sig .239	Sig .001	Sig .003	Sig .762	Sig .992	Sig .309	Sig .128	Sig1.000	Sig .386
INCOMLOS	.3069	-.2779	-.2157	.3330	.1546	-.0143	.1380	.0259	-.1220
	N(75)	N(90)	N(89)	N(90)	N(90)	N(77)	N(77)	N(76)	N(77)
	Sig .007	Sig .008	Sig .042	Sig .001	Sig .146	Sig .902	Sig .231	Sig .824	Sig .290
	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA	CONTCHEM

(Coefficient / (Cases) / 2-tailed Significance)

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	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA	CONTCHEM
LAWN	.2195	-.0345	-.0260	.0293	.0056	.0940	.4383	.0982	.2479
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .034	Sig .703	Sig .776	Sig .745	Sig .951	Sig .367	Sig .000	Sig .349	Sig .016
LAWS	.0604	-.0865	.1763	.0406	.1368	.1747	.0342	.1776	.0137
	N(74)	N(89)	N(88)	N(89)	N(89)	N(76)	N(76)	N(75)	N(76)
	Sig .609	Sig .420	Sig .100	Sig .706	Sig .201	Sig .131	Sig .769	Sig .128	Sig .907
MOISTURE	.0078	-.1677	-.1077	.3327	.1395	.1347	.0640	.0669	-.0757
	N(75)	N(90)	N(89)	N(90)	N(90)	N(77)	N(77)	N(76)	N(77)
	Sig .947	Sig .114	Sig .315	Sig .001	Sig .190	Sig .243	Sig .580	Sig .566	Sig .513
NETPFARM	.2273	-.4461	-.0893	.1464	.0727	-.1215	.0078	.2560	-.0517
	N(80)	N(106)	N(103)	N(106)	N(106)	N(80)	N(80)	N(79)	N(80)
	Sig .043	Sig .000	Sig .370	Sig .134	Sig .459	Sig .283	Sig .945	Sig .023	Sig .649
OTHERUSE	.	.	.	.	.	.	.	.	.
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
OWNACRES	.0146	-.2610	.0125	.0880	.0956	-.0368	.1596	.1582	.1242
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .889	Sig .003	Sig .891	Sig .329	Sig .289	Sig .725	Sig .124	Sig .130	Sig .233
PASTALL	-.0200	.2316	.0849	-.4937	-.4221	.0098	-.1342	-.0249	-.0693
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .848	Sig .009	Sig .352	Sig .000	Sig .000	Sig .926	Sig .197	Sig .813	Sig .507
PASTPART	.0200	-.2316	-.0849	.4937	.4221	-.0098	.1342	.0249	.0693
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .848	Sig .009	Sig .352	Sig .000	Sig .000	Sig .926	Sig .197	Sig .813	Sig .507

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PLANT91	-.0606	.	-.0126	.1591	-.0031	-.0490	-.1041	-.0120	-.0280
	N(84)	N(113)	N(111)	N(113)	N(113)	N(83)	N(83)	N(82)	N(83)
	Sig .584	Sig .	Sig .895	Sig .092	Sig .974	Sig .660	Sig .349	Sig .915	Sig .802
PLANTFOR	-.0868	.	.1553	.1591	-.1783	-.0436	-.0925	-.1201	-.0248
	N(84)	N(113)	N(111)	N(113)	N(113)	N(83)	N(83)	N(82)	N(83)
	Sig .432	Sig .	Sig .104	Sig .092	Sig .059	Sig .696	Sig .406	Sig .283	Sig .824
PLANTGOV	-.0426	.	-.0594	-.0827	-.0783	-.0214	-.0454	-.0589	-.0122
	N(84)	N(113)	N(111)	N(113)	N(113)	N(83)	N(83)	N(82)	N(83)
	Sig .700	Sig .	Sig .536	Sig .384	Sig .410	Sig .848	Sig .684	Sig .599	Sig .913
PLANTGRA	-.0888	.	.1436	-.0114	.4944	-.1019	-.0501	-.1389	-.0581
	N(84)	N(113)	N(111)	N(113)	N(113)	N(83)	N(83)	N(82)	N(83)
	Sig .422	Sig .	Sig .133	Sig .905	Sig .000	Sig .359	Sig .653	Sig .213	Sig .602
PLANTNAT	.0033	.	-.0986	.3917	.3042	.1394	.0754	.2835	-.0390
	N(84)	N(112)	N(110)	N(112)	N(112)	N(82)	N(82)	N(81)	N(82)
	Sig .976	Sig .	Sig .305	Sig .000	Sig .001	Sig .212	Sig .501	Sig .010	Sig .728
PLANTNOR	.1312	.	-.0771	-.4341	-.5265	.0438	.0930	.0072	.0990
	N(84)	N(113)	N(111)	N(113)	N(113)	N(83)	N(83)	N(82)	N(83)
	Sig .234	Sig .	Sig .421	Sig .000	Sig .000	Sig .694	Sig .403	Sig .949	Sig .373
PLANTTIM	.2421	-.2829	.0472	.2310	.0204	-.0327	-.0092	.3268	.0853
	N(71)	N(86)	N(85)	N(86)	N(86)	N(73)	N(73)	N(72)	N(73)
	Sig .042	Sig .008	Sig .668	Sig .032	Sig .852	Sig .783	Sig .938	Sig .005	Sig .473
RIPARYES	.	.	.	.	.	.	.	.	.
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA	CONTCHEM

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	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA	CONTCHEM
ROWALL	.	.	.	.	.	.	.	.	.
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWIDLE	-.0377	-.0279	-.0659	.1100	.1177	.	.	.	.
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .718	Sig .757	Sig .471	Sig .222	Sig .191	Sig .	Sig .	Sig .	Sig .
ROWPART	.0009	.0955	-.0257	.1336	.1647	-.0695	.0314	-.1074	-.0397
	N(94)	N(125)	N(122)	N(125)	N(125)	N(94)	N(94)	N(93)	N(94)
	Sig .993	Sig .289	Sig .778	Sig .137	Sig .066	Sig .506	Sig .764	Sig .306	Sig .704
SEASON	.2898	-.2756	.0462	.3338	.0249	.0309	.0469	.3490	.0820
	N(72)	N(86)	N(85)	N(86)	N(86)	N(73)	N(73)	N(72)	N(73)
	Sig .014	Sig .010	Sig .674	Sig .002	Sig .820	Sig .795	Sig .694	Sig .003	Sig .490
SHAREBIP	.0541	.0052	.1528	.1086	-.1226	.0588	.0200	.1100	.0335
	N(71)	N(86)	N(85)	N(86)	N(86)	N(73)	N(73)	N(72)	N(73)
	Sig .654	Sig .962	Sig .163	Sig .320	Sig .261	Sig .621	Sig .866	Sig .358	Sig .779
SHAREOTH	.1116	-.0397	.1696	.2219	-.0956	.0640	.1547	.2549	.0449
	N(69)	N(83)	N(82)	N(83)	N(83)	N(70)	N(70)	N(69)	N(70)
	Sig .361	Sig .722	Sig .128	Sig .044	Sig .390	Sig .598	Sig .201	Sig .035	Sig .712
SHARETIM	.2179	-.3555	.0657	.2166	-.1424	-.0564	.2061	.3303	.0692
	N(70)	N(85)	N(84)	N(85)	N(85)	N(72)	N(72)	N(71)	N(72)
	Sig .070	Sig .001	Sig .553	Sig .046	Sig .194	Sig .638	Sig .082	Sig .005	Sig .563
STRMWIDE	-.0868	.2738	.1050	.0532	.1173	.0420	.1013	.0317	-.0648
	N(94)	N(123)	N(121)	N(123)	N(123)	N(94)	N(94)	N(93)	N(94)
	Sig .405	Sig .002	Sig .252	Sig .559	Sig .196	Sig .688	Sig .331	Sig .763	Sig .535

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TREES10	-.0839	.	.0243	.0325	.0904	-.1163	.0531	-.1774	-.1163
	N(26)	N(29)	N(29)	N(29)	N(29)	N(26)	N(26)	N(26)	N(26)
	Sig .684	Sig .	Sig .900	Sig .867	Sig .641	Sig .571	Sig .797	Sig .386	Sig .571
TREES20	-.1391	-.0845	.5196	.4041	.1291	-.0845	-.1291	-.1291	.
	N(6)	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)
	Sig .793	Sig .842	Sig .187	Sig .321	Sig .761	Sig .842	Sig .761	Sig .761	Sig .
TREES30	.5000	-.8165	.0000	.0000	.7071	.0000	.0000	.0000	.
	N(3)	N(4)	N(4)	N(4)	N(4)	N(4)	N(4)	N(4)	N(4)
	Sig .667	Sig .184	Sig1.000	Sig1.000	Sig .293	Sig1.000	Sig1.000	Sig1.000	Sig .
TREESPER	.2582	-.7071	.2887	.0000	.5774	-.3536	-.2887	-.2887	.
	N(4)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)
	Sig .742	Sig .182	Sig .638	Sig1.000	Sig .308	Sig .559	Sig .638	Sig .638	Sig .
WATERQUL	.1095	.2377	.2004	-.0543	.1653	.1062	.0566	.1386	-.0605
	N(76)	N(91)	N(90)	N(91)	N(91)	N(78)	N(78)	N(77)	N(78)
	Sig .346	Sig .023	Sig .058	Sig .609	Sig .117	Sig .355	Sig .623	Sig .229	Sig .599
YRSFARM	.1456	-.3635	-.1671	.1165	.1299	.0291	-.0558	.0585	-.0665
	N(86)	N(111)	N(108)	N(111)	N(111)	N(89)	N(89)	N(88)	N(89)
	Sig .181	Sig .000	Sig .084	Sig .223	Sig .174	Sig .786	Sig .603	Sig .588	Sig .536
YRSMANAG	.2657	-.3604	-.1221	.2609	.0242	.	.1190	-.0680	.0626
	N(59)	N(79)	N(76)	N(79)	N(79)	N(56)	N(56)	N(55)	N(56)
	Sig .042	Sig .001	Sig .293	Sig .020	Sig .832	Sig .	Sig .383	Sig .622	Sig .646
	AWPUBMTG	BIPADOPT	BIPAWYES	BUFFORES	BUFGRASS	CONTAES	CONTCES	CONTCFSA	CONTCHEM
CONTNEIG	.0840								
	N(94)								
	Sig .421								
	CONTDNR								

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	CONTDNR	CONTNEIG	CONTNONE	CONTNRCS	CONTOTHE	CONTSOIL	DEER	EDUCATE	EROSION
CONTNONE	-.1905 N(94) Sig .066	-.1388 N(94) Sig .182							
CONTNRCS	-.1768 N(93) Sig .090	-.1287 N(93) Sig .219	-.3185 N(93) Sig .002						
CONTOTHE	-.0992 N(94) Sig .341	-.0723 N(94) Sig .489	-.1786 N(94) Sig .085	-.1657 N(93) Sig .112					
CONTSOIL	.0496 N(94) Sig .635	-.0354 N(94) Sig .735	-.2972 N(94) Sig .004	-.1422 N(93) Sig .174	-.0110 N(94) Sig .916				
DEER	-.0737 N(75) Sig .530	-.1345 N(75) Sig .250	.0846 N(75) Sig .470	-.2228 N(74) Sig .056	.0637 N(75) Sig .587	-.0728 N(75) Sig .535			
EDUCATE	.0549 N(57) Sig .685	-.0514 N(57) Sig .704	-.0176 N(57) Sig .897	-.0711 N(56) Sig .603	.0440 N(57) Sig .745	-.1666 N(57) Sig .216	.0586 N(52) Sig .680		
EROSION	.0852 N(78) Sig .458	.1165 N(78) Sig .310	-.2290 N(78) Sig .044	.0461 N(77) Sig .690	.0961 N(78) Sig .403	-.1155 N(78) Sig .314	.0885 N(88) Sig .412	.2751 N(54) Sig .044	
GRASS10	. N(16) Sig .	. N(16) Sig .	.4278 N(16) Sig .098	-.2926 N(16) Sig .271	. N(16) Sig .	.1270 N(16) Sig .639	.2617 N(14) Sig .366	-.1822 N(10) Sig .614	.2634 N(14) Sig .363

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	CONTDNR	CONTNEIG	CONTNONE	CONTNRCS	CONTOTHE	CONTSOIL	DEER	EDUCATE	EROSION
GRASS20	.	.	.3802	.0000	.	.2489	.0000	-.6325	.6742
	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)	N(7)	N(4)	N(7)
	Sig .	Sig .	Sig .353	Sig1.000	Sig .	Sig .552	Sig1.000	Sig .368	Sig .097
GRASS30	.	.	.3627	.0000	.	.	.0000	.	.5000
	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(4)	N(1)	N(4)
	Sig .	Sig .	Sig .548	Sig1.000	Sig .	Sig .	Sig1.000	Sig .	Sig .500
GRASSPER	.	.	.3536	.0000	.	.	1.0000	.	.2108
	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(4)	N(2)	N(4)
	Sig .	Sig .	Sig .559	Sig1.000	Sig .	Sig .	Sig .000	Sig .	Sig .789
GROSFARM	-.2233	-.1187	-.0689	.0998	-.0761	.2158	.0956	.0145	.1179
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .030	Sig .254	Sig .509	Sig .341	Sig .466	Sig .037	Sig .376	Sig .898	Sig .266
HABITAT	.3044	.0623	-.3808	.1017	.1888	-.1749	.1942	.3192	.3295
	N(75)	N(75)	N(75)	N(74)	N(75)	N(75)	N(86)	N(52)	N(88)
	Sig .008	Sig .595	Sig .001	Sig .389	Sig .105	Sig .134	Sig .073	Sig .021	Sig .002
INCOMLOS	-.2188	.0125	.0290	-.0022	.0161	-.0132	.1727	-.1135	.1865
	N(77)	N(77)	N(77)	N(76)	N(77)	N(77)	N(88)	N(53)	N(90)
	Sig .056	Sig .914	Sig .803	Sig .985	Sig .889	Sig .909	Sig .108	Sig .419	Sig .078
LAWN	-.0346	-.0992	-.1079	.2761	-.0205	-.0489	.1038	.0895	.0783
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .741	Sig .342	Sig .301	Sig .007	Sig .844	Sig .640	Sig .336	Sig .427	Sig .460
LAWS	-.1435	-.0655	-.0914	.0700	.0874	.0227	.1518	-.0955	.1263
	N(76)	N(76)	N(76)	N(75)	N(76)	N(76)	N(86)	N(52)	N(89)
	Sig .216	Sig .574	Sig .432	Sig .550	Sig .453	Sig .845	Sig .163	Sig .501	Sig .238

(Coefficient / (Cases) / 2-tailed Significance)

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- - - - - - - - - - - S P E A R M A N C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - -

	CONTDNR	CONTNEIG	CONTNONE	CONTNRCS	CONTOTHE	CONTSOIL	DEER	EDUCATE	EROSION
MOISTURE	-.1918	.0637	.0289	.0851	.1369	.0802	.1819	-.1493	.2013
	N(77)	N(77)	N(77)	N(76)	N(77)	N(77)	N(88)	N(53)	N(90)
	Sig .095	Sig .582	Sig .803	Sig .465	Sig .235	Sig .488	Sig .090	Sig .286	Sig .057
NETPFARM	-.3562	-.0499	.0922	.0441	-.1072	.1730	.1060	-.2783	.0704
	N(80)	N(80)	N(80)	N(79)	N(80)	N(80)	N(74)	N(71)	N(76)
	Sig .001	Sig .660	Sig .416	Sig .699	Sig .344	Sig .125	Sig .369	Sig .019	Sig .546
OTHERUSE	.	.	.	.	.	.	.	.	.
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
OWNACRES	-.1672	-.0323	-.1124	.0915	-.1384	.0488	.0750	-.0137	-.0418
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .107	Sig .757	Sig .281	Sig .383	Sig .183	Sig .640	Sig .487	Sig .903	Sig .694
PASTALL	.0175	-.1583	.1371	-.0741	.0439	-.1414	-.0331	.1518	-.2083
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .867	Sig .127	Sig .188	Sig .480	Sig .674	Sig .174	Sig .759	Sig .176	Sig .048
PASTPART	-.0175	.1583	-.1371	.0741	-.0439	.1414	.0331	-.1518	.2083
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .867	Sig .127	Sig .188	Sig .480	Sig .674	Sig .174	Sig .759	Sig .176	Sig .048
PLANT91	.1795	-.0570	-.1615	-.0120	-.0641	.1649	.0027	.2024	.1254
	N(83)	N(83)	N(83)	N(82)	N(83)	N(83)	N(77)	N(70)	N(80)
	Sig .105	Sig .609	Sig .145	Sig .915	Sig .565	Sig .136	Sig .981	Sig .093	Sig .268
PLANTFOR	-.0506	-.0506	.1046	.1535	-.0570	-.1477	-.0596	-.0215	.0305
	N(83)	N(83)	N(83)	N(82)	N(83)	N(83)	N(77)	N(70)	N(80)
	Sig .649	Sig .649	Sig .346	Sig .169	Sig .609	Sig .183	Sig .606	Sig .860	Sig .788

(Coefficient / (Cases) / 2-tailed Significance)

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	CONTDNR	CONTNEIG	CONTNONE	CONTNRCS	CONTOTHE	CONTSOIL	DEER	EDUCATE	EROSION
PLANTGOV	-.0248	-.0248	-.0704	.2095	-.0280	-.0725	.	.1409	.
	N(83)	N(83)	N(83)	N(82)	N(83)	N(83)	N(77)	N(70)	N(80)
	Sig .824	Sig .824	Sig .527	Sig .059	Sig .802	Sig .515	Sig .	Sig .245	Sig .
PLANTGRA	.1546	.1546	-.1422	-.0677	-.0104	.2280	-.3016	.0978	.2725
	N(83)	N(83)	N(83)	N(82)	N(83)	N(83)	N(77)	N(70)	N(80)
	Sig .163	Sig .163	Sig .200	Sig .546	Sig .926	Sig .038	Sig .008	Sig .420	Sig .014
PLANTNAT	.1394	-.0795	.0314	-.0945	-.0895	.0217	-.0358	-.1661	.0174
	N(82)	N(82)	N(82)	N(81)	N(82)	N(82)	N(76)	N(69)	N(79)
	Sig .212	Sig .478	Sig .780	Sig .401	Sig .424	Sig .847	Sig .759	Sig .173	Sig .879
PLANTNOR	-.2509	-.0245	.1443	.0072	.1252	-.2037	.2875	-.0303	-.2755
	N(83)	N(83)	N(83)	N(82)	N(83)	N(83)	N(77)	N(70)	N(80)
	Sig .022	Sig .826	Sig .193	Sig .949	Sig .259	Sig .065	Sig .011	Sig .803	Sig .013
PLANTTIM	-.1058	-.0947	-.0436	-.0268	.0142	.1350	.1678	-.2156	.1051
	N(73)	N(73)	N(73)	N(72)	N(73)	N(73)	N(85)	N(50)	N(86)
	Sig .373	Sig .426	Sig .714	Sig .823	Sig .905	Sig .255	Sig .125	Sig .133	Sig .335
RIPARYES	.	.	.	.	.	.	.	.	.
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWALL	.	.	.	.	.	.	.	.	.
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWIDLE	.	.	.	.	.	.	-.1114	.	-.0212
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .302	Sig .	Sig .842

(Coefficient / (Cases) / 2-tailed Significance)

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	CONTDNR	CONTNEIG	CONTNONE	CONTNRCS	CONTOTHE	CONTSOIL	DEER	EDUCATE	EROSION
ROWPART	.3089	.0514	-.0778	.0223	-.0024	.2026	-.0361	-.0453	.0292
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(81)	N(91)
	Sig .002	Sig .623	Sig .456	Sig .832	Sig .981	Sig .050	Sig .738	Sig .688	Sig .784
SEASON	-.3348	-.1510	-.0660	.2132	.0879	.0865	.2102	-.1620	.0177
	N(73)	N(73)	N(73)	N(72)	N(73)	N(73)	N(85)	N(52)	N(86)
	Sig .004	Sig .202	Sig .579	Sig .072	Sig .460	Sig .467	Sig .054	Sig .251	Sig .871
SHAREBIP	-.0876	-.0326	.0516	.0404	.0745	-.1119	.3408	.1324	.1782
	N(73)	N(73)	N(73)	N(72)	N(73)	N(73)	N(85)	N(51)	N(86)
	Sig .461	Sig .784	Sig .665	Sig .736	Sig .531	Sig .346	Sig .001	Sig .354	Sig .101
SHAREOTH	-.1443	-.0148	-.1464	-.0638	.2133	-.0425	.2621	.4599	.3861
	N(70)	N(70)	N(70)	N(69)	N(70)	N(70)	N(82)	N(49)	N(83)
	Sig .233	Sig .903	Sig .226	Sig .602	Sig .076	Sig .727	Sig .017	Sig .001	Sig .000
SHARETIM	-.3442	.0369	.0260	.0687	-.0440	-.0879	.1725	.0837	.1683
	N(72)	N(72)	N(72)	N(71)	N(72)	N(72)	N(84)	N(50)	N(85)
	Sig .003	Sig .758	Sig .829	Sig .569	Sig .714	Sig .463	Sig .117	Sig .563	Sig .124
STRMWIDE	.1975	.1832	-.2129	.0779	-.0071	-.2251	-.1132	.1134	.1157
	N(94)	N(94)	N(94)	N(93)	N(94)	N(94)	N(88)	N(80)	N(91)
	Sig .056	Sig .077	Sig .039	Sig .458	Sig .946	Sig .029	Sig .294	Sig .316	Sig .275
TREES10	-.3635	.2327	-.0823	.0063	-.1163	.4618	-.0772	-.0778	-.0242
	N(26)	N(26)	N(26)	N(26)	N(26)	N(26)	N(26)	N(19)	N(27)
	Sig .068	Sig .253	Sig .689	Sig .976	Sig .571	Sig .018	Sig .708	Sig .752	Sig .905
TREES20	-.4226	.	.2535	-.0577	.	.4226	.6796	.0000	.3721
	N(8)	N(8)	N(8)	N(8)	N(8)	N(8)	N(7)	N(5)	N(7)
	Sig .297	Sig .	Sig .545	Sig .892	Sig .	Sig .297	Sig .093	Sig1.000	Sig .411

(Coefficient / (Cases) / 2-tailed Significance)

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TREES30	.	.	.	.0000	.	.	.8660	.	.0000
	N(4)	N(4)	N(4)	N(4)	N(4)	N(4)	N(3)	N(1)	N(3)
	Sig .	Sig .	Sig .	Sig1.000	Sig .	Sig .	Sig .333	Sig .	Sig1.000
TREESPER	.	.	.3536	.0000	.	.	1.0000	.	.2108
	N(5)	N(5)	N(5)	N(5)	N(5)	N(5)	N(4)	N(2)	N(4)
	Sig .	Sig .	Sig .559	Sig1.000	Sig .	Sig .	Sig .000	Sig .	Sig .789
WATERQUL	.3064	-.0354	-.1674	.0155	-.0285	-.1226	.0905	.3014	.4187
	N(78)	N(78)	N(78)	N(77)	N(78)	N(78)	N(88)	N(54)	N(91)
	Sig .006	Sig .759	Sig .143	Sig .893	Sig .804	Sig .285	Sig .402	Sig .027	Sig .000
YRSFARM	-.3204	-.1284	.2422	-.0967	.0046	.1456	.0377	-.4823	-.1126
	N(89)	N(89)	N(89)	N(88)	N(89)	N(89)	N(81)	N(71)	N(84)
	Sig .002	Sig .230	Sig .022	Sig .370	Sig .966	Sig .173	Sig .738	Sig .000	Sig .308
YRSMANAG	-.2174	-.2211	.2840	.1035	-.1629	-.0051	.1530	-.2734	.0251
	N(56)	N(56)	N(56)	N(55)	N(56)	N(56)	N(50)	N(55)	N(51)
	Sig .108	Sig .102	Sig .034	Sig .452	Sig .230	Sig .970	Sig .289	Sig .043	Sig .861

	CONTDNR	CONTNEIG	CONTNONE	CONTNRCS	CONTOTHE	CONTSOIL	DEER	EDUCATE	EROSION
GRASS20	.9212								
	N(8)								
	Sig .001								
GRASS30	.9747	1.0000							
	N(5)	N(5)							
	Sig .005	Sig .000							
GRASSPER	.9747	.9747	.9487						
	N(5)	N(5)	N(4)						
	Sig .005	Sig .005	Sig .051						

	GRASS10	GRASS20	GRASS30

(Coefficient / (Cases) / 2-tailed Significance)

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	GRASS10	GRASS20	GRASS30	GRASSPER	GROSFARM	HABITAT	INCOMLOS	LAWN	LAWS
GROSFARM	.3160 N(16) Sig .233	.2051 N(8) Sig .626	-.0789 N(5) Sig .900	.0000 N(5) Sig1.000					
HABITAT	-.5275 N(13) Sig .064	-.6382 N(7) Sig .123	-.8165 N(4) Sig .184	-.7746 N(4) Sig .225	-.1225 N(88) Sig .256				
INCOMLOS	-.2662 N(14) Sig .358	-.1699 N(7) Sig .716	-1.0000 N(4) Sig .000	.3162 N(4) Sig .684	.1086 N(90) Sig .308	.1215 N(87) Sig .262			
LAWN	-.3271 N(16) Sig .216	-.3169 N(8) Sig .444	-.1814 N(5) Sig .770	-.3536 N(5) Sig .559	.0933 N(125) Sig .301	.0850 N(88) Sig .431	.0193 N(90) Sig .857		
LAWS	-.1341 N(14) Sig .648	.0858 N(7) Sig .855	.7071 N(4) Sig .293	.4472 N(4) Sig .553	.1812 N(89) Sig .089	.1241 N(86) Sig .255	.0740 N(88) Sig .493	.0432 N(89) Sig .688	
MOISTURE	.1238 N(14) Sig .673	-.1348 N(7) Sig .773	.0000 N(4) Sig1.000	.2108 N(4) Sig .789	-.0005 N(90) Sig .996	-.0178 N(87) Sig .870	.2643 N(90) Sig .012	.1153 N(90) Sig .279	.2706 N(88) Sig .011
NETPFARM	.4210 N(12) Sig .173	.6669 N(5) Sig .219	1.0000 N(3) Sig .000	-.5000 N(3) Sig .667	.7138 N(106) Sig .000	-.2214 N(73) Sig .060	.2173 N(76) Sig .059	.1215 N(106) Sig .215	.1680 N(74) Sig .152
OTHERUSE	. N(16) Sig .	. N(8) Sig .	. N(5) Sig .	. N(5) Sig .	. N(125) Sig .	. N(88) Sig .	. N(90) Sig .	. N(125) Sig .	. N(89) Sig .

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	GRASS10	GRASS20	GRASS30	GRASSPER	GROSFARM	HABITAT	INCOMLOS	LAWN	LAWS
OWNACRES	.0415 N(16) Sig .879	.0000 N(8) Sig1.000	-.4104 N(5) Sig .493	.0000 N(5) Sig1.000	.6481 N(125) Sig .000	-.0634 N(88) Sig .557	.1890 N(90) Sig .074	.0262 N(125) Sig .772	.0910 N(89) Sig .396
PASTALL	.0000 N(16) Sig1.000	-.6971 N(8) Sig .055	-.7404 N(5) Sig .152	-.5774 N(5) Sig .308	.0125 N(125) Sig .890	-.1253 N(88) Sig .245	-.1337 N(90) Sig .209	-.2484 N(125) Sig .005	.0097 N(89) Sig .928
PASTPART	.0000 N(16) Sig1.000	.6971 N(8) Sig .055	.7404 N(5) Sig .152	.5774 N(5) Sig .308	-.0125 N(125) Sig .890	.1253 N(88) Sig .245	.1337 N(90) Sig .209	.2484 N(125) Sig .005	-.0097 N(89) Sig .928
PLANT91	.5747 N(15) Sig .025	.6382 N(7) Sig .123	.8165 N(4) Sig .184	.7746 N(4) Sig .225	-.0265 N(113) Sig .780	.1320 N(77) Sig .253	.0831 N(79) Sig .466	-.0842 N(113) Sig .375	-.0845 N(78) Sig .462
PLANTFOR	. N(15) Sig .	. N(7) Sig .	. N(4) Sig .	. N(4) Sig .	.1285 N(113) Sig .175	-.0910 N(77) Sig .431	-.1515 N(79) Sig .183	-.0842 N(113) Sig .375	-.1553 N(78) Sig .175
PLANTGOV	. N(15) Sig .	. N(7) Sig .	. N(4) Sig .	. N(4) Sig .	-.0926 N(113) Sig .329	. N(77) Sig .	. N(79) Sig .	-.0370 N(113) Sig .697	. N(78) Sig .
PLANTGRA	.0204 N(15) Sig .943	.3191 N(7) Sig .485	.2722 N(4) Sig .728	.2582 N(4) Sig .742	.1668 N(113) Sig .077	.1945 N(77) Sig .090	.0251 N(79) Sig .826	-.1062 N(113) Sig .263	.2765 N(78) Sig .014
PLANTNAT	-.1221 N(15) Sig .665	-.5584 N(7) Sig .193	-.5443 N(4) Sig .456	-.7746 N(4) Sig .225	-.2661 N(112) Sig .005	.0920 N(76) Sig .429	.0469 N(78) Sig .683	.1040 N(112) Sig .275	-.0786 N(77) Sig .497

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	GRASS10	GRASS20	GRASS30	GRASSPER	GROSFARM	HABITAT	INCOMLOS	LAWN	LAWS
PLANTNOR	-.3100	-.5149	-.5443	-.2582	.0666	-.1911	.0129	.0679	-.0800
	N(15)	N(7)	N(4)	N(4)	N(113)	N(77)	N(79)	N(113)	N(78)
	Sig .261	Sig .237	Sig .456	Sig .742	Sig .483	Sig .096	Sig .910	Sig .475	Sig .487
PLANTTIM	-.1963	-.3032	-.5000	.8660	.3109	.0467	.3335	-.0957	.1171
	N(12)	N(6)	N(4)	N(3)	N(86)	N(84)	N(85)	N(86)	N(84)
	Sig .541	Sig .559	Sig .500	Sig .333	Sig .004	Sig .673	Sig .002	Sig .381	Sig .289
RIPARYES	.	.	.	.	.	.	.	.	.
	N(16)	N(8)	N(5)	N(5)	N(125)	N(88)	N(90)	N(125)	N(89)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWALL	.	.	.	.	.	.	.	.	.
	N(16)	N(8)	N(5)	N(5)	N(125)	N(88)	N(90)	N(125)	N(89)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWIDLE	.	.	.	.	-.1456	.0978	.0907	-.0344	.0238
	N(16)	N(8)	N(5)	N(5)	N(125)	N(88)	N(90)	N(125)	N(89)
	Sig .	Sig .	Sig .	Sig .	Sig .105	Sig .365	Sig .395	Sig .703	Sig .825
ROWPART	-.1927	.0830	.	.3536	.0751	.0773	.0182	.0287	-.1657
	N(16)	N(8)	N(5)	N(5)	N(125)	N(88)	N(90)	N(125)	N(89)
	Sig .475	Sig .845	Sig .	Sig .559	Sig .405	Sig .474	Sig .865	Sig .750	Sig .121
SEASON	-.5211	-.7151	-.8333	.2582	.2151	-.0142	.2585	-.0007	.2850
	N(14)	N(7)	N(4)	N(4)	N(86)	N(84)	N(86)	N(86)	N(84)
	Sig .056	Sig .071	Sig .167	Sig .742	Sig .047	Sig .898	Sig .016	Sig .995	Sig .009
SHAREBIP	-.1065	-.4720	-.8333	.3162	.1638	.0568	.1440	.1237	.1939
	N(14)	N(7)	N(4)	N(4)	N(86)	N(84)	N(85)	N(86)	N(85)
	Sig .717	Sig .285	Sig .167	Sig .684	Sig .132	Sig .608	Sig .188	Sig .257	Sig .075

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	GRASS10	GRASS20	GRASS30	GRASSPER	GROSFARM	HABITAT	INCOMLOS	LAWN	LAWS
SHAREOTH	-.0157	-.0804	.	.7746	.4085	.2588	.0679	.1835	.0111
	N(14)	N(7)	N(4)	N(4)	N(83)	N(81)	N(82)	N(83)	N(82)
	Sig .957	Sig .864	Sig .	Sig .225	Sig .000	Sig .020	Sig .545	Sig .097	Sig .921
SHARETIM	.2010	.1983	.7071	.9487	.4633	.0186	.1942	.0971	.3091
	N(14)	N(7)	N(4)	N(4)	N(85)	N(83)	N(84)	N(85)	N(84)
	Sig .491	Sig .670	Sig .293	Sig .051	Sig .000	Sig .867	Sig .077	Sig .376	Sig .004
STRMWIDE	-.2822	-.2274	-.1814	-.1118	-.1334	.1736	.0576	-.0669	.0147
	N(16)	N(8)	N(5)	N(5)	N(123)	N(88)	N(90)	N(123)	N(89)
	Sig .290	Sig .588	Sig .770	Sig .858	Sig .141	Sig .106	Sig .590	Sig .462	Sig .891
TREES10	.9359	.9856	.8660	1.0000	.3164	.0718	.0301	-.1596	.0142
	N(13)	N(6)	N(3)	N(4)	N(29)	N(25)	N(27)	N(29)	N(26)
	Sig .000	Sig .000	Sig .333	Sig .000	Sig .094	Sig .733	Sig .882	Sig .408	Sig .945
TREES20	.8933	.9549	.8165	.8944	-.0267	-.7184	-.0981	-.0845	.5524
	N(6)	N(6)	N(4)	N(5)	N(8)	N(6)	N(7)	N(8)	N(7)
	Sig .016	Sig .003	Sig .184	Sig .041	Sig .950	Sig .108	Sig .834	Sig .842	Sig .198
TREES30	.9487	1.0000	1.0000	.9487	-.5000	.	-1.0000	.0000	.5000
	N(4)	N(4)	N(4)	N(4)	N(4)	N(3)	N(3)	N(4)	N(3)
	Sig .051	Sig .000	Sig .000	Sig .051	Sig .500	Sig .	Sig .000	Sig1.000	Sig .667
TREESPER	.9747	.9747	.9487	1.0000	.0000	-.7746	.3162	-.3536	.4472
	N(5)	N(5)	N(4)	N(5)	N(5)	N(4)	N(4)	N(5)	N(4)
	Sig .005	Sig .005	Sig .051	Sig .000	Sig1.000	Sig .225	Sig .684	Sig .559	Sig .553
WATERQUL	-.1074	-.0728	.0000	-.2582	.1545	.2833	.0167	.1056	.3729
	N(14)	N(7)	N(4)	N(4)	N(91)	N(88)	N(90)	N(91)	N(89)
	Sig .715	Sig .877	Sig1.000	Sig .742	Sig .144	Sig .007	Sig .876	Sig .319	Sig .000

(Coefficient / (Cases) / 2-tailed Significance)

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- - - - - - - - - - - S P E A R M A N C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - -

YRSFARM	-.1517	-.4404	-.6489	-.8208	.1019	-.2240	.2761	-.0540	.1227
	N(15)	N(7)	N(5)	N(5)	N(111)	N(81)	N(83)	N(111)	N(82)
	Sig .589	Sig .323	Sig .236	Sig .089	Sig .287	Sig .044	Sig .012	Sig .574	Sig .272
YRSMANAG	.0036	.1026	.1054	.0000	.1257	-.0710	.5323	.0959	.0609
	N(12)	N(5)	N(4)	N(3)	N(79)	N(50)	N(51)	N(79)	N(50)
	Sig .991	Sig .870	Sig .895	Sig1.000	Sig .270	Sig .624	Sig .000	Sig .400	Sig .674
	GRASS10	GRASS20	GRASS30	GRASSPER	GROSFARM	HABITAT	INCOMLOS	LAWN	LAWS
NETPFARM	.2659								
	N(76)								
	Sig .020								
OTHERUSE	.	.							
	N(90)	N(106)							
	Sig .	Sig .							
OWNACRES	-.0122	.4394	.						
	N(90)	N(106)	N(125)						
	Sig .909	Sig .000	Sig .						
PASTALL	-.1847	-.0913	.	-.0665					
	N(90)	N(106)	N(125)	N(125)					
	Sig .081	Sig .352	Sig .	Sig .461					
PASTPART	.1847	.0913	.	.0665	-1.0000				
	N(90)	N(106)	N(125)	N(125)	N(125)				
	Sig .081	Sig .352	Sig .	Sig .461	Sig .000				
PLANT91	-.0796	-.0293	.	.0172	-.1294	.1294			
	N(79)	N(94)	N(113)	N(113)	N(113)	N(113)			
	Sig .485	Sig .779	Sig .	Sig .857	Sig .172	Sig .172			
	MOISTURE	NETPFARM	OTHERUSE	OWNACRES	PASTALL	PASTPART			

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PLANTFOR	.0230	.0725	.	.0475	-.1294	.1294	-.0463		
	N(79)	N(94)	N(113)	N(113)	N(113)	N(113)	N(113)		
	Sig .840	Sig .487	Sig .	Sig .617	Sig .172	Sig .172	Sig .626		
PLANTGOV	.	-.1318	.	-.0724	.1572	-.1572	-.0203	-.0203	
	N(79)	N(94)	N(113)	N(113)	N(113)	N(113)	N(113)	N(113)	
	Sig .	Sig .205	Sig .	Sig .446	Sig .096	Sig .096	Sig .831	Sig .831	
PLANTGRA	.0233	.0163	.	.1306	-.2167	.2167	-.0967	-.0967	-.0425
	N(79)	N(94)	N(113)	N(113)	N(113)	N(113)	N(113)	N(113)	N(113)
	Sig .838	Sig .876	Sig .	Sig .168	Sig .021	Sig .021	Sig .308	Sig .308	Sig .655
PLANTNAT	.1733	-.0942	.	-.0043	-.2274	.2274	-.1159	-.1159	-.0509
	N(78)	N(94)	N(112)	N(112)	N(112)	N(112)	N(112)	N(112)	N(112)
	Sig .129	Sig .367	Sig .	Sig .964	Sig .016	Sig .016	Sig .224	Sig .224	Sig .594
PLANTNOR	-.1168	.0698	.	-.1075	.4251	-.4251	-.2210	-.2210	-.0970
	N(79)	N(94)	N(113)	N(113)	N(113)	N(113)	N(113)	N(113)	N(113)
	Sig .305	Sig .504	Sig .	Sig .257	Sig .000	Sig .000	Sig .019	Sig .019	Sig .307
PLANTTIM	.0547	.3624	.	.2967	-.0247	.0247	.0647	.0633	.
	N(85)	N(71)	N(86)	N(86)	N(86)	N(86)	N(75)	N(75)	N(75)
	Sig .619	Sig .002	Sig .	Sig .006	Sig .821	Sig .821	Sig .581	Sig .589	Sig .
RIPARYES	.	.	.	.	.	.	.	.	.
	N(90)	N(106)	N(125)	N(125)	N(125)	N(125)	N(113)	N(113)	N(113)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
ROWALL	.	.	.	.	.	.	.	.	.
	N(90)	N(106)	N(125)	N(125)	N(125)	N(125)	N(113)	N(113)	N(113)
	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .	Sig .
	MOISTURE	NETPFARM	OTHERUSE	OWNACRES	PASTALL	PASTPART	PLANT91	PLANTFOR	PLANTGOV

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	MOISTURE	NETPFARM	OTHERUSE	OWNACRES	PASTALL	PASTPART	PLANT91	PLANTFOR	PLANTGOV
ROWIDLE	.1173	.	.	-.1294	-.0582	.0582	-.0203	-.0203	-.0089
	N(90)	N(106)	N(125)	N(125)	N(125)	N(125)	N(113)	N(113)	N(113)
	Sig .271	Sig .	Sig .	Sig .150	Sig .519	Sig .519	Sig .831	Sig .831	Sig .925
ROWPART	.0905	.0646	.	.0977	-.2830	.2830	-.0874	.0360	-.0384
	N(90)	N(106)	N(125)	N(125)	N(125)	N(125)	N(113)	N(113)	N(113)
	Sig .396	Sig .511	Sig .	Sig .278	Sig .001	Sig .001	Sig .357	Sig .705	Sig .687
SEASON	.1989	.2890	.	.1826	-.1317	.1317	-.1425	.0553	.
	N(86)	N(72)	N(86)	N(86)	N(86)	N(86)	N(75)	N(75)	N(75)
	Sig .066	Sig .014	Sig .	Sig .092	Sig .227	Sig .227	Sig .223	Sig .638	Sig .
SHAREBIP	.2232	.0883	.	.1114	-.0207	.0207	-.1546	.0628	.
	N(85)	N(71)	N(86)	N(86)	N(86)	N(86)	N(75)	N(75)	N(75)
	Sig .040	Sig .464	Sig .	Sig .307	Sig .850	Sig .850	Sig .185	Sig .592	Sig .
SHAREOTH	-.0073	.1986	.	.3101	-.1951	.1951	-.1509	.1049	.
	N(82)	N(68)	N(83)	N(83)	N(83)	N(83)	N(72)	N(72)	N(72)
	Sig .948	Sig .104	Sig .	Sig .004	Sig .077	Sig .077	Sig .206	Sig .380	Sig .
SHARETIM	-.0764	.2498	.	.3746	-.0857	.0857	-.1414	.2111	.
	N(84)	N(70)	N(85)	N(85)	N(85)	N(85)	N(74)	N(74)	N(74)
	Sig .490	Sig .037	Sig .	Sig .000	Sig .435	Sig .435	Sig .229	Sig .071	Sig .
STRMWIDE	.1115	-.1162	.	-.1011	-.1145	.1145	.0887	.1820	.1451
	N(90)	N(104)	N(123)	N(123)	N(123)	N(123)	N(112)	N(112)	N(112)
	Sig .295	Sig .240	Sig .	Sig .266	Sig .207	Sig .207	Sig .352	Sig .055	Sig .127
TREES10	.0018	.2711	.	.3447	.1187	-.1187	.4830	-.1458	.
	N(27)	N(21)	N(29)	N(29)	N(29)	N(29)	N(29)	N(29)	N(29)
	Sig .993	Sig .235	Sig .	Sig .067	Sig .540	Sig .540	Sig .008	Sig .450	Sig .

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TREES20	.2774	-.1579	.	-.0732	-.1291	.1291	.7977	.	.
	N(7)	N(5)	N(8)	N(8)	N(8)	N(8)	N(7)	N(7)	N(7)
	Sig .547	Sig .800	Sig .	Sig .863	Sig .761	Sig .761	Sig .032	Sig .	Sig .
TREES30	.5000	1.0000	.	-.6325	-.7071	.7071	1.0000	.	.
	N(3)	N(2)	N(4)	N(4)	N(4)	N(4)	N(3)	N(3)	N(3)
	Sig .667	Sig1.000	Sig .	Sig .368	Sig .293	Sig .293	Sig .000	Sig .	Sig .
TREESPER	.2108	-.5000	.	.0000	-.5774	.5774	.7746	.	.
	N(4)	N(3)	N(5)	N(5)	N(5)	N(5)	N(4)	N(4)	N(4)
	Sig .789	Sig .667	Sig .	Sig1.000	Sig .308	Sig .308	Sig .225	Sig .	Sig .
WATERQUL	.1462	.0674	.	.1119	-.0476	.0476	-.0209	-.1006	.
	N(90)	N(76)	N(91)	N(91)	N(91)	N(91)	N(80)	N(80)	N(80)
	Sig .169	Sig .563	Sig .	Sig .291	Sig .654	Sig .654	Sig .854	Sig .375	Sig .
YRSFARM	.1608	.3511	.	.2630	-.0845	.0845	-.2169	.0704	-.1471
	N(83)	N(94)	N(111)	N(111)	N(111)	N(111)	N(99)	N(99)	N(99)
	Sig .146	Sig .001	Sig .	Sig .005	Sig .378	Sig .378	Sig .031	Sig .489	Sig .146
YRSMANAG	.2140	.3359	.	.2181	.0383	-.0383	-.0159	-.0255	-.0829
	N(51)	N(67)	N(79)	N(79)	N(79)	N(79)	N(67)	N(67)	N(67)
	Sig .132	Sig .005	Sig .	Sig .053	Sig .737	Sig .737	Sig .898	Sig .838	Sig .505
	MOISTURE	NETPFARM	OTHERUSE	OWNACRES	PASTALL	PASTPART	PLANT91	PLANTFOR	PLANTGOV
PLANTNAT	-.2346								
	N(112)								
	Sig .013								
PLANTNOR	-.4617	-.5556							
	N(113)	N(112)							
	Sig .000	Sig .000							
	PLANTGRA	PLANTNAT							

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PLANTTIM	-.0085	-.0476	-.0095						
	N(75)	N(74)	N(75)						
	Sig .942	Sig .687	Sig .936						
RIPARYES	.	.	.	.					
	N(113)	N(112)	N(113)	N(86)					
	Sig .	Sig .	Sig .	Sig .					
ROWALL	.	.	.	.	.				
	N(113)	N(112)	N(113)	N(86)	N(125)				
	Sig .	Sig .	Sig .	Sig .	Sig .				
ROWIDLE	-.0425	.1771	-.0970	.1657	.	.			
	N(113)	N(112)	N(113)	N(86)	N(125)	N(125)			
	Sig .655	Sig .062	Sig .307	Sig .127	Sig .	Sig .			
ROWPART	.2246	.1488	-.2647	-.0544	.	.	.2058		
	N(113)	N(112)	N(113)	N(86)	N(125)	N(125)	N(125)		
	Sig .017	Sig .117	Sig .005	Sig .619	Sig .	Sig .	Sig .021		
SEASON	-.0584	.0112	.0418	.7331	.	.	.1626	.0346	
	N(75)	N(74)	N(75)	N(82)	N(86)	N(86)	N(86)	N(86)	
	Sig .619	Sig .924	Sig .722	Sig .000	Sig .	Sig .	Sig .135	Sig .752	
SHAREBIP	-.2541	.0670	.1755	.2825	.	.	-.0701	-.2572	.2078
	N(75)	N(74)	N(75)	N(84)	N(86)	N(86)	N(86)	N(86)	N(82)
	Sig .028	Sig .571	Sig .132	Sig .009	Sig .	Sig .	Sig .522	Sig .017	Sig .061
SHAREOTH	.0513	.0552	-.0866	.3619	.	.	-.0518	-.1055	.3260
	N(72)	N(71)	N(72)	N(81)	N(83)	N(83)	N(83)	N(83)	N(79)
	Sig .669	Sig .647	Sig .470	Sig .001	Sig .	Sig .	Sig .642	Sig .342	Sig .003
	PLANTGRA	PLANTNAT	PLANTNOR	PLANTTIM	RIPARYES	ROWALL	ROWIDLE	ROWPART	SEASON

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	PLANTGRA	PLANTNAT	PLANTNOR	PLANTTIM	RIPARYES	ROWALL	ROWIDLE	ROWPART	SEASON
SHARETIM	.0009	-.1593	.0157	.4077	.	.	-.0141	-.2896	.4188
	N(74)	N(73)	N(74)	N(83)	N(85)	N(85)	N(85)	N(85)	N(81)
	Sig .994	Sig .178	Sig .895	Sig .000	Sig .	Sig .	Sig .898	Sig .007	Sig .000
STRMWIDE	.0389	.1235	-.2601	-.0062	.	.	.1819	.2015	-.0152
	N(112)	N(111)	N(112)	N(86)	N(123)	N(123)	N(123)	N(123)	N(86)
	Sig .684	Sig .197	Sig .006	Sig .955	Sig .	Sig .	Sig .044	Sig .025	Sig .890
TREES10	.0379	-.0503	-.1856	-.1184	.	.	.	-.1094	-.1692
	N(29)	N(28)	N(29)	N(24)	N(29)	N(29)	N(29)	N(29)	N(26)
	Sig .845	Sig .799	Sig .335	Sig .582	Sig .	Sig .	Sig .	Sig .572	Sig .409
TREES20	-.1595	-.2657	-.5584	-.6350	.	.	.	.2535	-.3689
	N(7)	N(6)	N(7)	N(6)	N(8)	N(8)	N(8)	N(8)	N(7)
	Sig .733	Sig .611	Sig .193	Sig .176	Sig .	Sig .	Sig .	Sig .545	Sig .415
TREES30	.	-.5000	-.5000	.5000	.	.	.	.	-.5000
	N(3)	N(3)	N(3)	N(3)	N(4)	N(4)	N(4)	N(4)	N(3)
	Sig .	Sig .667	Sig .667	Sig .667	Sig .	Sig .	Sig .	Sig .	Sig .667
TREESPER	.2582	-.7746	-.2582	.8660	.	.	.	.3536	.2582
	N(4)	N(4)	N(4)	N(3)	N(5)	N(5)	N(5)	N(5)	N(4)
	Sig .742	Sig .225	Sig .742	Sig .333	Sig .	Sig .	Sig .	Sig .559	Sig .742
WATERQUL	.3253	.0115	-.2139	-.0435	.	.	-.0322	.0941	-.0277
	N(80)	N(79)	N(80)	N(86)	N(91)	N(91)	N(91)	N(91)	N(86)
	Sig .003	Sig .920	Sig .057	Sig .691	Sig .	Sig .	Sig .762	Sig .375	Sig .800
YRSFARM	-.0795	.1535	.0177	.2957	.	.	.0954	-.0029	.2713
	N(99)	N(98)	N(99)	N(79)	N(111)	N(111)	N(111)	N(111)	N(80)
	Sig .434	Sig .131	Sig .862	Sig .008	Sig .	Sig .	Sig .319	Sig .976	Sig .015

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YRSMANAG	-.2061	.0979	.0897	.2646	.	.	.	-.1267	.2459
	N(67)	N(66)	N(67)	N(48)	N(79)	N(79)	N(79)	N(79)	N(49)
	Sig .094	Sig .434	Sig .471	Sig .069	Sig .	Sig .	Sig .	Sig .266	Sig .089
	PLANTGRA	PLANTNAT	PLANTNOR	PLANTTIM	RIPARYES	ROWALL	ROWIDLE	ROWPART	SEASON
SHAREOTH	.4799								
	N(82)								
	Sig .000								
SHARETIM	.3476	.5837							
	N(84)	N(82)							
	Sig .001	Sig .000							
STRMWIDE	.1215	-.0174	-.1387						
	N(86)	N(83)	N(85)						
	Sig .265	Sig .876	Sig .206						
TREES10	-.0037	-.0426	.1091	-.1530					
	N(26)	N(25)	N(26)	N(29)					
	Sig .986	Sig .840	Sig .596	Sig .428					
TREES20	-.3495	-.1165	.3884	-.6543	.6307				
	N(7)	N(7)	N(7)	N(8)	N(7)				
	Sig .442	Sig .804	Sig .389	Sig .078	Sig .129				
TREES30	-.5000	.	.5000	.0000	.8660	.8165			
	N(3)	N(3)	N(3)	N(4)	N(3)	N(4)			
	Sig .667	Sig .	Sig .667	Sig1.000	Sig .333	Sig .184			
TREESPER	.3162	.7746	.9487	-.1118	1.0000	.8944	.9487		
	N(4)	N(4)	N(4)	N(5)	N(4)	N(5)	N(4)		
	Sig .684	Sig .225	Sig .051	Sig .858	Sig .000	Sig .041	Sig .051		
	SHAREBIP	SHAREOTH	SHARETIM	STRMWIDE	TREES10	TREES20	TREES30		

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WATERQUL	.1608	.3050	.1572	.1775	-.3575	.1861	-.5000	-.2582	
	N(86)	N(83)	N(85)	N(91)	N(27)	N(7)	N(3)	N(4)	
	Sig .139	Sig .005	Sig .151	Sig .092	Sig .067	Sig .690	Sig .667	Sig .742	
YRSFARM	.1333	.0146	.2065	-.2114	.1757	-.1683	-.8333	-.8208	-.1513
	N(79)	N(76)	N(78)	N(109)	N(28)	N(7)	N(4)	N(5)	N(84)
	Sig .242	Sig .901	Sig .070	Sig .027	Sig .371	Sig .718	Sig .167	Sig .089	Sig .169
YRSMANAG	.2157	.0771	.4692	-.2655	.0575	.5000	.0000	.0000	-.0863
	N(48)	N(47)	N(46)	N(77)	N(11)	N(4)	N(3)	N(3)	N(51)
	Sig .141	Sig .606	Sig .001	Sig .020	Sig .867	Sig .500	Sig1.000	Sig1.000	Sig .547

	SHAREBIP	SHAREOTH	SHARETIM	STRMWIDE	TREES10	TREES20	TREES30	TREESPER	WATERQUL
YRSMANAG	.5787								
	N(66)								
	Sig .000								

YRSFARM

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