Understanding the Science Behind Riparian Forest Buffers:

Factors Influencing Adoption

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The riparian area is that area of land located immediately adjacent to streams, lakes, or other surface waters. Some would describe it as the floodplain. The boundary of the riparian area and the adjoining uplands is gradual and not always well defined. However, riparian areas differ from the uplands because of their high levels of soil moisture, frequent flooding, and unique assemblage of plant and animal communities. Through the interaction of their soils, hydrology, and biotic communities, riparian forests maintain many important physical, biological, and ecological functions and important social benefits.

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Factors Influencing Adoption

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Introduction

Forested riparian buffers have been recognized for their ability to improve water quality, provide fish and wildlife habitat, and reduce the costs to communities of water treatment, flooding, and dredging (Figure 1). However, plans to restore forested stream buffers on private lands has been controversial. Private citizens, policy makers, and resource professionals alike are asking: Who will pay? How do we account for individual needs and circumstances? How do we set goals and standards that are flexible and fair to all?

Fig 1. Forested riparian buffers have been recognized for their ability to improve water quality, provide fish and wildlife habitat, and provide benefits to communities.

This publication will examine some of the issues surrounding the adoption of riparian forest buffers on private lands and highlight policies that may be used to implement them.

Adoption of agricultural conservation practices

While the issue of riparian forest buffer restoration is new in many parts of the country, farmers have adopted other types of conservation practices for years. Like restoring riparian buffers, these conservation programs are, for the most part, voluntary. Many studies have been made to determine the factors influencing the adoption of such programs. They have found:

Farmers have positive attitudes toward protecting the environment. A 1986-87 survey of farmers in Virginia and Iowa found that a majority of the farmers had positive attitudes toward protecting the environment and attached a high priority to protecting water quality and preventing soil erosion (Norris and Batie 1987). A large majority of the farmers surveyed were concerned with the potential effects of agricultural chemicals on groundwater in their area, considered the issue serious, and believed that more research and possibly stricter regulation of the use of agricultural chemicals was needed.

Another survey of Virginia farmers in the mid-1980s measured the attitudes of participants in Virginia's Filter Strip Program (Dillaha and others 1986). A majority of the farmers indicated that they participated in the program so that they could reduce soil erosion and improve water quality. Other reasons cited were economic considerations (such as the availability of state cost-share, extra hay production, etc.) and enhancing wildlife habitat.

A 1990 poll of farm operators in Iowa found that even though almost two-thirds reported some damage or loss to crops due to wildlife, 81 percent felt that the presence of wildlife was important to them, and 69 percent agreed that wildlife have as much right to exist on the land as they did. Many enjoyed fishing, birdwatching, hunting, or photographing wildlife (Figure 2). Others said that wildlife provided enjoyment just "from knowing they exist" (Lasley and Kettner 1990).

Fig. 2 Riparian landowners enjoy fishing, hunting, birdwatching, and photographing wildlife.

Farmers believe that they should be free to manage their land as they wish. The same 1990 Iowa poll found that 58 percent of these farmers felt that individuals should be allowed to use their own property without outside interference (Lasley and Kettner 1990). Likewise, a 1986 survey of Ohio farmers found that farmers believe they should have absolute rights to farm land they own, although they should not be free to abuse the land (Napier and others 1988).

Economic circumstances influence management decisions. Farmers face increasingly uncertain economic circumstances: costs of equipment, land, labor, and management are increasing; government support programs are decreasing; and new competition exists in international markets. Farmers are concerned about their ability to pay off debts and remain in business. They realize they must maintain flexibility and preserve their management options for their land in the long-term.

Some economists have argued that soil erosion and runoff from agricultural lands occur because farmers are behaving in a rational, predictable manner (Libby 1985). Farmers must make a living farming, maintain stability in their business, and respond to needs in the market. They have no economic incentive to bear the cost of producing benefits for others (for example, improved water quality), particularly if they feel that their actions will make little difference in solving problems on a regional scale.

Therefore, voluntary adoption of a conservation practice depends to a large degree on how well it maintains farm profitability, or at least does not decrease profitability significantly (Figure 3). Practices that are profitable, simple to implement, and compatible with existing machinery and operations are more likely to be implemented (Nowak and Korsching 1983, Marra and Zering 1996).

Fig. 3 Landowners must weigh environmental benefits with economic realities when deciding to retire lands from production (Photo by Ken Hammond, courtesy USDA).

Farmers are motivated by individual characteristics and values. A number of studies have examined the relationship between individuals' personal beliefs and their adoption of conservation practices. Researchers in Florida found that individuals with stronger views about the use of nonrenewable resources, preserving the integrity of renewable resources, and taking responsibility toward others were more likely to implement conservation efforts on their lands than other farmers (Lynne and others 1988). Individuals with strong beliefs in technology and profit maximization displayed less effort. Likewise, other studies have found that farmers who believe that "one has a moral obligation to maintain the land for future generations" were more likely to adopt conservation measures than those who believe "they have an inviolate, God-given right to use the land as they please" (Nowak and Korsching 1983).

Changing patterns of land ownership may also have implications in the adoption of conservation practices. Today, agricultural lands are often owned by individuals who lease the land to others for agricultural production. In some cases, the landowner may still live on the farm or in the vicinity, but in other cases farms are owned by individuals who live far away in urban areas, and who may have little or no farm experience (Constance and others 1995). Although it is the renter, rather than the owner who often makes most farm management decisions, renters are less likely to employ conservation practices and are less likely to benefit directly from economic incentives associated with conservation programs.

There may also be differences in attitudes between full-time farmers and part-time farmers. In Maryland, full-time farmers were less likely to have plans to develop riparian buffers than part-time farmers, partly because full-time farmers had a larger financial stake in the operation (Hagan 1996). Part-time farmers were more interested in amenities such as fisheries, wildlife, and aesthetics. Likewise, Olmstead and McCurdy (1989) found that the majority of landowners in Illinois who had planted trees under the Conservation Reserve Program (CRP) owned farms of less than 100 acres.

Adoption of Riparian Buffers

Several recent studies have dealt specifically with the establishment of forested riparian buffers on agricultural lands.

Maryland's Buffer Incentive Program

A study of Maryland's riparian landowners compared the characteristics of those who had established forested riparian buffers through Maryland's Buffer Incentive Program and landowners who did not (Hagan 1996). The Buffer Incentive Program (BIP) is a cost-share program initiated in 1992 by the Maryland Department of Natural Resources. It encourages landowners to install forested buffers along streambanks. This study found that the typical BIP participant was more educated (two-thirds had at least a college degree), younger, and had less farm management experience than landowners not in the program. Aesthetic factors and an interest in fish and wildlife were also important to these individuals. Participants had much less at stake financially when they converted their riparian lands; 55 percent earned less than $1,000 from the farm, while another 27 percent earned only $1,000 to $19,999. Participating farms were generally small; nearly a third were 20 acres or less.

Non-participants, on the other hand, were more likely to be individuals who were full-time farmers, farmed larger areas, and derived much or most of their income

from the farm. Reasons given for not participating in the BIP included: concern about the impact of current and future land laws; plantings were required at a busy, inconvenient time of year; too much time was required to maintain the buffer; and previous experiences with government programs. The study also suggested that many non-participating farmers would prefer to install grass buffers rather than forested buffers.

Hagan (1996) suggested several reasons participating landowners were willing to take part in the program: their cost of taking land out of production was much lower than for active farmers, these farmers were less concerned about possible hidden costs of having a buffer (such as increased wildlife damage to crops), they were less concerned that creating a buffer would eventually result in further regulatory problems (such as losing "farmable wetland" status), and these farmers may be more interested in on-site amenities generated by the buffer (such as the return of trout) than full-time farmers.

During public meetings in Maryland, the agricultural community expressed concerns that public benefits of riparian buffers (such as wildlife and aesthetics) will be forced on them at the expense of farm operational priorities (U.S. E.P.A. Chesapeake Bay Program 1995). Farmers were concerned about the loss of productive land and farm income and expressed belief that once riparian lands are planted in trees, additional regulations would be enacted to prevent their use. Some individuals expressed fears that the riparian forest could revert to wetlands or attract endangered species, making them subject to additional regulations. The introduction of pests, such as deer and noxious weeds onto the property was also an important issue.

Urban/suburban landowners had similar concerns. They were concerned about private property rights, wildlife damage, and the invasion of exotic and endangered species. Buffer appearance, home security, public access, liability, and responsibilities for maintenance were also mentioned (Figure 4).

Conservation Reserve Program

In 1989, farmers in Fayette County, Ill., were surveyed to determine their willingness to retire riparian lands through the Conservation Reserve Program (CRP) (Lant 1991). Those surveyed showed little interest in establishing trees or restoring wetland conditions in riparian areas. In fact, a requirement for tree planting on riparian lands would have likely reduced enrollment to below 10 percent of all eligible lands. Increasing the contract period to 20 years to allow for the development of stands of bottomland hardwood trees would have cut enrollments in half. Likewise, temporary plugging of drainage ditches and tiles in order to reestablish wetland conditions would have reduced enrollment.

However, farmers were more willing to create grass filter strips, particularly if haying or grazing were allowed on these areas. Interest in the filter strip program also increased as annual rental rates were higher — at $20 per acre per year, less than 6 percent of the eligible land would be enrolled in filter strips, but at $200 per acre per year, over 83 percent of the land would be enrolled.

Individuals who were interested in the CRP cited soil conservation, water quality improvement, wildlife habitat enhancement, and economics as their primary motivating factors. On the other hand, farmers who indicated that they would not enroll in CRP said that they could earn more by producing on the eligible land, they were hesitant to be tied to a fixed payment for 10 years, or they wished to avoid the program's rules and regulations (Figure 5).

Similarly, a 1993 nationwide survey of CRP participants conducted by the Soil and Water Conservation

Fig. 4 Buffer appearance and the need for maintenance are important considerations for urban communities (Photo by Bob Nichols, courtesy USDA).

Fig. 5 Landowners have concerns about how establishing forest buffers will impact farming operations and future use of their land (Photo by Ken Hammond, courtesy USDA).

Society found only about 12 percent of all respondents were willing to plant trees, although slightly more (16 percent) were willing to plant trees with a 10-year extension (Nowak and Schnepf 1994). On the other hand, half said they were willing to plant a different vegetative cover for wildlife habitat if the government provided cost-sharing for these plantings. More than half of those surveyed said economics would be the single most important factor in their decision to either keep their CRP acres in cover or return them to crop production. Only 14 percent cited conservation as the most important factor.

Norris and Shabman (1988) suggest that tree plantings may be of little interest to farmers because landowners are generally unwilling to incur the costs of investments from which they may not realize the profit. Therefore, waiting for a tree stand to develop is less desirable than crops which produce income annually. Furthermore, farmers see tree plantings as reducing their flexibility for future land use and a drain on time, labor, and financial resources. Most individuals prefer immediate returns to those for which they have to wait.

Conclusions

While farmers may be concerned about soil erosion, water quality, and the environment, this concern does not always translate into adopting conservation practices. Farmers must generate personal income, meet their debt obligations, and maintain future profitability. Establishing woody vegetation on riparian lands currently provides little economic value to most agricultural operations, but at the same time, buffer establishment requires time and money and reduces future options for that land. Therefore, it is not surprising that forested buffer establishment has met with some resistance by the agricultural community. Although landowners want to be good stewards of the land, they must also meet their financial obligations and preserve their options for the future.

A Riparian Forest Buffer Policy for the Chesapeake Bay Watershed

At a Chesapeake Bay riparian buffer workshop held in 1994, participants discussed their concerns for implementing a riparian forest buffer policy. They made many useful suggestions. Those representing the agriculture community believed:

- The policy should be based on sound scientific research and should be voluntary.
- It should take a "whole-farm" approach that is flexible and allows for site-specific design.
- Federal and state agency policies, and their work, should be coordinated and consistent as to establishment and maintenance requirements.
- Farmers should be provided educational, technical, and financial assistance and compensated for loss of agricultural production.
- Markets should be developed for products which may be produced in buffer areas.
- The buffer initiative should target specific areas of the watershed which have been identified through a resource inventory.

The urban/suburban discussion groups echoed many of these concerns and made additional suggestions:

- The policy should clearly set program priorities and objectives at the beginning, stating up front what the program is expected to achieve and be specific about where efforts should be applied.
- Alternatives to forested buffers should be explored, and the buffer policy should allow for new innovations.
- The support of local governments and the need for their input into the policy-making process was emphasized.
- Strong support should be provided for public education on the benefits and management of riparian areas in urban areas.
- Some support for regulation to ensure participation was indicated by this group.

From: U.S. E.P.A. Chesapeake Bay Program. 1995. Riparian forest buffers: restoring and managing a vital Chesapeake resource.

Policy options

Over the years, many types of federal and state programs have been used to encourage conservation on private lands. They may be classified in three general categories: volunteerism, economic incentives and disincentives, and regulation.

Voluntary Programs

Persuading individuals to voluntarily adopt conservation practices can be a complex and challenging task for conservation agencies. Harrington and others

(1985) identified conditions that must be met for voluntary programs to succeed. Among these were: 1) individuals must agree that the goals of the program are worthy, and that their action will advance the goal; 2) noncompliance must be observable, in order to create social pressure for compliance; and 3) the cost of the program should not greatly exceed its private benefits.

Education

A landowner's perception of a problem is one of the most important factors related to the adoption of conservation practices (Ervin and Ervin 1982). This may be especially true when dealing with water quality issues (Figure 6).

Fig. 6 Education and technical assistance are key components of a successful riparian restoration program.

For example, a 1990 Iowa poll of farm operators found that farmers were more likely to perceive that environmental problems had become worse at the national (50 percent) or state (34 percent) level than in their own communities (22 percent) or on their own farms (8 percent) (Lasley and Kettner 1990). These results were similar to those of earlier reports, both national and regional (Napier and others 1988, Steiner 1990). For example, a 1986 survey of Maryland farmers found that they recognized that water quality problems exist, but felt that they were caused by someone else (Lichtenberg and Lessley 1992). Throughout the state, farmers believed that there were only slight problems with water quality at the farm level, slight to moderate problems at the local level, but definite problems at the state level. While water quality problems were most prevalent in the principal agricultural regions of the state, farmers in these areas were less concerned about water quality than farmers near urban areas of the state.

In the case of riparian areas, landowners may not recognize or acknowledge that they own and farm these lands. In a 1995 survey of Maryland landowners, many farm owners whose property was adjacent to streams responded that they did not own riparian land (Hagan 1996). This occurred most often when property was adjacent to small ephemeral streams or streams altered by drainage or channelization.

Even if a problem is recognized, landowners may feel the problem is simply beyond their scope of effort. For example, Alexander (1994) argues that farmers are more concerned with using the land to support themselves than "how to keep an entire ecosystem operating smoothly". Nor are farmers interested in bearing the cost of ambiguous, long-term goals (Nowak 1987).

Therefore, a successful riparian restoration program must educate landowners about the exact nature of the problem, demonstrate benefit to the local environment, illustrate the role the individual plays in the process, and provide a relevant solution.

Technical assistance

Many technical assistance programs have been developed by governmental agencies and nonprofit organizations to assist landowners in installing conservation practices. Technical assistance can be particularly important when programs are first introduced and when conservation practices are complex or unfamiliar (Figure 7). In addition, many private firms exist which specialize in environmental restoration and mitigation.

Fig. 7 Technical assistance can be particularly important when programs are first introduced and when conservation practices are complex or unfamiliar.

Few studies have been made to measure the effect of technical assistance on landowner behavior. However, studies made of forest landowners suggest that those who worked with a professional forester were more likely to regenerate stands after harvest than landowners who did not get assistance (Alig and others 1990).

Ohio TREES program

The Ohio Department of Natural Resources TREES (Tree Resource Establishment and Enhancement Service) program offers a "turn-key"

landowner assistance program to individuals who wish to restore riparian lands. The program is managed by the Top of Ohio Resource Conservation and Development Council which contracts with local vendors to provide tree planting, shelters, mowing, and maintenance. Landowners can pay a flat fee to the council for a complete three-year planting and maintenance contract, or may contract for only some services. State and federal cost-share receipts may be applied toward the cost of installing and maintaining the buffer.

The Ohio TREES program successfully meets some of the obstacles landowners may face when they wish to install riparian buffers, such as time constraints, labor needs, and lack of expertise.

Economic Incentives and Disincentives

Economic incentives that have been used to encourage implementation of conservation practices include cost-share programs, land retirement payments, subsidy payments, and tax incentives. Economic disincentives such as taxes, fines, and environmental bonds may also be effective policies. Another alternative, cross-compliance, requires producers to comply with certain conditions before they are eligible to receive financial assistance such as cost-share, subsidy payments, federal loans, or crop insurance.

Cost share

There are a number of federal cost-share programs which may be applied to restoring forested riparian areas (Figure 8). In addition, many states offer their own programs.

Landowner response to cost-share programs has been mixed. One recent U.S. Forest Service review found that the availability of cost-share was a very significant factor in forest tree planting. It estimated that 70 percent to 80 percent of tree planting occurred with government assistance, and concluded that the effects of cost-share were additive — that is, cost-share programs served as a catalyst for landowners to plant additional trees (Alig and others 1990). However, another study found that cost-share funds were of limited value in actually convincing landowners to become involved in a particular program. This survey of nonindustrial private forest landowners in Tennessee found that it was the attitude of the landowner toward the goals of the program, rather than the availability of cost-share itself, that was the best indicator of landowner participation (Bell and others 1994). Landowners who had a negative attitude regarding the goals of the program would probably not participate, no matter what cost-share amount was offered. On the other hand, landowners with strong positive attitudes were likely to participate in conservation activities whether funds were available or not.

Fig. 8 Many landowners qualify for cost-share and other types of financial assistance to help recover costs of buffer establishment (Photo by Ken Hammond, courtesy USDA).

A 1987 study of a Virginia cost-share program found that when limited program funding is spread among a large pool of applicants, individual payments may be set too low to encourage program participation (Norris and Batie 1987). In this study, the average cost share awarded was only $150, while the average conservation expenditure was $1,900. The authors suggest that funding should be targeted to where it is most needed, in order to provide more realistic compensation to individual landowners.

Another survey of Virginia farmers measured the attitudes of participants in Virginia's Filter Strip Program. When asked if they would install new vegetative filter strips without cost-share funds, 40 percent said no and 27 percent were unsure. However, farmers believed the vegetative filter strip cost-share program should continue, that the use of wildlife plantings should be encouraged, and that more education was needed to make people more aware of the program (Dillaha and others 1986).

Red tape, design requirements, and lengthy application processes also discourage some individuals, particularly small or part-time farmers, from participating in cost-share programs (Hagan 1996).

Land retirement

Land retirement programs such as the Conservation Reserve Program and the Wetland Reserve Program have been used successfully by the USDA Natural Resource Conservation Service to "set aside" lands in their conservation efforts (Figure 9). Landowners may also voluntarily retire lands by enrolling them in a conservation easement. A 1990 survey of CRP participants

indicated that about 27 percent would consider selling a conservation easement to the government, 39 percent rejected the idea outright, and 34 percent were unsure.

Fig. 9 Landowners may place their riparian lands in long-term conservation easements.

Tax incentives

Tax incentives have been used for years to encourage landowners to reforest cutover timberlands and to reduce tax burdens on agricultural and forested lands. Tax incentives may include a reduction of federal and state income taxes or local property taxes. A recent survey of forest landowners in the Pacific Northwest found that federal tax relief could be a powerful incentive to encourage landowners to restrict harvesting in riparian areas. Fifty percent of landowners surveyed indicated that they would forego harvesting within the riparian area if given a 10-year reduction in federal income taxes (Johnson and others 1997).

Subsidy payment

Subsidies are payments made to a landowner to encourage a particular behavior, for example, the adoption of a conservation practice, and can take the form of cash, guaranteed prices, tax exemptions, insurance, or low interest loans (Harrington and others 1985).

Economic Disincentives

While economic incentives have generally been applied to voluntary conservation programs, it is possible to create economic disincentives to encourage the same behavior. Although disincentives have not been used to encourage forested buffer establishment, it is possible (though likely unpopular) that disincentives could induce landowners to plant forested riparian buffers.

Economic disincentives may take the form of pollution taxes, fines, liability payments, or environmental bonds and have been used primarily to control point-sources of water pollution. Taxes and fines work by charging the producer for pollution discharges or for failure to implement a certain practice. Environmental bonds may be issued to a farm or business for a specified sum of money and refunded at a future date only if certain management practices are installed (Malik and others 1994).

Regulation

Past efforts to control nonpoint source pollution have relied almost exclusively on voluntary compliance and financial incentives. However, as lawmakers and the general public become increasingly frustrated with the lack of progress in reducing nonpoint source pollution, regulatory approaches to meeting water quality goals are gaining wider interest.

Many studies in recent years find that the public is becoming increasingly concerned about soil erosion and water quality problems that result from agricultural practices (Figure 10). In 1986, a nationwide survey of U.S. citizens found that almost 40 percent supported applying penalties to farms that failed to adopt needed conservation practices (Molnar and Duffy 1987). A similar survey conducted in 1992 found a majority agreed that most farmers take good care of the soil, but also indicated that "laws regulating excess soil erosion are badly needed." Citizens also agreed that "farmers who do not adopt the needed soil conservation practices should be fined" (Jordan and Elnagheeb 1992).

Fig. 10 Public concern about soil erosion and water quality problems is high.

A survey of residents of eastern North Carolina found the majority believed the government was doing too little to control agricultural pollution from cropland and livestock production, and just over half agreed that government regulations to control water pollution were more important than landowners' rights to use the land as they saw fit (Hoban and Clifford 1994).

However, a regulatory approach to nonpoint source pollution does not necessarily result in the greatest improvement to water quality, and can be expensive to implement and monitor. A comparison of Virginia's voluntary approach and Maryland's regulatory approach to control forestry nonpoint source pollution suggests that the voluntary approach results in the same level of water quality improvement, but at a significantly lower cost to both the landowner and to the state forestry agency (Hawks and others 1993).

Regulation of nonpoint source pollution in Virginia

The Commonwealth of Virginia has passed three major pieces of legislation to encourage communities and individuals to voluntarily protect water resources. These include the Chesapeake Bay Preservation Act, the Forest Water Quality Law, and the Agricultural Stewardship Act. These acts give citizens the primary responsibility for protecting the state's waters during agricultural and forestry activities and urban development. Citizens are allowed great flexibility in how they will prevent pollution; however, if water pollution does occur, the state may take corrective actions and levy fines. In addition, state agencies have been charged with providing technical and financial assistance to help citizens meet water quality objectives.

Chesapeake Bay Preservation Act

The 1988 Virginia General Assembly passed the Chesapeake Bay Preservation Act, which requires local governments in the Tidewater Region (roughly the eastern one-third of the state) to incorporate water quality protection into their zoning ordinances and comprehensive plans. One result of this law is most jurisdictions in the region now require 100 foot vegetative buffers bordering sensitive environments such as tributary streams and wetlands (however, most allow buffer widths to be reduced to 25 feet on agricultural lands where an approved Soil and Water Quality Conservation Plan is in place or 50 feet on building lots where a wide buffer would render the lot unbuildable). Fines of up to $5,000 per day may be levied against anyone who violates local regulations (Croghan 1994, Lipman 1995).

Forest Water Quality Law

The Forest Water Quality Law was enacted in 1993 to protect the waters of the state from nonpoint source pollution during silvicultural activities. The law requires forest landowners or operators to notify the State Forester of a commercial timber harvest at least three days prior to the beginning of the harvest and encourages them to voluntarily implement forestry Best Management Practices during harvest operations. The law gives the State Forester the authority to issue special orders to anyone who is causing pollution to cease all silvicultural activities until corrective measures have been implemented (pollution is defined as "alteration of the physical, chemical, or biological properties of any state waters resulting from sediment discharge"). Violators may be fined up to $5,000 per day until the problem is corrected. However, special orders will not be issued where acceptable Best Management Practices have been incorporated but have failed due to unusual weather activity (Lipman 1995, Virginia Department of Forestry 1997).

Agricultural Stewardship Act

In 1996, the Virginia General Assembly passed the Agricultural Stewardship Act to prevent pollution of the state's waters from agricultural activities. Under this act, farmers are encouraged to implement voluntary conservation measures to correct water quality problems on their lands. The act gives the Commissioner of Agriculture the authority to investigate any complaint that an agricultural activity is creating pollution (pollution is defined as "any alteration of the physical, chemical, or biological properties of any state waters resulting from sedimentation, nutrients, or toxins"). If the complaint is founded, the farmer is required to develop and begin implementing a plan to correct the problem within six months. If the farmer fails to carry out the plan, the Commissioner (or an appointed agent) may enter the land and begin to implement the measures. The farmer will be held responsible for all costs, and can be subject to a fine of up to $5,000 for each day the violation occurs (Virginia Department of Agriculture and Consumer Services 1998).

Funding of riparian forest buffer programs

Riparian forest buffer programs are funded by a variety of federal, state, and local sources, as well as a variety of nonprofit organizations. King and others (1997) suggest that funds could also be generated from wetland mitigation banking, watershed restoration funds received as compensation for natural resource damages (for example, oil spills), and from point-nonpoint source pollution trading. Point-nonpoint trading

works by allowing the sources of point source pollution (for example, water treatment plants, industrial operations, etc.) to fund nonpoint source pollution control projects, rather than installing additional point controls themselves.

When funds and resources are limited, it may be most cost effective to target efforts to specific areas of the watershed rather than support efforts across a larger area (Duda and Johnson 1985, Libby 1985, Pritchard and others 1993). As outlined by King and others (1997), this may be particularly true for riparian restoration because:

- not all buffers will provide the same range of benefits. The effectiveness of the buffer will depend on site characteristics, land use, stream characteristics, and the degree to which buffers exist elsewhere along the stream.

- not all stream buffers will be restored. The voluntary nature of the program suggests that landowners who are not interested will not create riparian buffers on their property. If streams within the watershed are for the most part protected by buffers, occasional interruptions in the stream buffer may not be significant. Conversely, installing short sections of riparian buffers along streams that are mostly unbuffered may provide limited benefits.

- riparian buffers must be part of a larger sediment and erosion control plan. On agricultural lands, BMPs must be in place to reduce erosion and nutrient and pesticide inputs and to handle animal manure. In urban areas, measures should be taken to reduce rapid runoff created by impervious surfaces, to prevent erosion from construction sites, and to encourage homeowners to reduce the use of fertilizers, pesticides, and household chemicals.

Summary and Conclusions

Riparian forest buffers can provide many benefits to society at large. However, restoration of stream buffers will come at a price and through the action of many individual landowners. The decision to install streamside buffers is a result of each individual's unique circumstances and beliefs, their perception of the problem, and a ready, workable solution. Education, technical assistance, and financial support can encourage the protection of riparian areas. However, these programs must clearly define the problem and address the concerns and needs of the landowner. If funding and resources are limited, programs will be most effective if they target specific areas where they will create the greatest benefit.

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Riparian forests are forests which occur adjacent to streams, lakes, and other surface waters. Through the interaction of their soils, hydrology, and biotic communities, riparian forests protect and improve water quality, provide habitat for plants and animals, support aquatic communities, and provide many benefits to humans. Virginia, along with other states in the Chesapeake Bay region, has recognized the importance of riparian forests by implementing a plan to restore forested buffers along streams, rivers, and lakes. This series of publications by Virginia Cooperative Extension reviews selected literature on riparian forest buffers, including water quality functions, benefits to fish and wildlife, and human benefits. The review also discusses riparian buffer restoration and some of the costs and barriers associated with riparian forest buffer establishment. Information on financial and technical assistance programs available to Virginia landowners is included.

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