

# Managing Nonpoint Source Pollution in Western Washington: Landowner Learning Methods and Motivations

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**Abstract** States, territories, and tribes identify nonpoint source pollution as responsible for more than half of the Nation's existing and threatened water quality impairments, making it the principal remaining cause of water quality problems across the United States. Combinations of education, technical and financial assistance, and regulatory measures are used to inform landowners about nonpoint source pollution issues, and to stimulate the use of best management practices. A mail survey of non-commercial riparian landowners investigated how they learn about best management practices, the efficacy of different educational techniques, and what motivates them to implement land management activities. Landowners experience a variety of educational techniques, and rank those that include direct personal contact as more effective than brochures, advertisements, radio, internet, or television. The most important motivations for implementing best management practices were linked with elements of a personal stewardship ethic, accountability, personal commitment, and feasibility. Nonpoint source education and social marketing campaigns should include direct interpersonal contacts, and appeal to landowner motivations of caring, responsibility, and personal commitment.

**Keywords** Nonpoint source pollution · Best management practices · Motivations · Education and outreach · Landowner behavior

## Introduction

Nonpoint source (NPS) pollution is widely accepted as the greatest remaining threat to U.S. water quality (Horan and Ribardo 1999; Gannon and others 1996). As the term implies, NPS pollution is generated from numerous sources whose origin and amounts cannot always accurately be determined (Wolf 1995). Human activities affect NPS pollution, and include management practices (e.g., pesticide application, irrigation, allowing livestock in streams), and land use (e.g., amount of land under production, location of production). The diffuse nature of NPS pollution, and the scientific uncertainty surrounding it, creates challenges for any program or policy that seeks to address it. This is problematic when attempting to determine if an educational program and related land management practice has been successful in minimizing NPS pollution. The crux of managing individual private land use activities often lies in voluntary programs, whose goal is to educate and motivate participants to make informed decisions and alter their behavior. These programs are limited to those who voluntarily decide to participate, so incentives such as subsidies, tax reductions, low interest loans, and labor assistance are often a major component of such programs. Because implementation of land and water management activities is primarily voluntary, knowledge about the efficacy of different methods for landowner education, as well as their motivations for conducting land management actions, is critical to NPS pollution program design and delivery.

The goal of this study was to identify how non-commercial riparian landowners in western Washington State learned about different land management practices, understand how effective they thought those learning methods were, and explore their motivations for implementing management practices. A riparian area is the interface

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between land and a stream. Riparian areas are significant in ecology and environmental management because of their role in soil conservation, biodiversity, and their influence on aquatic ecosystems. A consideration to keep in mind is that this study captured the perceptions of the population of landowners who have participated in Conservation District land and water management programs. As such, the results do not reflect the perceptions of those landowners who did not participate, which ultimately may be the most important audience for NPS pollution programs. However, it is an important first step in understanding the motivations of non-commercial riparian landowners to implement best management practices for NPS pollution.

### Promoting Behavior Change: Education and Motivation

When designing and implementing NPS pollution programs, it is important to know what delivery methods (such as brochures, tours, or classes) are most effective in communicating information, and what motivates people to adopt particular practices. To effectively transfer information, we must know how people learn, and how different communication formats meet their needs. Unfortunately, little research has been conducted on the effectiveness of different educational techniques for NPS pollution management. What literature there is suggests that techniques that are problem-based (including short and simple messages) and link closely with a personal or community connection will be most effective. In addition, credibility and trust of the information source is extremely important.

Toman and others (2006) provide an excellent summary of the literature on learning, addressing several important concepts for understanding adult learners. First, adults typically approach learning situations from a problem-based rather than a subject-based approach (Knowles and others 1998; Merriam and Caffarella 1999). Thus, effective information programs will relate information to contextual conditions, particularly places people know and care about. Second, the variety of prior experiences and knowledge adults bring to the learning situation is of substantial value in solving natural resource problems (Toman and others 2006). Such experience often creates a diverse learning group and can provide a rich resource for learning activities (Knowles and others 1998). For instance, members of affected interests (e.g., residential areas targeted for fuel reduction treatments) may be ready to accept new scientific information because they have witnessed wildfires in neighboring communities and struggle with their own vulnerability. At the same time, they will expect management decisions to be based on these local experiences as well as good science (Shindler and Collson 1998). However, prior experiences

can also lead to biases and assumptions that must be addressed to enable the learning of new ideas. Shindler and Toman (2003) also found a high correlation between support for prescribed fire and citizens' beliefs that the Forest Service provided credible and reliable technical information. In another study, more positive outcomes accrued when citizens were able to evaluate the range of information related to timber harvests rather than bits of information selected for them (Brunson and Reiter 1996). Moreover, adults are not likely to believe information from a source they do not view as credible (Steel and others 1992–1993). Wright and Shindler (2001) note that citizens and organizations find information about an upcoming project more useful when they have trust in the agency that provides it.

In other research, Rohrmann (2000) examined the use of information for brushfire preparedness in Australia. Not surprisingly, this study found that information dissemination is not enough—the information must be perceived to be effective. Those findings suggested that short, one-issue leaflets were useful in certain contexts, and fancy colored brochures were less so. Graphs and drawings were less appealing, but more instructive. In efforts using multimedia techniques, accompanying booklets with summaries were found to be more useful. Newton (2001) found that simple messages that affect individuals personally are effective, and even more so when the messages inform people about specific actions they can take.

A large literature exists that addresses public understanding of science, as well as communication and integration of science into policy. This literature is relevant for NPS pollution programs, in light of the management paradigm in the U.S. encouraging adoption of more deliberative methods for environmental problem solving that involves stakeholders in research design, as well as a more integrated role for scientists in society. In short, scientists cannot just present facts, but must interact with stakeholders (Larson 2007). Allen and others (2001) note that many environmental problems call for models that inform policy and action at large scales, especially for complex problems. The more deliberative model also requires different communication processes that link scientists with societal actors. For example, regular interaction (via small groups or joint problem solving) with stakeholders over a long period of time is necessary to create common language and build trust. In addition, an appreciation for the fact that actors have different degrees of risk aversion, must make decisions under uncertainty, and do not have complete knowledge is needed when attempting to influence behavior and choices (Welp and others 2006). Public (and individual) judgments and actions do not derive solely from scientific understanding, but from a suite of factors including context, trust, esthetics, and personal history (Stankey and Shindler 2006), all of which should be incorporated into NPS pollution programs.

Behavioral and social science research indicates that the conventional wisdom—that education is enough to solve social problems—is often oversimplified and misleading. For example, decades of careful study of health promotion campaigns show that it is possible to get people to stop smoking tobacco or eat healthier foods, but not with education alone. In the 1960s and 1970s, a large number of programs were conducted in schools to keep children from developing the smoking habit. These programs, which operated mainly by providing information on why smoking is bad for health, changed some of the students' beliefs and attitudes, but rarely changed the behavior, or onset of smoking behavior (Thompson 1978). Education programs related to environmental issues are in many cases oversold, inform poorly, and have disappointing results (Condelli and others 1984; Ester and Winett 1982).

Controlling NPS pollution requires behavior change—usually voluntary, sometimes coerced. Those who design and implement NPS control programs face simultaneous challenges: first, to determine what methods will encourage behavior change; next, to design and implement a program that will get the behavior changed; and finally, to make those changes durable over time. Techniques for changing behavior have been organized in different ways in the conservation behavior literature. In general, there are three major categories of interventions that lead to behavior change (see De Young 1993 for a more complete discussion). These include information techniques, positive motivational techniques, and coercive motivational techniques. *Information techniques* work on the assumption that once people are made aware of and understand why and how to change their behavior, they will change it. Another perspective suggests that people are already aware and willing to change their behavior but they need assistance to proceed (De Young 1993). Others have suggested that information strategies can be particularly effective for inducing behavior changes in smaller, marginal producers, whose lack of environmental awareness is often the basis for noncompliance (Gunningham and Grabosky 1998). Information strategies can be most effective when private interests of the individual actor converge with the wider public interest. In situations where the interests do not converge, information techniques can be used to justify more coercive strategies to the actors, thereby making compliance more palatable to the actor (Gunningham and Grabosky 1998).

*Positive motivational techniques* use extrinsic motivations, such as financial and social incentives, to entice people into changing behaviors (De Young 1993). In Washington State, some Conservation Districts use financial incentives to encourage landowners to implement certain practices. Social incentives, such as public recognition and support, provide critical validation from other people during the transition of a behavior change. Some

Conservation Districts in Washington state use social incentives with awards given to participants, such as “Model Farm” or “Wildlife Steward” designations. Typically these are plaques or signs that participants can display on their property.

*Coercive motivational techniques* are those that change behavior by constraining choice either physically or perceptually. People are known to rapidly alter their behavior while under duress, but the environmental psychology literature argues against the use of punishment as a conservation behavior change technique (Geller and others 1982). However, there are techniques that coerce without directly punishing. These include the use of monetary disincentives (e.g., consumption-based taxes), social disincentives (e.g., social pressure) and the use of physical barriers to non-conserving behavior (e.g., high occupancy vehicle lanes on commuter routes) (De Young 1993). In Washington State, the Conservation Districts and Cooperative Extension units do not employ these strategies, as they do not have regulatory authority.

Local governments can influence the impacts associated with land-based activities through coercive strategies such as zoning and ordinances. Zoning determines what types of land use will be allowed or prohibited in certain areas of a watershed. Its limitation is that it does not affect whether landowners adopt land management practices to correspond with those activities. Local ordinances can be used to influence the adoption of some practices. For example, King County, Washington created the Livestock Management Ordinance (LMO) in 1993. This requires livestock owners to implement certain land management practices or create a Farm Plan with the Conservation District if owners have six or more animal units per acre (King County Department of Natural Resources 2007). Examples of practices required by the LMO include fencing livestock away from streams and manure management. While coercive strategies are not widely used in the context of this study, there is some evidence suggesting that simply the *threat* of coercive strategies can induce voluntary compliance, particularly with regards to the U.S. Endangered Species Act regulations (Gunningham and Grabosky 1998). Most scholars and practitioners encourage using a mix of all three approaches, variable according to location, ecological, economic, social, and political contexts.

### **Land Management and Conservation Research: Beginning to Fill the Gap**

Much of the existing research on land management practices has been conducted with commercial farmers or agricultural landowners, not with private land owners who are not using the land for large scale agriculture or

commerce. Because this study targeted non-commercial riparian landowners, it begins to fill a prominent gap in the literature. While both groups are responsible for environmental problems, a major difference between the groups is that commercial farmers derive all or most of their economic livelihood from their land use activities, while the other landowners do not. In spite of this difference, it is useful to review this literature to gain a better understanding of the non-commercial riparian landowners that were the focus of this study. Much of the literature identifies a “stewardship ethic” as an important predictor of participation, as well as provision of financial incentives, education, and linking the management practices to specific problems and environments.

One study examining farmers’ motivations for adopting conservation practices in Michigan found that farmers are intrinsically motivated by factors such as attachment to their land and stewardship, rather than economic compensation (Ryan and others 2003). Ribaldo (1998) suggests several criteria that may increase participation in programs among farmers. First, participation, and adoption of alternate practices, may increase when farmers recognize a connection between agriculture and local resource problems, such as ground water impairment. Second, they must perceive a connection between their land practices and a resource problem. The practices must generate higher returns for farmers so that they have incentive to maintain them after original program assistance has ceased. The programs should have some cost-share component and one that is flexible in its distribution of funds, as farmers may be receptive to adopting alternate practices yet not have the initial funds for implementation, or may not be willing to take the financial risk entailed with an unfamiliar practice. Programs should strive to offer coordinated educational, technical, and financial assistance, as each of these methods will cater to and be received by farmers differently based on their personal needs. Finally, farmer participation in voluntary programs may be enhanced by the threat of future regulation (Ribaldo 1998).

Rhodes and others (2002) assessed the relationships between the extent to which farmers in New Zealand reported exposure to relevant information, and their attitudes, knowledge of and adoption of riparian management strategies. They found a positive correlation between receipt of information and funding and the adoption of specific riparian management measures. Wagenet and others (1999) examined pre- and post-treatment of a watershed educational program. However, this study was focused on assessing levels of knowledge of watershed and water quality issues due to an education program, not perceptions of how effective landowners thought the educational information was.

An early study (Nowak and Korsching 1983) suggested that attitudes of stewardship, agrarianism, and risk

orientation influence the adoption of conservation practices among farmers. A stewardship attitude has been found to be positively associated with the adoption of conservation practices, although other factors, such as economic returns, may also be positively related (Clearfield and Osgood 1986). For commercial agricultural producers, education efforts are more effective when the actions that improve water quality also increase profitability, producers have strong altruistic or stewardship motives, or the costs of water quality impairments are shown to be sufficiently large (Ribaldo and Horan 1999). Additional factors affecting support for conservation measures on riparian lands include financial costs, ability to control management, and confidence that measures are based on good science (Hairston-Strang and Adams 1997).

Studies of riparian landowners show strong support for the values of riparian buffer systems, but less actual practice (Hairston-Strang and Adams 1997; Schrader 1994). Similarly, Dutcher and others (2004) found that riparian landowners expressed a community obligation to consider the downstream consequences of their management styles, yet they often failed to appreciate their own contributions to water pollution. One reason may be that while riparian landowners may be supportive of conservation, they lack access to understandable and reliable information (Johnson 1996).

### Understanding Landowners in Western Washington: Survey Design and Administration

NPS pollution occurs in riparian areas located throughout an extensive mosaic of land uses, ownerships, and land cover within Western Washington State. This study set out to investigate how non-commercial riparian landowners learn about best management practices, how effective they think educational techniques are, and what motivates them to implement management practices. Due to the cost of administering the survey, the study area was limited to western Washington state, which includes urban settlements and rural areas that are connected by the north/south I-5 freeway corridor (Fig. 1). Although this study area is not representative of the entire state of Washington or the United States more broadly, it is similar to other parts of the U.S. that are experiencing challenges with rapid growth and land conversion, along with increasing pressure to maintain, enhance, and restore riparian areas for a variety of environmental services.

An 8-page mail survey was developed and administered to 1827 landowners with riparian lands in the study area. Prior “key informant” interviews with 17 landowners provided a basis for the design of survey questions related to educational techniques and motivations to implement best



**Fig. 1** Western Washington study area

management practices (BMPs) that were of interest in this study. The first part of the survey focused on information about the character of the land parcels (e.g., land and water features, productive uses) owned and managed by respondents, and the land management activities conducted by the landowner. Subsequent sections dealt with different education methods for learning, learning effectiveness rankings, motivations, satisfaction, environmental attitudes, and socio-demographic items. Most variable items were pre-coded questions with defined responses or Likert scales (1 = not at all ... 5 = a great deal) to indicate the extent to which they agreed with a particular item. The survey was designed and administered using the Tailored Design Method (Dillman 2000) with regards to design of the cover letter and survey booklet, survey pre-testing, follow-up and timing of reminder mailings. Staff of local USDA Natural Resource Conservation Service districts in western Washington facilitated recruitment of potential respondents by providing mailing lists of landowners who had recently participated in land and water management programs. A study limitation is that this survey did not capture those landowners who did not participate in land management programs, so the study results reflect the perceptions of landowners who are perhaps particularly motivated and active in implementing BMPs for NPS pollution management. Critical target audiences for NPS pollution programs are those landowners who currently do not implement BMPs on their land, and we cannot say whether their motivations would be similar or different from those who are more active in NPS management.

The lists from the Conservation Districts provided 1827 names that received the mail survey. With the receipt of 480 usable responses, the survey response rate was 26%. This response rate may be the result of several issues, one of which may be the character and values of some landowners in semi-rural areas who value their privacy and are not inclined to provide information about themselves, their property, or their activities. In addition, the recent (at the

time of this study) federal listing of several Puget Sound salmon species under the Endangered Species Act may have incited fears of new regulations affecting private landowners for salmon habitat protection, prompting a low response rate.

Survey data were analyzed depending on variable type using SPSS statistical software. In addition, data were analyzed using factor analysis, which is used to identify interrelationships among a large set of observed variables and to group smaller sets of variables into dimensions or factors that have common characteristics (Nunnally and Bernstein 1994). Factor analysis is used when the researcher does not know how many factors are necessary to explain the interrelationships among a set of characteristics, indicators, or items (Pett and others 2003). The variables loading on to each factor were identified, and the factor was then assessed for meaningfulness and to identify the underlying dimension. In addition, the degree of correlation between the variables was examined to determine if any variable pairs were highly correlated.

### Survey Respondents

The respondents in this study were relatively well educated (90.4% reported some college, a 2- or 4-year degree, or a graduate or professional degree), with incomes ranging from less than \$35,000/year (15.4%); \$35,000–\$75,000/year (48.1%); to greater than \$75,000/year (36.5%). Although most work part-time (15.8%) or full-time (58.1%) at off-site jobs, they reported conducting a variety of different management practices on their land parcels (Table 1).

With regard to land management, 47% report being active up to 5 years. Twenty percent report that they have actively managed their land from 5 to 10 years, and 29% reported 10 years or more. When asked to indicate the proportion of their land that they are actively managing, 12% indicated 25% of their land or less, 16% are actively managing half of their land, 21% report actively managing three-quarters of the property, and 50% reported actively managing all of it.

Many respondents (63.7%) have young children and have owned the land within the lifetime of their children. The mean land ownership parcel size was 20.6 acres, though the average was influenced by several very large (>100 acre) holdings. Thirty two percent of respondents own less than 5 acres, 40% own 5 to 10 acres and 27% own more than 10 acres. A range of ownership tenure was reported. Twenty five percent have owned their land for less than 5 years, 33% from 5 to 10 years, 24% from 11 to 20 years, and 18% have owned more than 20 years. The longest reported ownership period was 114 years, representing multi-generational ownership.

**Table 1** Land and water management activities

I conduct these land and water management activities on my land:	Percent reporting
Limit number of domestic animals per acre	70.6
Provide areas of native plants as habitat	65.8
Use compost instead of synthetic fertilizer	64.2
Collect and direct water runoff from buildings	60.6
Restrict animal access to pasture during wet season	59.8
Create area for dry manure storage	44.2
Encourage native trees/shrubs along stream banks	44.0
Line corrals or paddocks with absorbent materials	35.6
Install or leave trees or wood in water bodies	33.8
Cover manure with tarp	31.0
Install fence(s) along stream bank	30.8
Install drainage channels	24.4
Use slow release nitrogen fertilizers	19.6

### Learning Methods and Effectiveness: Personal Contacts are Key

Respondents were asked to indicate whether they had experienced a number of different educational delivery techniques, such as site tours, brochures, television, word of mouth, internet, and others. Respondents were allowed to check multiple items, and they were then asked to rank the effectiveness (1 = not at all, to 5 = very much) of the different educational techniques. There are many ways that the landowners in this study learned about land management activities, and the most effective techniques involve direct personal contact (Table 2).

Landowners reported that they most often learned about activities by (1) directly contacting the Conservation District or other organization to get information; (2) seeking information from books, journals, or the Internet; (3) attending an on-site tour or demonstration; (4) receiving a brochure or ad in the mail; (5) receiving information at fairs or other public events; or (6) receiving information from community or professional group. It is interesting to note that the *most frequently experienced* methods of learning, were *not always the most effective* methods of learning. When asked to rank effectiveness, the two most effective techniques were when an individual landowner contacted the Conservation District (reported as the *most often* experienced learning method), or a representative from the District or other organization contacted the landowner (reported as the *eighth most often* experienced learning method). Attending an on-site tour or demonstration was also ranked as highly effective (and third most experienced method), along with receiving information from a community or professional group. Clearly, methods that involve direct personal contacts and interactions as part of the learning situation are most effective for the landowners in this study.

### Motivations for Land Management Activities: Stewardship, Accountability, Commitment, and Feasibility

Respondents were asked to rate (1 = not at all important, to 5 = very important) each of 24 statements regarding their importance as motivations for their decisions to implement land and water management activities. Five categories emerged from the factor analysis procedure, and a total of 16 statements were included in the categories (Table 3). Category descriptions were derived from inspection of component items and are presented in order of mean ratings.

Motivation dimensions reflect conditions that are both external to the landowner, as well as dynamics that are at the personal or household level. *Stewardship*, the highest rated category, is composed of statements that reflect interest in land and water resource protection on the owner's land as well as adjacent properties, suggesting a sense of connectivity to the landscape and other nearby stewards. The sense that the activities are the "right" thing to do for the environment also reflects this dimension. *Accountability* includes items that describe a sense of control over practical concerns, such as reputation and property, money saved and animal health. *Personal Commitment* means having both the time and skills to implement the activities, as well as an aesthetic sensibility conducive to conducting management activities. The fourth category, *Feasibility*, addresses concerns of ease and expense in the landowners' decisions to adopt management activities. Finally, the *External Influences* category, with a mean almost three points less than Stewardship, reflects a relatively low level of reaction to the expectations of external entities. This was somewhat surprising, as some of the literature suggests that this may be a stronger motivation for behavior change. However, landowners may be aware of the various external entities that oversee and influence land and water management, yet

**Table 2** Learning methods and effectiveness rankings

Learning about land and water management activities	Percent reporting	Mean effectiveness rating	SD
I contacted the Conservation District or other agency for information	77.0	4.35	0.83
I sought information from books, journals magazines or the internet	60.4	3.87	0.90
Attended a tour or on-site demonstration	56.2	4.08	0.90
Received brochure or ad in the mail	54.1	3.27	1.00
Received information at fairs or public events	52.2	3.43	0.92
Received information from community or professional group	44.1	3.90	0.92
Heard about from a friend or neighbor	41.4	3.65	0.96
Representative from Conservation District or other agency contacted me	39.6	4.22	0.95
Read about in newspaper	38.3	3.09	0.95
I contacted a nonprofit or volunteer group for information	26.4	3.87	1.02
Heard about on TV or radio	22.2	2.79	0.94
I was contacted by a nonprofit or volunteer group	11.4	3.83	1.11
Heard about from previous owner or parent	10.8	3.46	1.15

**Table 3** Motivation categories developed through factor analysis

Category	Mean	SD	Factor loading
Stewardship	4.27	0.74	
I want to protect my land and water resources	4.59	0.69	0.792
The activities are the “right” thing to do for the environment	4.34	0.96	0.691
I do not want to harm my neighbor’s land or water	3.88	1.21	0.397
Accountability	3.85	0.87	
I do not want to be singled out as a problem property or landowner	3.10	1.60	0.588
It saves money in the long run	3.58	1.40	0.568
I want to protect the health of my animals	4.31	1.13	0.446
I like to have control over what happens on my land	4.44	0.91	0.399
Personal commitment	3.30	1.05	
I have the time and skills to implement the activities	3.14	1.25	0.544
The actions make my property look neat and tidy	3.47	1.33	0.494
Feasibility	3.24	1.09	
The activities are easy to implement	3.33	1.25	0.765
The activities are not too expensive	3.13	1.31	0.596
External influences	1.63	0.70	
I do the activities so I will be granted a permit for other activities on my land	1.69	1.20	0.537
Volunteer labor has been available	1.70	1.20	0.518
I do the activities because a government agency is involved	1.45	0.91	0.491
I do the activities because a non-governmental agency is involved	1.77	1.23	0.482
Community leaders have encouraged me to do the activities	1.54	0.98	0.418

claim negligible influence of such when adopting their own management activities.

### Implications for Nonpoint Source Pollution Education Programs

Although landowners experience a wide variety of educational methods, those that include elements of direct

interpersonal contact were overwhelmingly ranked as the most effective. While many land and water management programs are already heavily oriented toward personal contacts, this finding is consistent with previous studies, and underscores the need to explore ways to incorporate direct personal contacts and field activities into new or existing programs. One approach might be to shift resources away from the less effective methods (brochures, ads, radio and TV) and to invest in the more effective

interpersonal techniques. In addition, because the initial contact and response between landowners and the information provider is such an important component of the learning method, organizations will want to ensure that an effective contact and response system is in place and functioning. Landowners reported the most effective learning situations when they contacted the Conservation District, indicating individuals in this study who demonstrated initiative to make contact. To reach those landowners who are not inclined to initiate contact, educational programs should include a component where the Conservation District (or other entity) directly contacts landowners in an appropriate manner. This was ranked as one of the less often experienced techniques, but one of high effectiveness. In this way, other landowners that simply do not have the initiative or knowledge to contact the Conservation District or other group may be encouraged to participate in land management and conservation programs.

One issue in this study was that it only captured those landowners who *already participate* in nonpoint source pollution land and water management programs, so we do not know what might motivate those landowners who do not currently participate. This can be addressed by encouraging Conservation Districts or other organizations to contact non-participating landowners directly, as suggested earlier. Future research efforts should attempt to capture the non-participating population, as they may have entirely different perceptions of the efficacy of educational techniques, as well as different motivations for behavior change.

Understanding landowner motivations for implementing BMPs poses a difficult challenge in designing and delivering NPS pollution programs. This study confirms previous research indicating the importance of a stewardship ethic as a key motivator for behavior. Closely related are elements that reflect accountability, personal responsibility, and commitment as important motivators for the landowners in this study. Interestingly, this study indicates that the profit and cost motivations identified in other studies as primary motivators for commercial landowners are not as important a motivator for the non-commercial landowners in this study.

To apply this study's findings, NPS education and social marketing efforts should target non-commercial riparian landowners as a distinctly different audience than commercial landowners, and emphasize different motivations (e.g., profit motive is not a strong motivator for non-commercial landowners) for adopting land management practices. Community based social marketing (McKenzie-Mohr and Smith 1999) relies on research that indicates that initiatives to promote behavior change are most effective when they are carried out at the community level and

involve direct contact with people. The approach operates on the assumption that behaviors have benefits and barriers, and benefits and barriers are different for different individuals. Social marketing approaches urge an understanding of the benefits and barriers for different behaviors, followed by efforts to change the benefits and barriers so that the desired behavior has fewer barriers and more benefits, and will be adopted. Social marketing can be applied in NPS pollution efforts, and this study suggests several specific benefits to landowners for implementing BMPs. Those benefits should be explicitly addressed in NPS education programs.

For example, materials could be developed that show how NPS management practices conform to an ethic of stewardship by focusing on how they protect land and water resources, are the "right" thing to do, and do not harm neighboring property. Explicit examples of how the activities address landowner concerns about accountability could emphasize not being a "problem" landowner, saving money in the long run, protecting health of animals, and maintaining control over activities on private property. Personal commitment and feasibility dimensions could be addressed by showing that individuals do have the time and skills to implement management actions, how the actions improve property appearance, and that the activities are in many cases easy and inexpensive to implement. In this way, many of the barriers to adopting the behavior of implementing BMPs can be diminished, and potential benefits increased. Ultimately, more effective appeals to appropriate landowner motivations will inspire more landowners to implement BMPs on their lands, which will address and solve the complex and challenging NPS pollution problems faced throughout the United States.

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