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# Farmers' Motivations for Adopting Conservation Practices along Riparian Zones in a Mid-western Agricultural Watershed

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ABSTRACT *In the agricultural Mid-west, riparian corridors are vital for protecting biodiversity and water quality. The cumulative management decisions of hundreds of private landowners have a tremendous impact on this riparian zone. This study of 268 farmers in a typical Mid-western watershed in Michigan looked at farmer's motivations for adopting conservation practices, their current management practices along their rivers and drains as well as their future management plans. The results of the study showed that farmers are intrinsically motivated to practise conservation by such factors as their attachment to their land, rather than by motivations such as receiving economic compensation. Farmers are also likely to engage in conservation practices that make their farm appear well-managed. Furthermore, those farmers with strong intrinsic motivations were likely to adopt conservation practices that protect streams, such as maintaining a woody vegetative buffer or practicing no-till farming. This study shows that protecting riparian resources in agricultural watersheds requires strategies for conservation that respect farmers' attachment to their land and their desire to practise good stewardship.*

## Introduction

Forested riparian buffers are essential for maintaining water quality and ecological health in the streams and rivers that flow through agricultural watersheds. Riparian buffers protect water quality by filtering out excess nutrients and sediments which drain off adjacent farm fields (Karr & Schlosser, 1978; Lowrance *et al.*, 1983; 1984a, b; 2000; Osborne & Wiley, 1988). The tree canopy of the riparian forest also moderates water temperatures (Karr & Schlosser, 1978) and provides food supply and habitat for aquatic and terrestrial organisms (Caduto, 1990).

Agriculture can have a tremendous impact on the riparian zone. Streams are channelized to improve drainage, which can have the unforeseen consequences of increasing sediment and chemical loading (Yarbro *et al.*, 1984; compare

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Binford & Buchenau, 1993). Riparian forests are cleared in order to farm the rich floodplain soil, destroying or compromising the ability of riparian forests to filter sediments and nutrients (Cooper *et al.*, 1987). In fact, agriculture is viewed in some circles as having the most significant impact, in the form of non-point-source pollution, on the USA's rivers and streams (Smith *et al.*, 1987).

Protecting water quality and ecological integrity in agricultural watersheds in the USA depends on private landowners' decisions about how they manage their land (Baudry, 1993; Henry *et al.*, 1999). Farming practices, such as ploughing near streams, can increase soil run-off and transportation of chemicals into streams. Conservation practices, such as maintaining riparian buffers, adding grass filter strips along drainage swales and no-till farming, can minimize the agricultural impacts on nearby rivers and streams (US Department of Agriculture (USDA), 1996). Management along the riparian zone is critical for maintaining ecological health. For government agencies, environmental groups and others interested in protecting water quality, it is important to understand what motivates farmers to engage in conservation practices and responsible management of the riparian zone.

## Background

Conservation practices and, consequently, agricultural landscape patterns are influenced by both government policy and farmers' motivations and attitudes. In the USA, farm policy has relied heavily on economic incentives and regulatory measures to encourage soil conservation on the nation's farms. A review of the literature related to farmers' adoption of conservation practices also finds a heavy emphasis on economic incentives (Napier & Forster, 1982). Conservation practices require a long-term investment from farmers with little or no short-term benefits. However, the lack of widespread adoption of conservation practices and the continuing trend of soil erosion have caused researchers to explore other motivations (Carlson *et al.*, 1994; Napier *et al.*, 2000).

Some researchers have proposed that the adoption of conservation behaviour, in general, is not solely explained by extrinsic motivation, such as economics, but by a range of motivations including social pressures (other people) and intrinsic motivations (i.e. personal satisfaction) (Christensen & Norris, 1983; De Young, 1996). Furthermore, De Young (1996) argues that extrinsic motivations (i.e. influences on an individual's behaviour that come from outside forces such as government regulation or economics) provide less durable changes in conservation behaviour than do intrinsic motivations. For example, several studies have found a strong connection between farmers' environmental attitudes and their actual conservation practices (Carlson *et al.*, 1994; Vogel, 1996).

Napier *et al.* (1984) proposed that farm structure (i.e. the type and scale of farming operations) may influence the adoption of soil conservation practices. In a study of farmers in three Mid-western states, Napier *et al.* (2000) found that farmers with larger farms and higher gross farm income were more likely to adopt conservation practices, such as no-till farming. In this study, receiving financial support from the government had little or no significant influence on adopting conservation practices. Early studies in the Palouse region of the North-west also revealed that large-scale farmers were more likely to adopt soil conservation practices (Carlson *et al.*, 1976; Carlson & McLeod, 1977); however, more recent studies have shown that farmers' attitudes toward soil erosion

problems have become a much more important predictor than farm structure (Carlson *et al.*, 1994).

In contrast to these studies, Buttel *et al.* (1981) found an inverse relationship between farm size and farmers' attitudes toward conservation in their study of Michigan and Ohio farmers. Larger-scale farmers reported more economic motivations, while small-scale farmers reported more non-economic motivations and more support for soil conservation in general. Similar results were found in a Michigan study of organic and non-organic farmers (McCann *et al.*, 1997). In a Danish study, Primdahl (1999) found that part-time farmers were more likely to engage in innovative conservation practices, because they relied less on farm income and viewed their farm as a residential setting rather than as a place of business. A Michigan study by the authors of this paper (Erickson *et al.*, 2002) found that part-time farmers are also more likely to allow marginal fields to go fallow.

It is important to note that the vast majority of conservation studies focus on farmers' soil conservation practices on entire farms rather than on the riparian edge. In one of the few studies that has focused on farmers' attitudes toward riparian management and conservation practices, Schrader (1995) found that streamland was important to landowners for protecting environmental quality, including the visual appearance of the countryside, income production from logging and recreation. However, economics was not seen as "the driving force behind [landowners'] attitudes toward stream protection" (p. 382). In fact, those landowners who thought streamland was more important for environmental quality were more willing to consider participating in streamland protection programmes. This was especially true for those landowners with more off-farm income and smaller parcels.

Nassauer (1988, 1989) proposes that farmers are strongly motivated to be good stewards of their land. The visual appearance of one's farm plays an important role in conveying this message of stewardship to one's neighbours. In her studies of Mid-western rural residents' perceptions of their local landscape, Nassauer (1988, 1989) found that landscape scenes showing conservation practices, such as contour ploughing, that give the appearance of neatness and stewardship were perceived as more aesthetically pleasing by local residents. Farmers' aesthetic perceptions, in particular, were more significantly influenced by the use of conservation practices in these landscape scenes than were non-farm residents. To farmers, the desire to appear 'progressive' has a strong influence on their management decisions (Nassauer & Westmacott, 1987). Farmers had negative perceptions of conservation practices, including riparian forest buffers, that made a farm appear messy.

The importance of maintaining a tidy farm was also found to be an important motivation for removing hedgerows in a study of English farmers (Carr & Tait, 1991). Keeping drainage ditches clean was also listed as another important aspect of this tidy rural aesthetic. In a Michigan study, Ryan (1998) found that scenes of overgrown, narrow streams and ditches were aesthetically less preferred by farmers and other rural residents than were scenes of wide-open rivers with large trees. Erickson & De Young (1994) found intrinsic motivations, including aesthetics, to play an important role in Mid-western farmers' use of farm woodlots and windbreaks. Farmers who were intrinsically motivated retained and managed more area of their farm in woodlots and hedgerows than those farmers who were more externally motivated by economics. Farmers'

satisfaction from creating a landscape that they consider to be aesthetically pleasing may have important consequences for riparian forest management.

In a study of Minnesota farmers' adoption of conservation practices, Jackson (1996) found that adoption of more ecologically restorative practices, such as woody vegetation and permanent cover cropping, was associated with participants who believed that conservation has long-term benefits for the environment. Having a greater concern for long-term sustainability was also found to be an important motivation for organic farmers in Michigan, who were more willing than non-organic farmers to incur the short-term financial risk of engaging in conservation practices (McCann *et al.*, 1997).

Previous literature has uncovered a range of motivations for farmers' adoption of conservation practices. However, few studies have focused specifically on management of the riparian zone. In addition, government policy continues to over-emphasize economics as the sole motivation for farmers' management decisions, with mixed success (Carlson *et al.*, 1994; Napier *et al.*, 2000). The diminishing amount of money available to 'motivate' farmers' conservation practices, as well as the magnitude of the environmental crisis, suggest the need for alternative ways to motivate good stewardship of the land. In order to explore some of these options, a study was conducted of farmers' management practices and motivations for conservation along the riparian zone in a Midwestern agricultural watershed.

## Study Context

### *River Raisin Watershed*

The River Raisin watershed is located in south-eastern Michigan near the growing Detroit metropolitan region and Toledo, OH (Figure 1). The watershed had a population of 152 000 in 2000 (US Census Bureau, 2000) clustered in the major cities of Adrian and Monroe as well as in several smaller villages. The River Raisin is a major source of drinking water for the watershed's population. The watershed is 1072 square miles (2776 $km^2$) in area and is typical of the lower Great Lakes rural landscape. The River Raisin flows eastward 135 miles (218 km) from its headwaters in the forested Irish Hills at 1200 feet (330 m) above sea level through a hilly landscape formed by glacial moraines. The river then enters a flat lake plain which is dominated by corn and soybean agriculture before draining into Lake Erie at Monroe, MI (Manson *et al.*, 1994).

While the watershed is predominantly agricultural (70% in Lenawee County, according to the 1997 US Agricultural Census), it faces residential development pressure from nearby metropolitan areas. Previous studies in a 10-township sample of the watershed showed an increase in urban development and a concurrent decrease in agriculture land use over the 20-year period from 1968 to 1988 (Erickson, 1995; Allan *et al.*, 1997). These changes in land use were associated with an increase in forest cover and connectivity throughout the watershed, especially along the riparian corridors. While new urban development poses a threat to the water quality, non-point-source pollution from agriculture has been identified as the major water quality problem in the watershed (Manson *et al.*, 1994), as well as in the entire Lake Erie drainage basin (Forster, 2000).

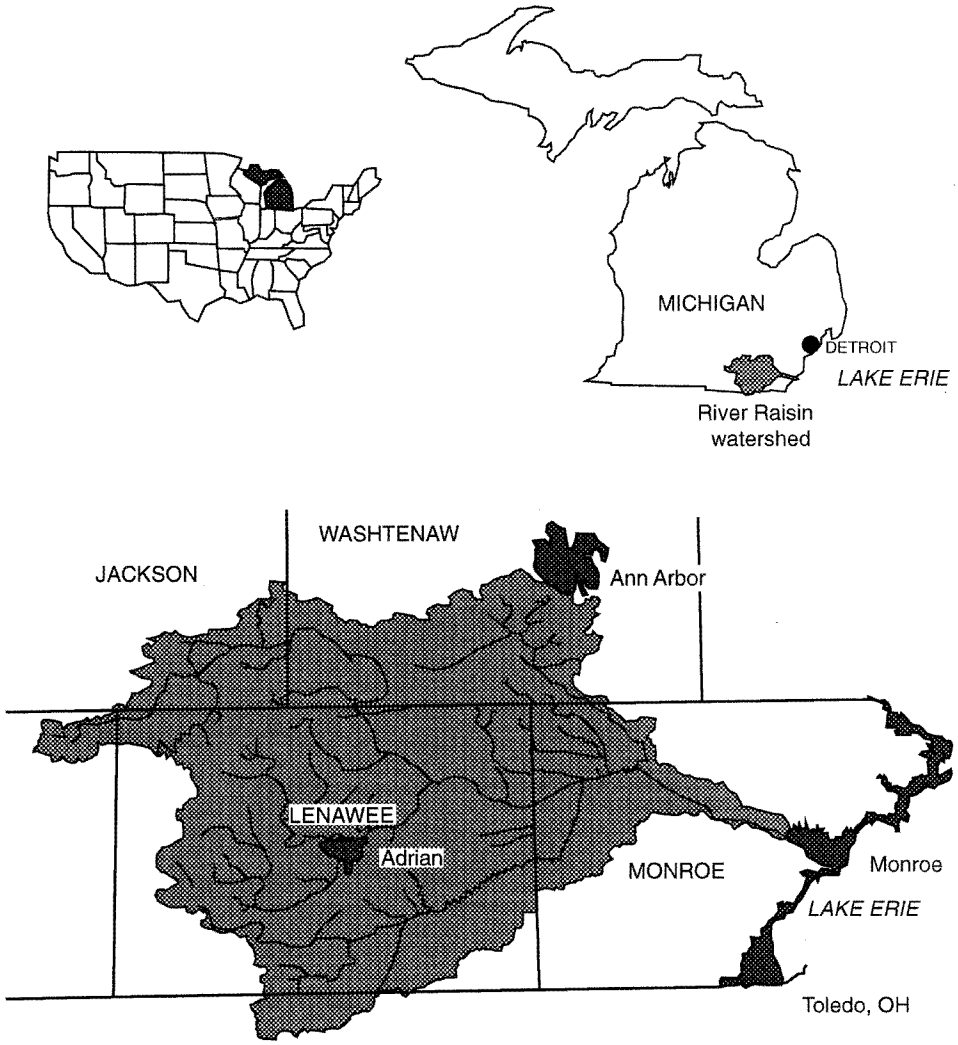


**Figure 1.** River Raisin watershed.

In order to address the impacts of agriculture on water quality, it is essential to learn more about farmers' current management along the riparian zone. Local USDA Natural Resource Conservation Service (NRCS) offices and the River Raisin Watershed Council have been actively promoting grass filter strips along the river and its tributaries. However, these programmes have not emphasized the planting of more permanent cover along rivers and streams, such as riparian vegetation that would have greater ecological benefits (Manson *et al.*, 1994). In the hope of expanding conservation efforts, it is important to understand farmers' motivations to engage in conservation and the management practices they are likely to adopt in the future along their streams and drains.

Previous studies in the River Raisin watershed suggest that farmers and non-farmers have different attitudes about land management. A study of woodlot owners' motivations for managing non-industrial private forests found significant differences between residential and farm owners (Erickson *et al.*,

2002). Likewise, another study in the watershed found significant differences between farmers' and residential landowners' perceptions of the river corridor (Ryan, 1998). Therefore, this study explores the relationship between motivation and the likelihood of adopting conservation practices along the riparian zone.

*Research Questions/Hypotheses*

The following are the specific research questions and hypotheses that motivated this study.

(1) What are farmers' motivations for adopting conservation practices? In light of the authors' previous research findings (Erickson & De Young, 1994; Erickson *et al.*, 2002), we would expect intrinsic reasons, including aesthetics, to be stronger motivations for conservation than economic motivation, despite the emphasis on economics in the soil conservation literature.
(2) What are farmers' current management practices along the streams and drains? If current conservation programmes have been successful, we would expect to see widespread use of conservation practices, such as no-till farming and grassy filter/buffer strips, which are promoted by current US agricultural policy and local agencies (Manson *et al.*, 1994; USDA, 1996).
(3) What future management practices are farmers likely to adopt along their streams and drains? Recent NRCS programmes have begun to place more emphasis on environmental protection (i.e. the Wetland Reserve Program, the Environmental Quality Incentive Program and the Forestry Incentive Program). If these more environmentally centred outreach programmes are successful, we would expect farmers to be more likely to consider using woody riparian vegetation along streams and drains in the future.
(4) What is the relationship between farm income and likelihood of adopting conservation practices? We would expect that farmers with less dependence on farm income would be more likely to take the financial risk of engaging in innovative conservation practices.
(5) How do farmers' motivations affect their likelihood of adopting conservation strategies along the streams and drains that run through their farm? On the one hand, we would expect intrinsic motivations to be stronger reasons for adopting more aggressive conservation strategies. On the other hand, extrinsic motivations, such as economics, may play a factor in adopting more conventional conservation strategies, such as no-till farming, which are often required to receive government subsidies.

## Methods

*Survey Instrument*

A survey instrument was developed through a review of the literature on conservation motivations, as well as through the authors' previous studies on conservation (Erickson *et al.*, 2002). Key informant interviews with farmers, government officials and outreach co-ordinators in the River Raisin watershed helped focus the survey on the specific conservation issues and practices that were pertinent to the study area (Erickson *et al.*, 1998). The research team also collaborated with local NRCS staff in developing the survey and pre-tested it with local farmers.

The survey instrument looked at, among other things, farmers' motivations for using conservation practices, their likelihood of adopting specific conservation practices in the future and their current conservation practices. Most of the questions asked participants to use a 5-point Likert scale (1 = not at all ... 5 = a great deal) to indicate the extent they agreed with a particular item.

Background questions asked participants about their enrolment in government conservation programmes and information about their farm, including size, type of farm production and landscape features (i.e. soil type, slopes, vegetation and hydrology). Demographic questions on issues such as age and farming experience were also included.

*Study Sample*

The study sample consisted of farm operators in the River Raisin watershed who had worked with their local USDA NRCS office. This sample included both those who participated in programmes and those who had only received programme information. The majority of farmers in the watershed (75%) were sent a copy of the survey. Overall, 1340 surveys were mailed to farm owners in the River Raisin watershed. Of these surveys, 27 were returned as undeliverable for an effective distribution of 1313 surveys. The majority of surveys, 1023, were distributed in Lenawee County, which covers the largest area of the watershed; the balance were sent to farmers in Monroe and Washtenaw counties. A total of 268 surveys were returned, for a response rate of 20%.

Comparison of the study sample with the overall population of farmers in the watershed revealed this sample to be very representative with regard to percentage of farmers with off-farm income, median farm size, farm type and age (USDA, 1997). The background information provided by the respondents indicated that about half of the sample were part-time farmers, with 51% of respondents indicating that they received 25% or less of their income from farming and another 32% of the participants indicating that they received 25–99% of their income from farming. Only 16% were full-time farmers, relying solely on their farm for income. The majority of respondents (55%) raised primarily crops, while one-third raised crops and livestock.

The study sample was characterized by family farm owners. The median farm size was 120 acres (49 hectares) and at least half of the participants' families had owned their farms more than 35 years. A vast majority were experienced farmers who operated their own farm alone (61%) or with the help of family members (32%). This sample reflects the aging farm population nation-wide, with a large percentage (47.3%) in their 50s and 60s; only 36% were in their 30s and 40s, and 17% were 70 years and older in age.

Three-quarters of respondents indicated that they had a conservation plan for their farm. Of those respondents who had a conservation plan, the majority (84%) indicated that most of their plan had been implemented. Since conservation plans are often required to participate in government programmes, it is not surprising that approximately 42% of the respondents participate in the USDA Conservation Reserve Program and an equal percentage participate in the Agriculture Conservation Program. NRCS programmes that focus on specific environmental issues received much lower participation: the Wetland Reserve Program 16%; the Environmental Quality Incentive Program 15%; and the Wildlife Habitat Incentive Program 9%.

The landscape features that respondents indicated having on their property give a good description of the farms in the watershed. The vast majority of participants (85%) indicated that they had some form of river, stream or drain on their property. In addition, 65% reported that they had woodlots on their property. Topographically, the farmers indicated having slightly rolling topography, although 23% also indicated having some steep topography (greater than 9% slope). Overall, the soil erodibility was slight to medium (heavy clays to clay/loams) rather than highly erosive (silts/sands), which corresponds with the typical surficial geology of the watershed.

### *Data Analysis*

The survey results were analysed using factor analysis in order to identify discrete categories within these large data sets. In particular, categories within the data were identified using principal axis factor analysis with varimax rotation and pairwise deletion of missing data. The criteria used for inclusion of items in a factor category were loadings greater than 0.50 in a category, no dual loadings of greater than 0.50 in two or more categories and separation between dual loadings of 0.10. Factors were required to have eigenvalues of greater than 1.0. The output of the factor analysis programme was used to identify highly coherent and stable categories. In order to enhance internal validity, categories were required to have a Cronbach's coefficient of internal consistency, alpha (Cronbach, 1951; Nunnally, 1978), of at least 0.70 (except as noted). Scales were then constructed using a respondent's average rating of the items that formed the category. Paired sample *t*-tests and one-way analysis of variance were used to compare different participant groups.

## Results

### *Motivations for Adopting Conservation Practices*

Factor analysis of the 16 items related to farmers' motivations for practising conservation resulted in six categories of motivations with Cronbach's alpha of internal consistency ranging from 0.71 to 0.86, which suggests coherent and stable categories (see Table 1). Four survey items did not meet the selection criteria for categories and were eliminated from further analysis.

The highest-rated category (mean = 4.55) consisted of four items relating to intrinsic motivation/attachment to the land. The items in this category included a desire to conserve land for future generations and feeling attached to one's land. This category supported the authors' hypothesis that farmers are strongly motivated to adopt conservation practices by intrinsic motivations, in this case a love for their land.

A single-item category showed that farmers also feel that reducing soil erosion makes economic sense for their farm. This item, although highly rated (mean = 4.41), was rated lower than the intrinsic motivation/attachment to the land category. Thus, the participants report that soil conservation is good business.

The visual quality of management was the next-highest-rated category (mean = 3.96). This category consisted of the single item, 'conservation practices make my farm look well-managed'. This finding is consistent with Nassauer's

**Table 1.** Motivations for adopting conservation practices

| Category | Mean | Standard deviation | Alpha |
|---|---|---|---|
| Intrinsic motivation/attachment to land | 4.55 | 0.59 | 0.86 |
| I would be upset if my activities harmed my land | 4.45 | | |
| Protecting the environment is important to me | 4.51 | | |
| I want to conserve this land for future generations | 4.61 | | |
| I am very attached to my land and want to protect it | 4.62 | | |
| Soil conservation is good business | | | |
| Reducing soil erosion makes economic sense *for my farm* | 4.41 | 0.86 | |
| Visual quality of management | | | |
| Conservation practices make my farm look well-managed | 3.96 | 1.13 | |
| Concerns for neighbours | 3.73 | 0.93 | 0.71 |
| Polluting the stream would harm my downstream neighbours | 4.22 | | |
| Soil erosion will damage my neighbours' property | 3.28 | | |
| Soil erosion may harm fish in the nearby stream | | 3.75 | |
| Concern for the land | 3.45 | 1.10 | 0.71 |
| Allow me to keep marginal fields out of production | 3.43 | | |
| Reduce agricultural chemical use | | 3.46 | |
| Economic motivation | | | |
| Receive payment for conservation | 3.19 | 1.46 | |

(1988, 1989) work, in which the aesthetic characteristics of conservation practices were important to Mid-western farmers, in particular, because they convey the message of good stewardship about the landowner.

The fourth category involved motivations for conservation that acknowledged the negative effects that soil erosion and stream pollution might have on one's neighbours. This concerns for neighbours category, with a mean of 3.73, suggests that farmers are aware of the consequences that poor conservation practices can have for the nearby environment.

The next category, concern for the land, illustrates that at some level, farmers adopt conservation practices that allow them to keep marginal fields out of production and reduce agricultural chemical use. The fact that this two-item category (mean = 3.45) was rated significantly lower than most of the other categories makes sense, considering that some conservation practices, such as no-till farming, actually increase farmers' use of chemicals, especially herbicides

Finally, the lowest-rated category (mean = 3.19) involved economic motivation for adopting conservation practices and consisted of a single item, 'receive payment for conservation'. This category contradicts the long-standing assumption that farmers only practise conservation when they receive extrinsic rewards, such as cash payments. This result also supports the authors' hypothesis that farmers are motivated by many other factors besides simply economics.

### *Group Differences: Motivations for Adopting Conservation Practices*

It was hypothesized in this study that motivations for adopting conservation practices would be affected by several independent variables, such as percentage of farm income, size of farm or length of time participants' land had been in their family. These hypotheses were not supported by the research results. In fact, in all but one comparison, the motivations for adopting conservation

practices were equally shared by a wide range of participants—part-time farmers and full-time farmers, experienced and less experienced farmers, younger farmers and older farmers. It is also important to note that no group, including full-time farmers, was highly motivated by economic reasons for engaging in conservation practices.

### *Current Management Practices along the Riparian Zone*

Participants were asked to indicate the management practices that they were currently using along their streams and drains from a list of 21 management options. These management options included conservation practices, such as 'maintain a grassy buffer strip', as well as practices that could be detrimental to stream health, such as 'till up to the edge of streams and drains'. The most commonly used management practices along the riparian zone were no-till farming (27.2%), grassy buffer or filter strips (26.9%), cleaning out rubbish (22.4%) and clearing brush (21.6%) from streams and drains (Table 2). It is not surprising that the top two conservation practices, no-till farming and grass filter strips, were also supported by the 1995 Farm Bill (which was in effect during the time of this study). Maintaining a vegetative buffer of trees and shrubs (14.6%) and allowing stream banks to revert to brush and woods (9.3%) were used by a much smaller percentage of farmers. While having more woody buffer strips would be better for stream health, the fact that very few farmers (1.1%) indicated that they tilled up to the edge of streams and drains suggests a widespread understanding of the importance of having at least minimal stream buffers.

### *Likelihood of Adopting Management Practices along Streams and Drains in the Future*

Participants were asked to use a 5-point Likert scale (1 = not at all ... 5 = a great deal) to indicate their likelihood of adopting management practices along their streams and drains (in the future) from the list of management options used in the previous question. It was expected that farmers would be more interested in adopting management practices that were conservation-oriented rather than ones which might be ecologically damaging, especially considering the efforts of local NRCS offices to promote conservation practices. The results of this survey support this hypothesis. Factor analysis of the management practices that participants were likely to adopt along their streams and drains revealed four factor categories with Cronbach's alpha of internal consistency ranging from 0.74 to 0.83, as well as three individual items which did not cluster on any category (see Table 3). In addition, four survey items loaded on more than one category and were eliminated from further analysis.

The most highly rated management practice (mean = 3.61), which did not factor on any category, was no-till farming. It is important to note that farmers may conceptualize no-till farming as a range of conservation tillage practices, such as minimum tillage.

The next-highest-rated management category (mean = 3.36) involved the likelihood of using mown grass buffer strips along streams and drains. This category included the highest-rated single item, 'maintain a grassy buffer strip/filter strip' (mean = 3.86), as well as items relating to managing this vegetation in a neat and ordered manner, including 'keep grass mown along streams and drains' and 'clear brush'. Grass buffer and filter strips, like no-till

**Table 2.** Current management practices along streams and drains

| Practice | Percentage of respondents using practice |
|---|---|
| Use no-till farming to minimize soil erosion | 27.2 |
| Maintain a grassy buffer strip/filter strip | 26.9 |
| Clean out rubbish from streams and drains | 22.4 |
| Clear brush | 21.6 |
| Install drain tiles | 19.0 |
| Keep grass mown along streams and drains | 18.7 |
| Clear out logjams and other woody debris | 16.0 |
| Dredge drains or streams to improve stream flow | 16.0 |
| Use rip-rap (i.e. stones or concrete rubble) to shore up stream banks | 15.3 |
| Keep area along streams neat and well-ordered | 14.6 |
| Maintain a vegetative buffer of trees and shrubs | 14.6 |
| Allow stream banks to revert to brush and woods | 9.3 |
| Maintain views to stream by keeping vegetation pruned | 8.6 |
| Use herbicides to keep vegetation under control | 7.5 |
| Retention basin for run-off from livestock areas | 7.5 |
| Set back new buildings from streams | 6.3 |
| Plant trees and shrubs along stream banks | 6.3 |
| Add new drainage channels | 5.6 |
| Straighten streams to improve drainage | 4.9 |
| Remove drain tiles from some fields | 1.5 |
| Till up to edge of streams and drains | 1.1 |

farming, are strongly encouraged by current farm policy and programmes. Thus, it is not surprising that these were the two top management practices that farmers were likely to engage in along their streams and drains. These results suggest that the farm programmes and outreach efforts of the USDA, and in particular the NRCS offices, are making a difference in farmers' management plans. However, farm programmes do not prescribe how farmers should manage their grassy filter strips. Therefore, it is interesting to note that farmers in this study expressed a preference for maintaining their riparian areas in a neat, well-ordered manner, including mowing grass and clearing brush. This supports other research findings (Nassauer, 1988, 1989; Carr & Tait, 1991; Erickson & De Young, 1994), that farmers are more likely to engage in conservation practices that they consider aesthetically pleasing and convey the message that they are good stewards of their land.

The third category involved construction practices that protect stream health, including retention basins for livestock run-off, setting back new buildings from streams and using rip-rap for stream bank stabilization. With a mean of 3.12, these practices were in the mid-range for adoption by study participants.

The fourth category centred on improving drainage along streams and drains, such as installing drain tiles or channels and straightening streams. While participants might consider these important management practices to get excess water off their fields, drainage 'improvements' such as these can negatively impact local streams by altering the hydrological regime (Yarbro *et al.*, 1984).

**Table 3.** Likelihood of adopting management practices along streams and drains in the future

| Category | Mean | Standard deviation | Alpha |
|---|---|---|---|
| No-till farming | | | |
| Use no-till farming to minimize soil erosion | 3.61 | 1.39 | |
| Maintain mown grass buffers | 3.36 | 1.13 | 0.83 |
| Keep area along streams neat and well-ordered | 3.23 | | |
| Keep grass mown along streams and drains | 3.02 | | |
| Clear brush | 3.34 | | |
| Maintain a grassy buffer strip/filter strip | 3.86 | | |
| Construction practices | 3.12 | 1.25 | 0.75 |
| Retention basin for run-off from livestock areas | | 2.82 | |
| Set back new buildings from streams | 3.41 | | |
| Use rip-rap (i.e. stones or concrete rubble) to shore-up stream banks | 3.07 | | |
| Improving drainage | 2.61 | 1.16 | 0.77 |
| Install drain tiles | 3.24 | | |
| Straighten streams to improve drainage | 2.15 | | |
| Add new drainage channels | 2.47 | | |
| Woody cover | 2.36[a] | 1.05 | 0.74 |
| Plant trees and shrubs along stream banks | 2.27 | | |
| Allow stream banks to revert to brush and woods | 2.53 | | |
| Maintain a vegetative buffer of trees and shrubs | | 3.16 | |
| Remove drain tiles from some fields | 1.42 | | |
| Use herbicides | | | |
| Use herbicides to keep vegetation under control | 2.15[a] | 1.28 | |
| Till up to stream | | | |
| Till up to edge of streams and drains | 1.47 | 0.92 | |

[a]Means showing superscripts are *not* significantly different at the $p < 0.05$ level.

This category only received a low rating of 2.61, barely above mid-point of the scale.

Maintaining woody cover along streams and drains was the fifth category of management options that resulted from factor analysis. This category included items related to both maintaining a vegetative buffer of trees and shrubs (that may already exist) and planting new trees and shrubs or allowing stream banks to revert to brush and woods. Despite the fact that woody riparian vegetation provides more habitat benefits and filtering capabilities for sediment and nutrient run-off than mown grass buffer strips (Karr & Schlosser, 1978; Binford & Buchenau, 1993), this category was rated significantly lower (mean = 2.36) than the maintain mown grass buffers category. One reason for this difference in preference for management options may be that farmers perceive woody vegetation as more messy than a mown grass buffer strip. In addition, woody buffers may take more farmland permanently out of production than grass strips, since woody plants are more difficult and costly to remove.

The lowest-rated individual items in the survey (which did not cluster on any category) involved the use of herbicides to keep vegetation under control and tilling up to the edge of streams and drains, with respective means of 2.15 and 1.47. It was reassuring that participants were least likely to engage in these management practices that would be negative for stream health.

**Table 4.** Significant differences in likelihood of adopting management practices along streams and drains by percentage of farm income

| | Mean score | | | | |
|---|---|---|---|---|---|
| Likelihood of adopting management | Part-time farmers (0–25%) | Full-time farmers (26–100%) | $t$ | Degrees of freedom | Significance |
| No-till farming | 3.41 | 3.80 | −2.105 | 225 | $p < 0.05$ |
| Refined management: grass buffer | 2.95 | 3.73 | −5.592 | 228 | $p < 0.000$ |
| Construction practices | 2.92 | 3.29 | −2.154 | 216 | $p < 0.05$ |
| Improving drainage | 2.22 | 3.01 | −5.519 | 225 | $p < 0.000$ |
| Maintaining woody cover | 2.83 | 1.93 | 7.049 | 230 | $p < 0.000$ |
| Use herbicides | 2.00 | 2.28 | | | NS |
| Till up to stream | 1.39 | 1.57 | | | NS |

NS, Not significant.

*Group Differences for the Likelihood of Adopting Management Practices along Streams and Drains*

Of all of the background variables, percentage of farm income and farm size made the most significant differences in the likelihood that participants would adopt a particular category of management practices along streams and drains in the future. However, these two variables were positively correlated (i.e. full-time farmers were more likely to own larger farms) and produced the same significant differences. Thus, only the results for farm income are reported in Table 4. The study sample was evenly divided between part-time farmers (i.e. those who received 25% or less of their income from farming) and full-time farmers (i.e. those who received greater than 25% of their income from farming). Full-time farmers were significantly more likely than part-time farmer to adopt no-till farming and mown grass buffer strips along their stream and drains. These differences also held true between large farms and small farms. Part-time farmers, on the other hand, were significantly more likely to maintain woody vegetative cover along their streams and drains. In addition, full time farmers were significantly more likely to consider improving drainage of their land (i.e. install drain tiles, etc.) and using construction practices, such as creating retention basins for livestock run-off, along streams and drains. It makes sense that those who receive a significant amount of their income from farming would be more inclined to engage in practices such as improving drainage that would increase farm production.

For the most part, the landscape characteristics of participants' farms (i.e. forest cover, hedgerows, major rivers and streams) had little effect on their likelihood of adopting particular management practices. However, there was one noteworthy exception. Those who indicated that they had hedgerows on their land were also more likely to maintain woody cover along their streams and drains in the future (mean = 2.63, $t = 3.063$, $p < 0.005$, degrees of freedom = 236) than were those who had no hedgerows (mean = 2.20). This result suggests that those who already engage in one type of conservation practice on their land (i.e. hedgerows) may be more likely to engage in other practices. In addition, the

presence of hedgerows on participants' property indicates a familiarity and willingness to allow woody vegetation to persist on one's farm.

### *Effects of Motivation on Likelihood of Adopting Management Practices*

Central to this research study was the question: how do farmers' motivations for conservation affect the likelihood of adopting conservation-minded management practices along their streams and drains? The study found several significant relationships between different types of intrinsic motivations and likelihood of adopting conservation practices that support the authors' research hypotheses. Those farmers who indicated that they were strongly motivated by intrinsic motivation/attachment to the land were significantly more likely to indicate that they would maintain woody cover (mean = 2.62, $t = -3.57$, $p < 0.000$, degrees of freedom = 2.35) along their streams and drains than did those who were slightly less intrinsically motivated (mean = 2.14). Likewise, those farmers with strong intrinsic motivation and attachment to their land were also more likely to consider adopting no-till farming along streams and drains (mean = 3.95, $t = -3.49$, $p < 0.001$, degrees of freedom = 231) than were those who were less intrinsically motivated (mean = 3.33). Thus, it appears that intrinsic motivations and attachment to one's land are not only strong motivations for adopting conservation practices, but also good determinants of which farmers may adopt these conservation practices.

Participants who indicated that they were highly motivated by the visual quality of management (i.e. 'conservation practices make my farm look well-managed') were significantly more likely to adopt no-till farming (mean = 3.97, $F = 3.61$, $p < 0.05$, degrees of freedom = 2, 215), mown grass buffer strips (mean = 3.66, $F = 4.69$, $p < 0.01$, degrees of freedom = 2, 219) and construction practices (mean = 3.40, $F = 4.90$, $p < 0.01$, degrees of freedom = 2, 206) such as retention basins for livestock run-off than were those who were much less motivated by this reason (respective means = 3.40, 3.13, 2.76). Farmers may consider these particular practices, which are highly visible, to convey the message of good stewardship (to other farmers). The type of care appears to play an important role in considering adoption of management practices. Farmers considered neatly mown grass buffer strips to give the impression of good management, while woody vegetation along streams and drains was not associated with giving one's farm a well-managed appearance.

The other motivation categories, economic motivation (i.e. 'receive payment for conservation') and concern for neighbours, were not significant factors in determining the likelihood of adopting particular conservation practices.

## Discussion: Implications for Protecting the Riparian Zone

This study has important implications for protecting riparian streams in agricultural watersheds. As shown by other researchers (e.g. Battershill & Gilg, 1997), understanding landowners' motivations for adopting conservation practices is vital for promoting widespread protection of threatened resources such as streams and rivers. The results of this study show that farmers are more intrinsically motivated to practise conservation than extrinsically motivated by economics. The importance of intrinsic motivations is supported by other conservation behaviour studies (Christensen & Norris, 1983; De Young, 1996).

Farmers' attachment to their land and their desire to protect it for future generations are an integral part of their desire to be good stewards of their land. Attachment to the land has also been found to be an important motivation for landowners to donate their property to a land trust (Ochterski, 1996). It is heartening that the sample of farmers made the connection between practising conservation and its long-term benefits for the land.

Farmers are concerned about the aesthetic quality of conservation practices. In support of previous research (Nassauer, 1988, 1989; Carr & Tait, 1991; Erickson & De Young, 1994), the study found that farmers engage in conservation practices along the riparian zone that make their farm appear well-managed (to other farmers). Conservation practices, such as neatly mown grassy swales and no-till farming, that are visible on the land convey the message of good stewardship better than less visible conservation practices, such as reducing chemical use along streams. Unfortunately, maintaining woody riparian cover, while very visible and environmentally beneficial, was not perceived as giving the appearance of good stewardship, especially by full-time farmers.

Another motivation for practising conservation along the riparian edge was farmers' concern about the effects their farming practices had on downstream neighbours. Tapping into farmers' sense of obligation to their community may be a new strategy for convincing farmers to engage in conservation. The social dimension of farmers' conservation behaviour is a variable worth further exploration in environmental planning and policy research.

The results of this study suggest that adopting conservation practices may be more likely when supported by a range of motivations (e.g. aesthetic, social and economic) rather than solely by economics. While intrinsic motivations were the most important reasons that farmers practised conservation, it is important to note that extrinsic motivations were also a contributing factor. Farmers indicated that soil conservation made economic sense. After all, conserving soil is essential for the long-term economic viability of their farms. However, the role of economic motivations is not as clear-cut as has been suggested by some researchers (Napier & Forster, 1982). The authors were surprised in the study to discover that receiving government payments for conservation was rated the least likely reason to adopt conservation practices. It may be that government payments for conservation are too low to make a significant difference in adopting conservation practices or that the smaller-scale farms in this watershed are less likely to receive government subsidies.

With regard to current management of the riparian zone, this study showed that no-till farming and grass buffer strips were the most commonly practised management along streams and drains in this watershed. Not coincidentally, these are also the conservation practices that are promoted by local NRCS offices and are often required of farmers who receive government subsidies. Thus, government programmes play a strong role in the type of conservation practices that farmers use along the riparian edge. Interviews with farmers and other key informants in the River Raisin watershed showed that farmers are reluctant to allow fallow acreage enrolled in government programmes to revert to woody riparian vegetation, because many government programmes are considered too short-term and unpredictable (Erickson *et al.*, 1998). Grass buffer strips are much easier to convert back to farmland than woody vegetation when government programmes end. Despite the fact that grass filter strips provide many benefits for water quality, such as sediment and fertilizer removal (Lyons *et al.*, 2000),

there is a need for long-term government programmes that promote more environmentally diverse riparian buffers, such as native, woody vegetation (Lowrance *et al.*, 2000).

As shown by the results of this study, farmers' enrolment in current conservation programmes is by no means widespread. To achieve the goals of widespread conservation and improved water quality, government agencies need to understand the diverse range of farmer motivations for conservation. Government conservation programmes need to be restructured to take into consideration the aesthetics of management practices and farmers' desire to be perceived as good stewards of their land. While economics certainly plays a role in adopting conservation, it appears that attachment to one's land and other intrinsic motivations play a stronger role in adopting more environmentally beneficial practices, such as woody buffer strips. Conservation practices which are more consciously designed and managed have a better chance of widespread acceptance by farmers. It may be possible to design woody vegetative strips in a manner that creates the neat, well-managed appearance that farmers appreciate in mown grass buffers.

The study findings show that farm structure (i.e. percentage of income received from farming) was an important factor in determining the types of conservation practices that study participants were likely to adopt along their streams. Part-time farmers were significantly more likely than full-time farmers to consider maintaining a woody vegetative buffer along their streams. This result supports the notion that small-scale, part-time farmers are more likely to support soil conservation (Buttel *et al.*, 1981) and environmentally beneficial streamland management (Schrader, 1995). Part-time farmers are less dependent on their land for income and may be able to afford to allow more woody encroachment along streams and drains. This finding is supported by the authors' study of woodlot owners in the River Raisin watershed (Erickson *et al.*, 2002), which found that part-time farmers and non-farmers were much more likely to allow woody revegetation to encroach on their fields. The fact that the watershed has seen a significant increase in riparian vegetation over a 20 year period (Erickson, 1995) suggests that part-time farmers' actions can have a landscape-wide effect on the land. Government conservation programmes which promote woody riparian buffers may have a better chance of success if they target part-time farmers. As farm income continues to decline relative to off-farm income, the number of part-time farmers will continue to grow—providing further rationale to diversify government programmes for the changing farm owner population.

In conclusion, this study contains several key implications for environmental planning and policy that focuses on improving the ecological health of streams and rivers within agricultural watersheds. The study shows that farmers are motivated to engage in conservation practices by a variety of motivations, many of which are not economic. Therefore, environmental policy and programmes should embrace a wider set of motivations when developing new programmes and outreach activities. For example, educating farmers about the effects of their actions on downstream neighbours may tap into their social obligation to the local community. This study also shows that there is a need to lengthen the time-frame for government programmes in order to encourage farmers to make the long-term commitment of allowing woody riparian buffers to revegetate along their streams and rivers. Government programmes also need to be

restructured to target part-time farmers—a significant part of the farm owner population which is under-served by current programmes, yet is the most likely to adopt more environmentally beneficial conservation practices. Finally, environmental planners need to work with farmers to develop new strategies for promoting riparian buffers that tap into farmers' aesthetic motivations and their desire to be perceived as good stewards of their land. Researchers such as Nassauer *et al.* (2001) have begun work to develop conservation buffers that farmers consider to be aesthetically pleasing and convey the message of good stewardship, but there is still much work to be done. For example, research should be conducted on alternative crops that might extend the benefits of the riparian buffer. Intentional plantings of native riparian vegetation, such as willows, could provide a crop for sale to the floral or craft industry.

As eloquently stated by one of our study participants, "A good farmer does many things to be caretaker of his land regardless of the government programmes. The end result is the good farmer making a living off the land protects his land and drainage ditches". Tapping into farmers' intrinsic desire to be good stewards of their land may provide new avenues for expanding conservation programmes. However, good stewardship in a farmer's eyes may not necessarily be the most ecologically beneficial. For example, the same farmer went on to say: "We have farmed minimum and no-till for a period of years. We have heavy sod banks on our ditches ... We keep ditch[es] mowed once a year to keep woody plants down". New conservation strategies need to be devised that promote more diverse riparian vegetative cover and yet fit into farmers' perceptions of 'good management'.

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