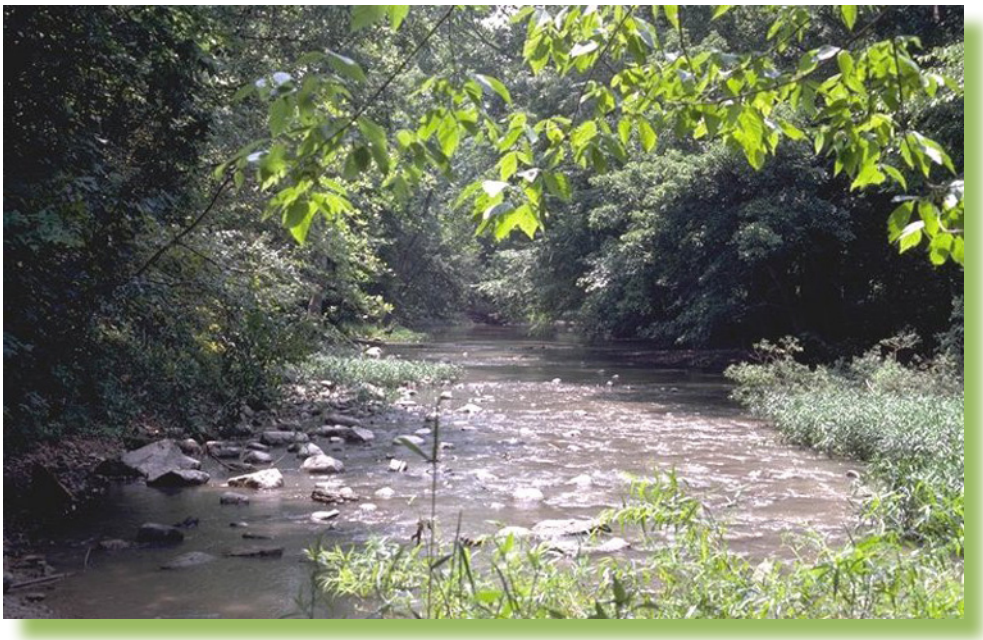
Farmer Participation in Collaborative Management and Best Management Practice Adoption in Two Ohio Watersheds



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INTRODUCTION

Non-point source water pollution can come from a variety of different human activities. Since nonpoint source pollution results from many diffuse actions, managing it can present multiple challenges. In the context of Midwestern United States watersheds, agricultural activities are one common source of non-point source water pollution. In fact, agriculture is listed as the largest cause of non-point source water pollution in the state of Ohio (US EPA 2007).

The chief government agency responsible for addressing non-point source pollution is the U.S. Environmental Protection Agency (EPA). The EPA uses a combination of policy tools, including the assessment of Total Maximum Daily Loads (TMDLs), for impaired waterways. These assessments describe the maximum amount of particular pollutants that can enter a waterbody without violating water quality standards and provide a management outline for remediation. Another EPA policy tool is Section 319 grant funding, a mechanism that provides flexible funding to states to conduct a variety of remediation projects and programs. Both of these policy tools typically emphasize behavior change among private citizens. In agriculturally-dominated area, this often means land manager adoption of agricultural best management practices (BMPs).

BMPs are practices that limit the transport and delivery of water pollutants, through actions such as no-till or reduced tillage cultivation, manure management planning, vegetated buffers along streams, servicing septic systems, etc. Over the past several decades, scholars have examined the motivations for farmers to adopt BMPs, and a variety of variables have been tested. Recently, researchers at Purdue University (Prokopy et al., in press) compiled a list of the factors most often positively associated with farmer adoption of BMPs across 54 different studies over a span of 25 years. According to these studies, the factors most positively associated with BMP adoption are higher degrees of the following: education levels, capacity, capital, income, farm size, access to information, social networks, environmental awareness, and positive environmental attitudes.

The last two variables have been emphasized by policy makers using what Napier and Bridges (2002) term the IETS model: Information to build knowledge and understanding about environmental problems and conservation practices, Educational learning experiences about these problems and practices, Technical assistance for BMP implementation, and economic Subsidies to overcome potential barriers to adoption. In other words, the adoption process begins with information and education, which are thought to affect farmers' environmental awareness and attitudes.

While IETS efforts have been longstanding, a more recent approach to encourage BMP adoption is the use of collaborative watershed groups. These organizations exist in a variety of forms. Of particular interest for this study is the "collaborative watershed partnership" (Sabatier et al. 2005, p. 6), comprised of non-governmental stakeholders (such as farmers) and governmental

stakeholders (such as university extension personnel), who hold little formal legal authority, but offer a forum to discuss water quality data and regulations, strategic management plans, and other land use practices (see Weaver et al. 2005). In this study, the collaborative watershed partnership is the Sugar Creek Partners (see Campbell 2008).

The Sugar Creek Partners group was built from the bottom up, emphasizing support from a narrow portion of the local farming population at the beginning. This was due to tensions between farming and non-farming populations, and the fact that the Ohio Environmental Protection Agency (Ohio EPA) identified the agricultural community as the primary source of water quality impairment in the Sugar Creek watershed (Weaver et al. 2005). Past studies in collaborative watershed management have suggested that a more homogeneous subset of the watershed population may aid in building consensus and local networks for long-term management implementation (Steelman and Carmin 2002; Korfmacher 2000).

In the case of the Sugar Creek Partners, farmers and university staff came together to create a management plan that measured and addressed the environmental concerns imposed by a regulatory agency -- Ohio EPA -- but reflected the values and beliefs of the farming community that comprised it (Weaver et al. 2005). A key aspect of this group is the incorporation of community-based research to build knowledge and awareness of water quality issues. A number of programs developed by the group are dedicated to building awareness of water quality issues and data in relation to the agricultural sector and to the community at-large.

RESEARCH QUESTIONS

Despite the increasing use of collaboration as a strategy to encourage BMP adoption, little is known about the connection between the two. To better understand the role of collaboration in BMP adoption, this study uses a survey of farmers in two different watersheds (one with a collaborative partnership and one without) to answer the following research questions:

1. Where and from whom are respondents getting information about water quality issues?
2. What are the respondents' beliefs about water quality issues?
3. What BMPs are respondents currently using?
4. What are some reasons for adoption and non-adoption of BMPs?
5. What is the awareness of watershed Total Maximum Daily Loads (TMDL)?

RESEARCH METHODS

The two Ohio watersheds involved in this study are the Upper Sugar Creek watershed in Wayne County, where a collaborative watershed group has been formed, and the Pusheta Creek watershed in Auglaize and Shelby Counties, where no such group has emerged. These two watersheds were selected because both have had water quality assessments and management

suggestions detailed through a TMDL, they are similar sized watersheds (14-digit Hydrologic Unit Code (HUC)), and their land use is primarily agricultural, 88% in the Upper Sugar Creek watershed and 90% in Pusheta Creek watershed.

A survey questionnaire was implemented to better understand farmer characteristics and use of conservation practices in the two selected watersheds. The framework for the survey was developed by the EPA Region 5 Social Indicators Team (Genskow and Prokopy, in press), adjusted for variables pertaining to the watersheds in the study. The target population for this study was agricultural land managers in each of the two watersheds. A database containing names and mailing addresses of all owners of Current Agricultural Use Value (CAUV) land was obtained from the county auditor's databases. GIS-based auditor parcel and mailing address information was overlaid onto the Natural Resource Conservation Service's HUC data for the corresponding 14-digit HUC layers. Parcels flagged as CAUV in the auditor databases were identified as agricultural producing lands and were matched with the corresponding mailing addresses. GIS specialists in each of the county offices did this work.

The survey was distributed using the drop-off/pick-up method (Riley and Kiger 2002). Individuals were asked in person the qualifying question of whether or not they were the primary land manager of the agricultural operation. In the Upper Sugar Creek watershed, surveys were delivered to 79 farmers, which yielded 71 returns (90% response rate). In the Pusheta Creek watershed, surveys were delivered to 62 farmers, which yielded 59 returns (95% response rate). Surveys were distributed and collected between December 2007 and January 2008.

RESULTS

Farmer and Farm Characteristics

There were several similarities in respondent characteristics across the two watersheds, most notably in gender. Nearly all of the respondents in both watersheds were male (95% of respondents in Pusheta Creek, 97% in Upper Sugar Creek).

Slight differences were evident in age, education, and intergenerational land ownership. Nearly all of the respondents in the Pusheta Creek and the Upper Sugar Creek were over the age of 34. Respondents in the Upper Sugar Creek tended to be slightly younger, with the most frequent category of 45-54 years, compared to 55-64 as the most frequent age among Pusheta Creek respondents.

The majority of respondents in both watersheds have at least a high school diploma or GED. In addition, 41% of respondents in the Pusheta Creek, and 50 % of in the Upper Sugar Creek, have completed at least some college.

To get a better idea of intergenerational land ownership patterns in each watershed, the

questionnaire asked respondents, “How likely is it that any family member may continue farm operations when you retire or quit farming?” Close-ended responses were provided: “will not happen,” “unlikely,” “likely”, “will definitely happen”, and “unsure.” Pusheta Creek respondents were somewhat more likely to report “likely” or “will definitely happen” than were Upper Sugar Creek respondents, 67 % to 59 %.

The biggest differences between respondents in the two watersheds were in employment and farm size/type. Nearly half (46%) of Pusheta Creek respondents had worked for pay more than 200 days off-farm, for at least 4 hours per day, in the past year. This figure was lower for Upper Sugar Creek respondents, where just 32% had done so. Conversely, 37% of Pusheta Creek respondents did not engage in off-farm labor, compared to 48% of Upper Sugar Creek respondents.

Pusheta Creek respondents tended to have larger farms, with a range from three farmers producing over 2,000 acres to one farmer operating less than 9 acres; the median farm size was between 260 and 499 acres. In the Upper Sugar Creek watershed, respondents’ farm size ranged from three farmers producing between 1,000 acres and 1,999 acres to three farmers operating less than 9 acres. The median farm size was between 100 and 139 acres. Type of farming operation also differed; respondents in the Pusheta Creek watershed included a higher percentage of row crop farmers (92% compared to 84%) and lower percentage of livestock farmers (49% compared to 68%).

Question 1: Sources of Information

Survey data were compared across three groups: Pusheta Creek respondents (no collaborative partnership), respondents in the Upper Sugar Creek watershed who were participants in the Upper Sugar Creek Partners, and respondents in the Upper Sugar Creek watershed who were not participants (note: participants were those who had either attended more than one Partners meeting, attended a Partners family day event, or discussed water quality issues with members of the Partners). Just over one third (34%) of respondents in the Upper Sugar Creek watershed have participated with the Partners group. Although there exists no formal collaborative watershed group in the Pusheta Creek watershed, some respondents still listed this as a source of information. This may be partly attributed to the fact that some conservation programs within the county are diffused on a watershed scale from other locations with a collaborative watershed group.

This study measured sources of information about water quality problems in two ways. First, respondents were asked to check any of the following sources from which they had heard of water quality problems: newsletters, brochures, Internet, radio, newspaper, television, friends/family, local conservation representation, local watershed group, or other. As shown in Figure 1, newsletters and newspapers were top information sources among all three groups. Among Partner participants, the partnership was also a key source of information, whereas it was not a key source for non-participants in the watershed (or for Pusheta Creek respondents). Local

conservation representatives played a more prominent role among Pusheta Creek respondents and Upper Sugar Creek participants than in Upper Sugar Creek non-participants.

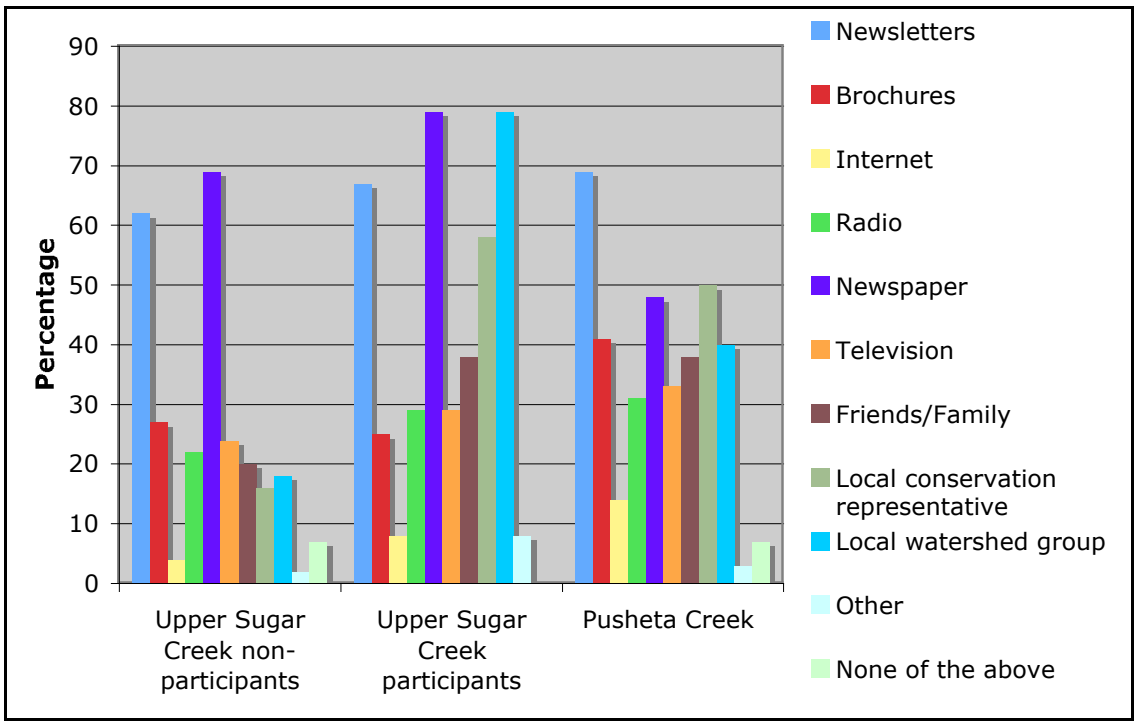

Figure 1. Frequency of sources of information about water quality problems.

Second, several water quality information sources were listed: local watershed project, Soil and Water Conservation District, Natural Resources Conservation Service, OSU Extension, other landowners/friends, Ohio EPA, environmental groups, Farm Bureau, fertilizer representatives, crop consultants, state agricultural agency, and the Ohio Agricultural Research and Development Center (only for Upper Sugar Creek). For each of these sources, respondents were asked to indicate the level of importance they place on it, from a scale that ranged from "not at all important" (0) to "very important" (4). As shown in Figure 2, all three types of respondents place a lot of importance upon their local watershed project, SWCD, NRCS, and OSU Extension as sources of information about water quality issues.

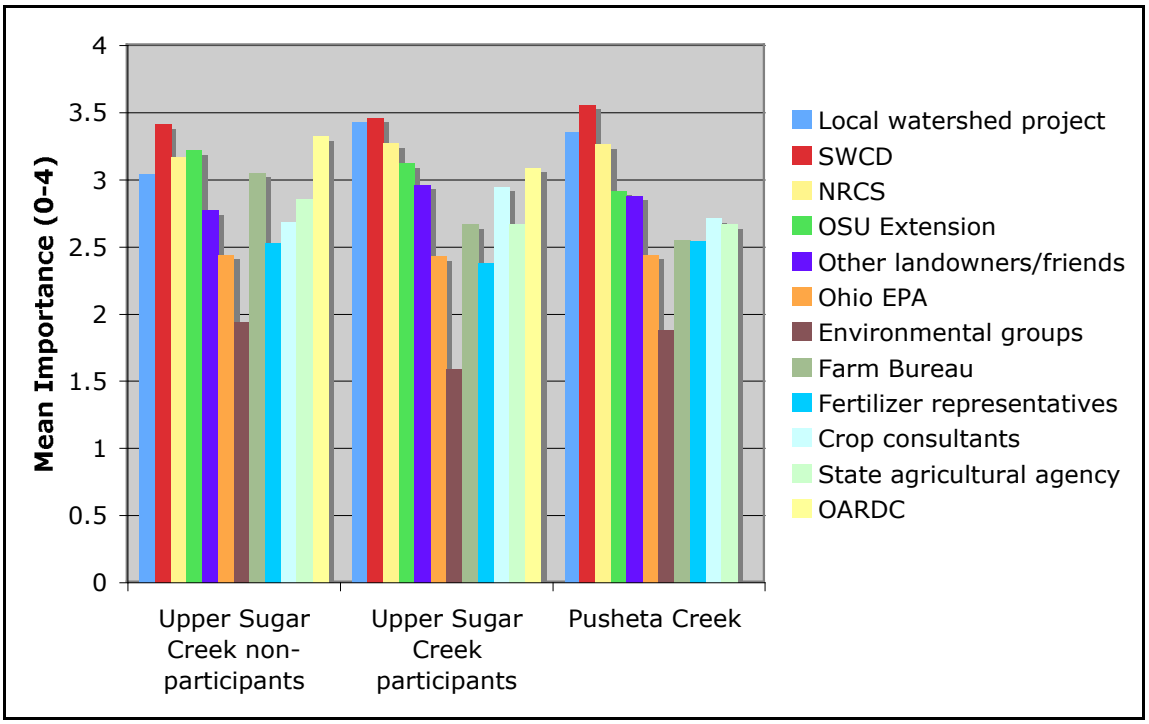

Figure 2. Importance of sources of information about water quality issues.

Question 2: Beliefs About Water Quality

To measure farmer beliefs about water quality, respondents were presented with five statements about general water quality and asked to indicate their level of agreement or disagreement on a five-point Likert scale ("strongly disagree", "disagree", "neither agree or disagree", "agree", or "strongly agree"). Mean scores are based on a ranking from 1 ("strongly disagree") to 5 ("strongly agree"). As shown in Figure 3, respondents support water quality initiatives, even those that may have a negative impact on economic development. Levels of agreement were similar across the three types of respondents (Upper Sugar Creek participants, Upper Sugar Creek non-participants, and Pusheta Creek farmers).

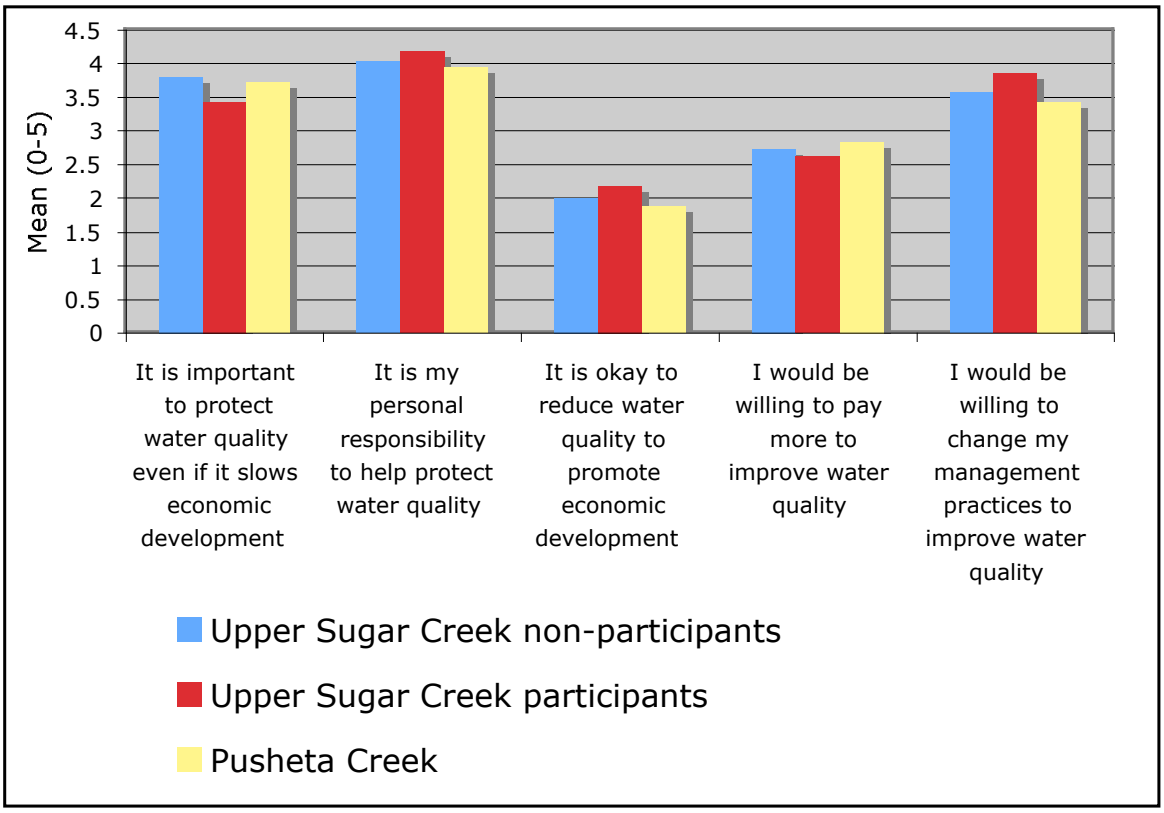

Figure 3. Water quality beliefs,

Question 3: BMP Adoption by Practice

To measure BMP adoption levels, a survey question listed 13 BMPs relevant to farmers in Midwestern U.S. watersheds (Genskow and Prokopy, in press). These BMPs include: using grass waterways, managing the flow of nutrients through control drainage, using no-tillage practices, using reduced tillage farm practices, using Integrated Pest Management (IPM), using a nutrient management plan for applying fertilizers, using a manure management plan for applying animal manure, keeping livestock from entering streams (fencing, etc.), planting or maintaining vegetated buffers along streams, using cover crops, capping and protection of wells, using phosphate-free fertilizer and detergents, and regularly servicing septic systems.

Figure 4 illustrates the percentage of respondents who replied, "I currently use it" for the given BMP. As this figure demonstrates, Pusheta Creek respondents overall are adopting the greatest number of BMPs, including reduced and no-tillage practices and adoption of manure management plans. However, Upper Sugar Creek Partner participants follow closely behind and are even higher on some practices including grass waterways and using phosphate-free fertilizer and detergents. Upper Sugar Creek non-participants overall have the lowest adoption rates, but do have the highest for cover crops, capping and protection of wells, and regularly servicing

their septic system. When the adoption rates of all 13 BMPs are totaled, on average farmers in Pusheta Creek adopted 68% of applicable BMPs, compared to 66% for Upper Sugar Creek participants, and 54% for Upper Sugar Creek non-participants.

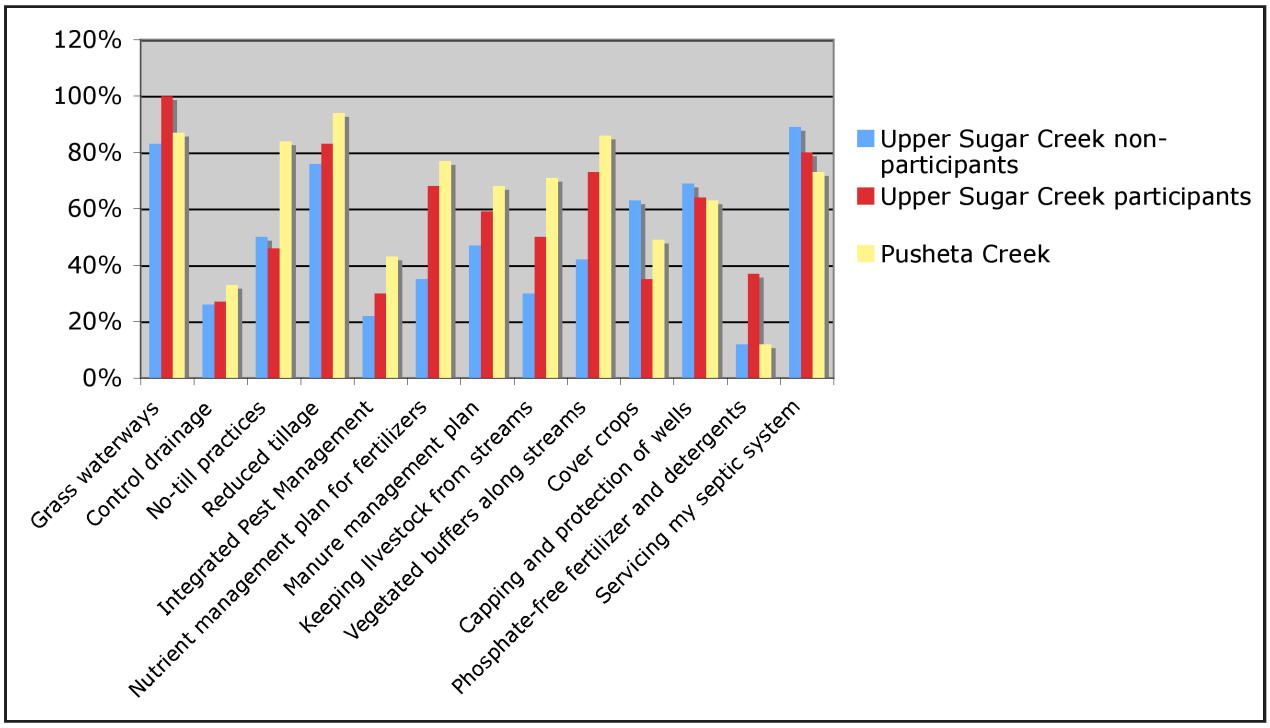

Figure 4. Current wse of BMPs.

To get a better idea of BMP awareness, respondents were asked to indicate one of the following six responses to each of the 13 practices: "I currently use it", "I have tried it, but I no longer do it", "I am familiar with it, but I've never done it", "I've heard of it, but I'm not very familiar with it", "I've never heard of it", or "does not apply".

In general, respondents seemed the most familiar with grass waterways, no-till and reduced tillage practices, manure management plans, cover crops, and keeping livestock from entering streams (see Table 1). On the other hand, they seemed least aware of control drainage, Integrated Pest Management, nutrient management plan for fertilizers, and phosphate-free fertilizer and detergents. Interestingly, a handful of respondents had once done, but no longer do, cover crops and no-till practices.

Table 1. Use of Best Management Practices.

BMP		Does not apply	I've never heard of it	I've heard of it, but I'm not very familiar with it	I am familiar with it, but I've never done it	I have tried it, but I no longer do it	I currently use it	Total
Using grass waterways	USC NON	1	1	0	4	2	35	43
	USC PART	0	0	0	0	0	24	24
	PC	2	0	1	6	0	45	54
Control drainage	USC NON	10	8	6	9	0	8	41
	USC PART	1	4	8	4	0	6	23
	PC	9	4	12	11	0	13	49
No-till practices	USC NON	6	0	3	10	6	19	44
	USC PART	0	0	0	5	8	11	24
	PC	5	0	1	4	3	42	55
Reduced tillage	USC NON	6	0	1	8	0	28	43
	USC PART	0	0	0	4	0	20	24
	PC	4	0	1	1	1	48	55
Integrated Pest Management	USC NON	8	10	8	6	1	7	40
	USC PART	3	2	4	7	1	6	23
	PC	8	10	8	6	2	19	53
Nutrient management plan for fertilizers	USC NON	6	5	10	8	1	13	43
	USC PART	2	0	5	2	0	15	24
	PC	5	3	4	3	1	37	53
Manure management plan	USC NON	11	2	6	8	1	15	43
	USC PART	5	0	4	2	1	10	22
	PC	23	1	3	6	0	21	54

BMP		Does not apply	I've never heard of it	I've heard of it, but I'm not very familiar with it	I am familiar with it, but I've never done it	I have tried it, but I no longer do it	I currently use it	Total
Keeping livestock from streams	USC NON	21	0	2	10	4	7	44
	USC PART	10	0	0	5	1	6	22
	PC	33	1	2	2	1	15	54
Vegetated buffers along streams	USC NON	16	3	1	10	1	11	42
	USC PART	0	0	1	5	0	16	22
	PC	12	0	1	5	0	36	54
Cover crops	USC NON	11	1	1	8	2	20	43
	USC PART	2	0	2	4	7	7	22
	PC	6	0	2	10	11	22	51
Capping and protection of wells	USC NON	17	1	4	3	0	18	43
	USC PART	8	0	3	2	0	9	22
	PC	29	2	1	6	0	15	53
Phosphate-free fertilizer and detergents	USC NON	7	9	10	11	0	4	41
	USC PART	3	4	3	4	1	7	22
	PC	8	12	13	12	0	5	50
Servicing my septic system	USC NON	4	1	1	1	1	33	41
	USC PART	1	0	1	3	0	16	21
	PC	8	2	8	2	0	33	53

Question 4: Motivations for BMP Adoption

There are a variety of factors that may encourage BMP adoption. For this research respondents were provided with the question, "When you make a decision about new management practices for your farm operation, how important is each of the following?" A set of closed-ended responses was provided: "not at all important", "somewhat important", "undecided", "important", and "very important." Average scores are based on a ranking from 1 ("not at all important") to 5 ("very important"). These mean scores are presented in Table 2. In general,

respondents ranked "personal out-of-pocket expense" and "my own views about effective farming methods" as the most important factors impacting their decision to adopt a new management practice. "Whether I have information about a practice" or "whether I have the equipment I need" were also ranked relatively high. Pusheta Creek farmers ranked "commodity prices," "availability of government funds for cost share," and "whether or not I'm involved in monitoring water quality" higher than the other groups. Upper Sugar Creek non-participants tended to fall in the middle of the ranking scale, however they rated "whether or not my neighbors agree" and "don't want to participate in government programs" higher than the other groups. Upper Sugar Creek Partner participants tended to either lie in the middle or rank reasons lower than the other groups.

Table 2. Motivations for Best Management Practices.

	Upper Sugar Creek non-participant	Upper Sugar Creek Partner participant	Pusheta Creek farmer
Personal out-of-pocket expense	4.12	4.04	3.82
My own views about effective farming methods	3.90	4.13	3.95
Whether I have the information about a practice	3.86	3.83	3.93
Whether I have the equipment that I need	3.79	3.61	3.69
Concerns about reduced yields	3.60	3.91	3.94
Whether it will interfere with my flexibility to change practices	3.60	3.65	3.65
Requirements or restrictions of gov't programs	3.57	3.52	3.43
Commodity prices	3.56	3.57	4.07
Uncertainty about the environmental impacts	3.34	3.59	3.54
Amount of time required for implementation	3.24	3.26	3.47
Availability of gov't funds for cost share	3.16	3.22	3.51
Whether I need to learn new skills	3.07	2.96	3.23
Whether or not I'm involved in monitoring water quality	3.02	2.70	3.16
Whether people I know are implementing the practice	3.02	2.52	2.82
Whether or not my neighbors agree	2.90	2.74	2.53
Don't want to participate in gov't programs	2.88	2.57	2.65

Question 5: Awareness of TMDL

To gauge farmer awareness of the TMDL assessment in their watershed, respondents were presented with a two-step, closed-ended question that asked whether they were aware that the Ohio EPA had established a TMDL for sediment and nutrients in their watershed. If the respondent answered "yes," the questionnaire asked if he/she had ever read or seen parts of the TMDL.

Results indicate that Upper Sugar Creek Partner participants are more aware of their watershed TMDL than are any other group (see Figure 5). They are also more likely to have read the document (29% of them have read or seen parts of this document, in contrast to 0 % and 7% among the Upper Sugar Creek non-participants and Pusheta Creek farmers, respectively). The least likely farmers to be aware of the TMDL or have read it are the Upper Sugar Creek non-participants.

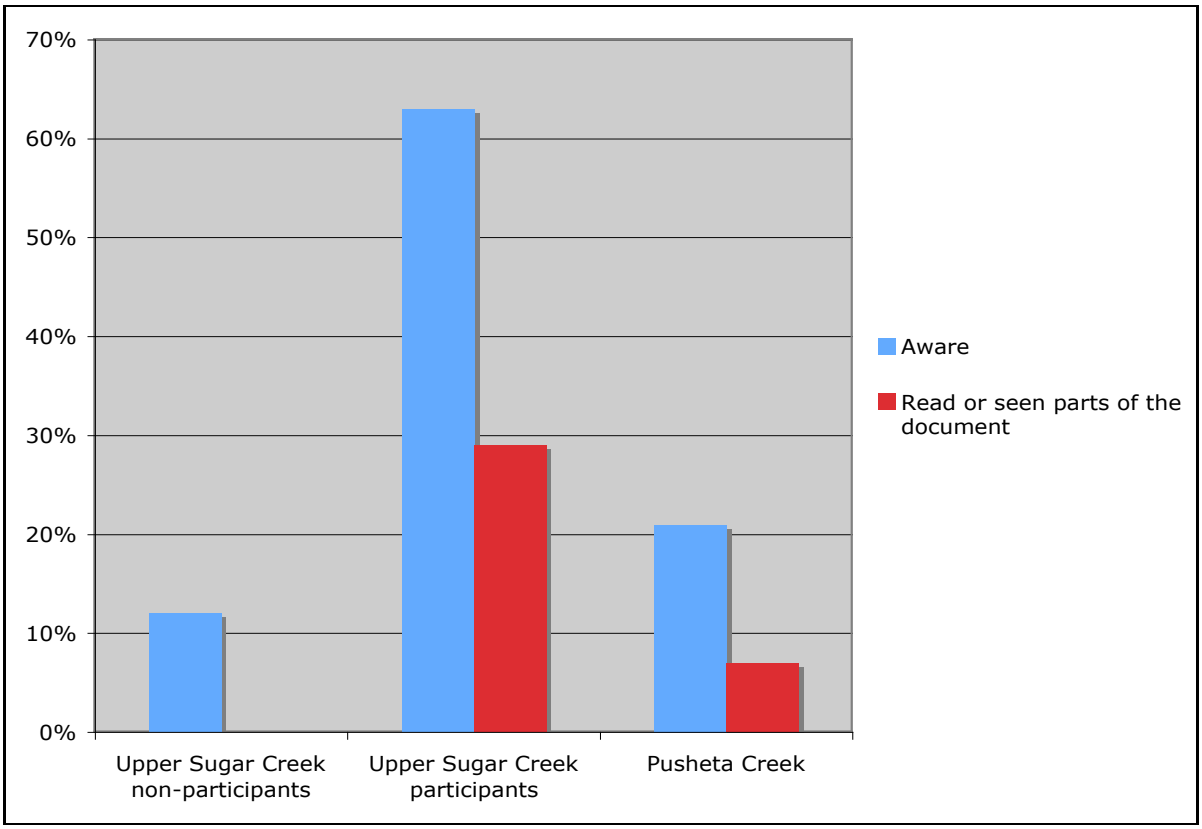

Figure 5. Awareness of total maximum daily load assessments.

DISCUSSION

Survey data indicated that respondents tended to be in their 40s or older, primarily male, and with at least a high school education and some college education. Rates of off-farm employment demonstrated relatively distinct differences, with Pusheta Creek respondents having a higher percentage of farmers working full time off-farm. Land tenure rates were similar between watersheds and demonstrated that the majority of farmers expect to pass on their farm to another family member, slightly more in the Pusheta Creek watershed. Farmers in the Upper Sugar Creek watershed were producing on fewer acres, but were more likely to be managing some form of livestock. Last, 34% of farmers in the Upper Sugar Creek watershed have had some involvement with the Sugar Creek Partners.

Prokopy et al. (in press) suggest that higher rates of education, capacity, capital, income, farm size, access to information, positive environmental attitudes, environmental awareness, and utilization of social networks are correlated with BMP adoption. Data from this study suggest that farmers in both watersheds share relatively similar rates of a few of these factors. However, some key differences were noted. First, Pusheta Creek has larger farm sizes, with less emphasis on livestock production, than does the Upper Sugar Creek. Second, the number of sources of information and awareness of the TMDL exhibited by the Upper Sugar Creek Partner participants differ from Upper Sugar Creek non-participants and Pusheta Creek farmers.

Pusheta Creek farmers overall are adopting the most BMPs. This may be partly attributed to their larger farm size and close contacts with program agents from SWCD and NRCS. Furthermore, Upper Sugar Creek participants had higher overall adoption rates in comparison to Upper Sugar Creek non-participants. This may be partly attributed to their increase in access to information, utilization of social networks, and environmental awareness (i.e. knowledge of TMDL), which collaborative watershed management aims to foster.

In sum, results suggest that collaboration can play an important, but nuanced, role in BMP adoption. Comparison between Partner participants and farmers in a watershed without a partnership suggest that similar rates of BMP adoption can be achieved without implementing collaborative management policies. This was indicated by BMP adoption rates of Pusheta Creek farmers and Sugar Creek Partners participants. At the same time, comparison between Partner participants and non-participants in the same watershed suggest that participants in collaborative watershed management were adopting BMPs to a greater degree than non-participants. Therefore it appears that collaborative watershed management policies are not necessary for BMP adoption, but do produce some positive effects in the context of the Upper Sugar Creek watershed.

CONCLUSION

Non-point source water pollution is a crucial environmental challenge in the 21st century. Due to the role of agricultural activities in contributing to this problem, it is necessary that effective policies are used, while at the same time considering the economic limitations and social constraints that stakeholders often face.

Best management practices (BMPs) have proven to be useful in reducing the impact of agriculturally based pollutants into waterbodies. They are a preferred policy because these programs and practices seek to involve the farmer in the process of environmental remediation by interweaving economic efficiency and cost-effectiveness with ideas of land stewardship and conservation. Cost, willingness to take action, and underlying social networks all appear to contribute to farmer adoption of BMPs.

This study has demonstrated that an effective conservation staff and the right kind of programs can foster BMPs, as in the case with the relatively larger farms in Pusheta Creek watershed. In addition, TMDL assessments aid in the outline of broader multiple-stakeholder management plans that set benchmark standards for water quality. At the same time, participation in collaborative watershed management efforts in the context of the Upper Sugar Creek goes hand-in-hand with restoration activities and BMPs.

Thus it is important for policy makers to match the policy prescription to the local context. In cases where larger scale farming is practiced and interactions with government agents bring farmers into contact with traditional IETS programs, collaborative management may not be necessary to attain high levels of BMP adoption. However, collaboration can be crucial for areas with smaller and more diverse farms, by increasing information, awareness, and social networks.

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