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# ATTITUDES, BEHAVIOR, AND COMMUNICATION PREFERENCES OF MICHIGAN AGRICULTURAL LANDOWNERS: IMPLICATIONS FOR WATER QUALITY AND THE EFFECTIVENESS OF WATERSHED CONSERVATION PROGRAMS

By

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## ABSTRACT

ATTITUDES, BEHAVIOR, AND COMMUNICATION PREFERENCES OF MICHIGAN AGRICULTURAL LANDOWNERS: IMPLICATIONS FOR WATER QUALITY AND THE EFFECTIVENESS OF WATERSHED CONSERVATION PROGRAMS

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In Michigan, as in many other states, agriculture comprises one of the leading sources of water quality impairment of rivers and lakes (USEPA, 2000). To address this concern, landowners from the Gun River, Lake Macatawa, North Branch Flint River, and Upper Thornapple watersheds were recruited to complete a survey instrument or participate in a focus group discussion to determine agricultural landowners' information needs, attitudes, behaviors, and communication strategy preferences. Results from this study indicate that the importance respondents associate with watershed conservation issues is influenced by respondents' age, level of education, and farming status. How informed respondents feel they are about watershed conservation issues depends on respondents' farming status, farm size, and watershed residence. In addition, respondents' preference for the Internet as a communication strategy is influenced by respondents' age, level of education, gross annual income level, and Internet access. Furthermore, respondents' level of feeling informed about watershed conservation issues and level of feeling satisfied with the water quality in their watershed affect their adoption of specific best management practices. Results from this study have the potential to improve the effectiveness of watershed conservation programs resulting in improved water quality in Michigan's agricultural watersheds.

## DEDICATION

This thesis is dedicated to those who have fallen victim to my studies: the under-appreciated provider of cookies and milk; the wise, non-intrusive supporter; and the noisy dishwasher.

Thanks go out to my loving husband, Ben who sacrificed so much so I could attend to my life goals and aspirations. Thank you for often holding down the fort and for providing the joy and proper perspective I needed to maintain my sanity throughout this project. Thanks also go out to my two devoted and supportive parents. I have never taken for granted all the times you two did without to make my dreams possible. I thank you both for always putting my education, my future, and my happiness first!

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I also want to thank the agricultural landowners of the Gun River, Lake Macatawa, North Branch Flint River, Rice Creek, Stony Creek, and Upper Thornapple watersheds who shared their experiences and valuable information necessary to meet the goals of this project. Funding for research, tuition, and a 2+ year stipend was generously provided by a United States Department of Agriculture Cooperative State Research, Education, and Extension Service grant awarded to my major advisor. Lastly, I want to "give thanks to the Lord, for He is good; His love endures forever" (Psalm 107: 1).

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# Chapter One: Introduction

## The Problem of Non-Point Source Pollution

Water pollution in the United States is a common and widespread ecological dilemma. Currently most water pollution is attributed to nonpoint sources (U.S. Environmental Protection Agency, 1996). Nonpoint source pollution arises across wide areas, such as agricultural fields throughout a watershed (Nerbonne and Vondracek, 2001). When it comes to assigning blame for nonpoint source pollution, fingers have been pointed at agriculture more than anywhere else (Lewis, 1996). Agriculture is currently the leading source of water pollution and a contributing factor to impairment of 70% of streams considered impaired in the 1996 National Water Quality Inventory (U.S. Environmental Protection Agency, 1996). According to the Environmental Protection Agency's 1992 *National Water Quality Inventory Report to Congress*, agriculture also affects 56% of the assessed lakes which report impairment and 43% of the estuaries.

Some agricultural practices have serious, adverse effects on Michigan streams. Increased surface water runoff and sediment delivery to streams from tilled lands probably have the biggest impact (Gaylord et al., 1995). In fact, 1.9 billion tons of soil is lost to wind or water erosion in the United States each year (USDA National Resources Inventory, 1997). A significant fraction of this eroded soil is transported into streams where it adversely modifies water clarity, stream bed type, and channel morphology before it is eventually deposited in lakes, reservoirs, marshes, harbors, or eventually the Great Lakes (USDA National Resources Inventory, 1997). In addition, chemical fertilizers, animal waste, herbicides, and pesticides drain into streams from agricultural lands (Gaylord et al., 1995). Furthermore, livestock have been implicated in the

degradation of stream bank soils and vegetation, which affect channel morphology, water chemistry, and fish and aquatic insect habitat (Kauffman and Krueger, 1984, Strand and Merritt, 1999).

There are numerous nonpoint source pollutants resulting specifically from improperly managed agricultural activities that adversely affect surface waters and overall watershed health. The most prominent of these nonpoint sources are: sedimentation, excess nutrients (specifically nitrogen and phosphorus) and pathogens, pesticides and herbicides, and other secondary effects such as increased water temperature (Lewis, 1996).

**Effects of Sedimentation on Aquatic Ecosystems**

After bacterial contaminations and pathogens, the most common agricultural pollutant found in streams is sediment, which impairs 84,503 river and stream miles (U.S. Environmental Protection Agency, 2000). Agricultural practices can contribute sediment to streams in several ways. In row-crop agriculture, bare soil between rows is easily eroded and can be transported to streams via runoff (Waters & Hebel, 1982). Grazing in riparian areas can reduce vegetation on stream banks, making them more susceptible to erosion (Strand & Merritt, 1999). Furthermore, humans are responsible for most of the sedimentation that enters North American streams, including vast amounts generated by the activities of cattle (Waters & Hebel, 1982). Although some sediment input to streams is natural, sedimentation in excess of natural erosion is recognized as the most prevalent and damaging pollution source in North American streams (Waters & Hebel, 1982). More United States stream habitat is degraded by sedimentation than by any other form of environmental pollution (Waters & Hebel, 1982).

Reductions in sediment input from agriculture are important to stream biota because many invertebrates and fishes require a streambed relatively free of fine sediment (Waters & Hebel, 1982)). Excess amounts of sediment deposited in the stream impact aquatic ecosystems by: increasing the turbidity of the water (Lewis, 1996), reducing transmission of sunlight needed for photosynthesis (Lewis, 1996), interfering with animal behavior dependent on sight (foraging, mating, and escape from predators) (Nerbonne & Vondracek, 2001), impeding digestion and respiration (by gill abrasion in fish) (Lewis, 1996), reducing dissolved oxygen concentrations in the water (Berkman & Rabeni, 1987), and by degrading spawning habitat by covering eggs which may suffocate (Lewis, 1996) or lead to fry that develop abnormally or are unable to emerge from the buried gravel bed (Berkman & Rabeni, 1987).

**Effects of Excess Nutrients and Pathogens on Aquatic Ecosystems**

An overabundance of nutrients such as nitrogen and phosphorus is another of the most serious problems facing the nation's lakes, estuaries, rivers, and streams (Lewis, 1996). While nutrients are essential ingredients in the food cycle and contribute to primary production of many aquatic plants, an overload of nutrients from manure and fertilizers carried into the water can have numerous adverse effects. One of the most devastating effects of excess nutrients on aquatic ecosystems is eutrophication. Excess nutrients can promote the overgrowth of algae and other aquatic plants which deplete dissolved oxygen concentrations in the water when plants die and decompose. The reduced dissolved oxygen concentrations often result in the suffocation of fish, shellfish and a wide range of aquatic invertebrates which fill essential roles in the life cycle as food sources (Lewis, 1996). In shallow areas, the overabundance of surface plants block

the light needed by underwater vegetation which provide food and nesting grounds for waterfowl, crustaceans, and fish (Lewis, 1996).

Livestock manure and urine input into streams also can affect aquatic insects through the effects of water-chemistry changes, increased fecal coliform counts, and consequent biological responses (Strand and Merritt, 1999). Livestock excrement deposited along stream banks and directly to channels elevates stream water concentrations of phosphorus and nitrogen (Lemly, 1982). When animals are allowed continuous, unrestricted access to streams and lakes, manure ends up in the water and can result in increased production by heterotrophic and autotrophic microbes that, when current velocities are low, can drastically reduce dissolved oxygen concentrations (Fleischner, 1994). Decreased dissolved oxygen concentrations may eventually lead to the suffocation of various fish and other aquatic organisms.

**Effects of Herbicides and Pesticides on Aquatic Ecosystems**

Chemical compounds used on agricultural lands are easily washed into ground and surface waters by rainfall, melting snow, and irrigation flows (Lewis, 1996). These chemical compounds can also be transported in the air—directly during application, or indirectly, through transpiration or volatilization from the surface of vegetation, water, and the ground (Lewis, 1996). Depending on the compounds involved, pesticides carried into the water can: (1) cause direct kills of fish and other aquatic organisms, interrupting the food chain, (2) cause sub-lethal effects on reproduction, respiration, growth, and development, (3) cause an increase in an organism's vulnerability to other environmental stresses such as disease or predation, (4) cause cancer, mutations or fetal deformities, (5)

inhibit photosynthesis in non-target plants, and (6) can bioaccumulate in an organism's tissues and be biomagnified through the food chain.

**Effects of Water Temperature Change on Aquatic Ecosystems**

Increased water temperatures caused by habitat modification (such as tree removal for cattle grazing) can be considered a pollutant to aquatic ecosystems as cooling effects of natural shade are limited or removed (Lewis, 1996). Livestock grazing, however, does not always cause pronounced changes in stream water temperatures but it can result in increased thermal variation and maximum temperatures (Kauffman and Krueger, 1984). These temperature effects are largely the result of increased solar input that follows vegetation removal and bank trampling by livestock (Kauffman and Krueger, 1984). Unnaturally elevated temperatures can affect the biological processes which take place in rivers and streams. In the relatively constant thermal environment of flowing water, increases as slight as 2 degrees Celsius can affect the physiology and alter distributions of sensitive species (Sweeney and Vannote, 1996). For instance, some fish species will not spawn in streams if the water temperature in their natural spawning grounds is increased by as little as one or two degrees (Lewis, 1996).

Riparian-forest clearing and subsequent pasturing also may affect aerial adult aquatic insects by eliminating shaded resting structures that are utilized extensively and, perhaps, required by many species. Most holometabolous aquatic insects rely on resources stored during the larval period to complete their life cycles. Therefore, reduction or elimination of cool, humid resting sites could limit the reproductive potential of aerial adult insects as a result of compromised conservation of resources sequestered during the larval stage (Strand and Merritt, 1999).

**Justification for Research**

In 1987, amendments to the Clean Water Act (CWA) ordered states to monitor nonpoint source pollution and develop management plans to reduce nonpoint source pollution through best management practices (BMPs). Previous research widely acknowledges that regulation will only provide some of the solutions and individual actions are essential when it comes to getting nonpoint source problems under control (Lewis, 1996). Therefore, because improperly managed agricultural practices have significant adverse effects on aquatic ecosystems, and because individual action is the means by which environmental improvements can be made, there is a need to communicate with agricultural landowners about water quality issues such as soil erosion into streams, excess nutrients, reduced and degraded fish habitat, eutrophication, and bacterial contamination.

Before communicating with agricultural landowners about water quality issues, research must first determine agricultural producers' knowledge about and level of concern for watershed conservation issues. Once these variables have been determined, there is an additional need to establish which communication strategies are most effective in communicating with agricultural landowners about watershed conservation practices. Furthermore, additional research is necessary to establish how current extension practices (e.g., the use of Internet to inform landowners about BMPs) could be improved to meet the informational needs of Michigan's agricultural producers. The research presented in this thesis aims to determine the informational needs and preferences of Michigan's agricultural producers so that agricultural communicators and Extension professionals

may more effectively educate agricultural landowners about watershed conservation issues and BMPs to prevent or reduce the contamination of aquatic ecosystems.

Previous research (Bruening, 1992; Rollins et al., 1991) determined various water quality information sources and communication strategies used by agricultural landowners. However, these efforts neglected to assess the audiences' preference for these strategies. In response, results from this thesis should reveal agricultural landowners' preference for various water quality communication strategies. The project reported in this thesis aims to help Extension reach its long-range and ultimate mission to "influence its clientele through education and to use the results of scientific technology to improve their quality of life" which should prevent and lessen the impacts of adverse agricultural practices ultimately resulting in improved water quality within Michigan's agricultural watersheds (Findlay et al., 1993, p.23).

**Discussion on How Thesis is Part of a Greater Project**

This thesis is part of a greater research project funded by a USDA-CREES grant awarded to my advisor, Dr. Geoffrey Habron. The title of the research project is: *Information Exchange, Citizen Monitoring and Agricultural Best Management Practices*. The goal of the overall research project is to determine more effective extension communication and agricultural best management practices to improve water quality in agricultural watersheds. The objectives of the overall research project are to: (1) determine the effectiveness of water quality communication strategies, (2) determine the variability of volunteer water quality monitoring, and (3) develop spatially explicit models to evaluate effectiveness of agricultural BMPs. While interested and to some

degree involved in each component of the overall research project, I concentrated this research on determining the attitudes and behaviors of agricultural landowners towards watershed conservation issues as part of determining the effectiveness of water quality communication strategies.

**Thesis Objective and Research Questions**

The overall purpose of this study is to determine research-based water quality communication strategies while establishing the most efficient methods of performing watershed extension in order to improve water quality within select agricultural watersheds in Michigan. This thesis specifically addresses the need to determine: (1) Michigan's agricultural landowners' attitudes towards and knowledge about conservation issues and the water quality in their watershed; (2) agricultural landowners' best management practice adoption behavior; (3) the communication preferences of Michigan's agricultural landowners; (4) how independent variables (such as age, income, level of education, and farming status) influence the degree to which farmers utilize and rely upon web sites to learn about watershed conservation issues and BMPs; and (5) how to develop more effective web sites that will meet the informational needs of Michigan's agricultural landowners. In order to improve the effectiveness of watershed conservation programs and enhance the water quality in Michigan's agricultural watersheds, the study will investigate the following research questions:

**Research Question 1: What are survey respondents' perceptions and attitudes about watershed conservation issues and the water quality in their watershed?**

1a: How important are watershed conservation issues to survey respondents?

1b: How satisfied are survey respondents with the water quality in their watershed?

1c: How informed do survey respondents feel they are about watershed conservation issues?

**Research Question 2: What attitudinal factors influence respondents' level of BMP adoption?**

2a: What percentage of survey respondents adopt BMPs?

2b: How does the perceived importance of watershed conservation issues affect survey respondents' willingness to adopt BMPs?

2c: How does survey respondents' satisfaction with the water quality in their watershed influence their willingness to adopt BMPs?

2d: What effect does feeling informed about watershed conservation issues have on survey respondents' willingness to adopt BMPs?

**Research Question 3: Which communication strategies do survey respondents prefer to learn more about watershed conservation issues and best management practices?**

3a: Do survey respondents prefer traditional or computerized communication strategies?

3b: What effect does watershed residence have on respondents' preference for communication strategies?

**Research Question 4: What factors influence the degree to which respondents utilize and rely upon the Internet to learn more about watershed conservation issues and best management practices?**

4a: Is computer and Internet preference related to age, level of education, gross annual income, farming status, farm size, or primary farming operation?

4b: Does Internet access influence survey respondents' preference for the Internet as a communication strategy to learn about watershed conservation issues?

**Research Question 5: How can one develop a more effective web site that will meet the informational needs of agricultural landowners?**

5a: What factors influence focus group participants' use of the Internet and web sites to learn more about watershed conservation issues and BMPs?

5b: What would focus group participants specifically recommend to improve web site content and usability?

**Potential Implications of this Study**

Findings from this research project have the potential to improve the ability of Extension and agricultural education programs to efficiently communicate with Michigan's agricultural landowners about best management practices and watershed conservation issues. As a result of this study, Extension professionals and other agricultural educators should be better equipped to choose the preferred method of communication for their targeted audience. By more effectively communicating with agricultural landowners about watershed conservation issues and conservation practices, farmers' attitudes about implementing BMPs should become more favorable. Farmers with more favorable attitudes about BMP implementation could potentially have higher adoption rates of various watershed conservation practices resulting in improved water quality in Michigan's agricultural watersheds.

## Chapter Two: Literature Review

### Agricultural Landowners' Perceptions of Water Quality Issues

Understanding agricultural landowners' perceptions about water quality issues is a prerequisite to encouraging farmers to adopt BMPs and improve water quality conditions. A review of the literature demonstrates that in general, farmers' beliefs about water quality problems are similar to those of the general public. In fact, farmers express on average, a middle-of-the-road level of concern toward most water quality related issues as well as pesticide specific issues (Lichtenberg and Zimmerman, 1999). Results from Lichtenberg and Zimmerman (1999) indicate that, farmers and the general public typically believe that water quality problems from agricultural chemicals are moderately serious. Furthermore, farmers' beliefs about the seriousness of pesticide effects matched those of the general public (Lichtenberg and Zimmerman, 1994).

In a previous study, farmers indicated that pesticide use is the most serious issue, followed by soil conservation, fertilizers, and water quality (Bruening, 1991). In a similar study, only a few farmers did not perceive water quality to be a problem they must deal with in their farming operation (Bruening, 1992). Findings from Bruening's studies also suggest that farmers are uncertain about the seriousness of environmental issues such as water quality, fertilizers, and soil conservation. While generally believing that soil erosion and water quality degradation are problems, farmers often hesitate to admit that there is any relationship between their farming practices and the national erosion problem (Christenson and Norris, 1983). These findings are particularly important when developing communication strategies for use by state and federal Extension organizations.

**The Link Between Farmers' Attitudes and Behaviors**

A number of studies have examined an attitude-behavior link such as the effects of farmers' attitudes, perceptions, or beliefs about the environment on their willingness to modify farming practices to protect environmental quality (Lichtenberg & Zimmerman, 1999). For example, Ohio farmers who believed environmental problems to be more important were more likely to adopt conservation practices such as crop rotation, retirement of erodible land, grassed waterways, and filter strips (Napier et al., 1986). In addition, farmers with a stronger conservation ethic exerted greater conservation effort as measured by the number of different conservation practices adopted (Lynne et al, 1988). Furthermore, Feather and Amacher (1994) discovered that farmers were more likely to adopt conservation practices if they believed that such practices would improve water quality. Intrinsic motivations such as "personal satisfaction derived from being environmentally responsible" can be effective in influencing a farmers' decision to employ new conservation practices (Jacobson et al., 2003, p. 603).

**Management Problem**

Approximately 40 percent of the nation's surface waters are polluted to the extent that they no longer support their intended uses such as drinking, swimming and fishing (USEPA, 2000). The major source of this pollution is from non-point sources, and in many states, one of the major contributors is agriculture. Major pollutants from agricultural activities include suspended sediment from soil erosion, coliform bacteria, and resultant decreased dissolved oxygen concentrations from livestock manure and nitrogen and phosphorus from fertilizers and pesticides.

The primary reason many environmental problems exist today is the reluctance on the part of many landowner-operators to adopt conservation practices (such as BMPs) and farm technologies at the farm-level (Napier et al., 2000b). In order to improve water quality in agricultural watersheds, rates of best management practice and farm technology adoption must increase. Research illustrates that "motivating farmers to adopt [best management] practices is not easy" (Napier et al., 1984, p.205). Nevertheless, it is imperative that Extension agents strive to effectively persuade agricultural producers to adopt conservation practices in order to alleviate some of the environmental problems currently occurring in agricultural watersheds.

The intent of this study is to provide Extension agents and agricultural communicators with the necessary information to effectively persuade agricultural producers to adopt various farm technologies and BMPs to improve water quality within agricultural watersheds. Best management practices are becoming increasingly innovative and it can be difficult to convince farmers of the environmental and financial benefits inherent to these practices. These research findings should provide information to Extension agents and agricultural communicators so they can consider factors affecting farmers' adoption of conservation practices and more effectively inform farmers about farm technologies and BMPs. The ultimate objective of providing information to farmers is to foster change in behavior or practice, rather than attitudes or beliefs, because only the former has the potential to benefit the environment (Rhodes et al., 2002).

**Factors Influencing Best Management Practice Adoption**

According to previous research, if Extension agents aspire to improve water quality by convincing agricultural producers to adopt innovative farm technologies and

BMPs, they need to: (1) inform farmers about existing environmental problems and how they make direct contributions to the problem, (2) teach farmers about existing technologies and convince farmers that these farm technologies and BMPs will improve water quality, (3) recognize the value of the information source to the farmer, (4) consider ability-to-act factors, (5) identify the values and attitudes farmers have about the environment, (6) consider farmers' perceived risks of adoption, and (7) take into account the relevance of the BMP or farm technology to the farmer.

Inform Farmers about Existing Environmental Problems and How They Make Direct Contributions to the Problem

The relationship between information and farmers' beliefs about environmental quality (and thus farmers' compliance with environmental protection measures) is complex (Lichtenberg & Zimmerman, 1999). Farmers' beliefs and perceptions about the environment can influence their selection of communication strategies. Therefore, the effect of information depends not only on the form in which the information is presented, but also on the farmers' attitudes regarding the sources presenting the information. For instance, the beliefs farmers hold can influence the type of information they seek, their receptivity to the information, and how relevant they consider that information in decision making (Stern & Dietz, 1994).

In order to address environmental problems and expect agricultural producers to adopt BMPs and farm technologies, agricultural producers must first be made aware that legitimate environmental problems exist within their watershed. Extension agents should take on the important role as information providers. Furthermore, Extension agents

should do so by offering persuasive information about valid environmental problems relevant to the farmers' watershed and their farming practices/farming operation.

In addition to informing agricultural producers about environmental problems, Extension agents need to convince farmers that they are directly responsible for impaired water quality. Before they will react to an environmental dilemma, research illustrates that many agricultural producers must be convinced that their chemicals and livestock are directly responsible for impairing water quality. Hines et al. (1987) points out that not only awareness of the existence of a problem but also knowledge on appropriate strategies to address it, are essential for action to be taken.

Access to information is among the most important predictive factors associated with adoption behavior. According to Napier et al., (1986) once farmers are informed of the advantages of using specific practices, they will be more inclined to adopt the innovations. Farmers who have interacted with public information sources about BMPs are significantly more likely to use these practices (Lichtenberg & Zimmerman, 1999). Napier et al. (1986) cites a number of resources about information diffusion that point to the fact that information is important in the adoption of conservation technologies.

Teach Farmers about Existing Technologies and Convince Farmers that These Farm Technologies and BMPs will Improve Water Quality

Previous research discovered that farmers in Maryland, Minnesota, North Carolina and Wisconsin were more likely to adopt conservation practices if they believed that such practices would improve water quality (Feather & Amacher, 1994). Additional

research determined that the perceived effectiveness of a conservation practice would greatly influence a farmer's decision on whether to implement a conservation program (Christensen & Norris, 1983). The traditional diffusion modes studied by Napier et al. (2000a) argue that adoption of technological innovations will not occur unless potential adopters become aware that the existing problem can be resolved in a more efficient manner by new technologies. The diffusion model speculates that potential adopters must perceive that technological innovations are an improvement over what already exists or they will not change use patterns. Agricultural producers need to know that the technologies exist and must be able to recognize their relevance before they will consider adopting best management practices.

The diffusion model created by Napier et al. (1984) assumes that adoption behavior is primarily a function of exposure to information that makes the potential adopter aware that action options exist. Such sources of information include formal education, the mass media, personal contact, participation in formal organizations, and business contacts. The model hypothesizes that exposure to information about ideas, technologies, and techniques results in attitudes favorable to the object to be adopted. Once positive attitudes have developed, adoption follows (Napier et al., 1984).

Recognize the Value of the Information Source to the Farmer:

In order to convince agricultural producers about the validity of environmental problems or to persuade farmers to adopt BMPs or farm technologies, one must inform the farmers in a manner they feel is valid and trust-worthy. The source of the information must be reputable and highly regarded to provoke serious thought from the reader. The

more "second-hand" the information is, the less importance farmers tend to attach to it. Farmers placing greater importance on information from news media and Extension services than written information such as newsletters and bulletins expressed greater concern about all forms of environmental quality problems associated with agricultural chemicals (Lichtenberg & Zimmerman, 1999).

In addition, the diffusion model (Napier et al., 1984) asserts that various socio-demographic factors affect adoption of BMPs because certain individual characteristics influence how much and what kind of information is exposed to the individual. In other words, it is important to recognize that different sources of information will appeal to and apply differently to various audiences and that individuals living in remote areas may be less likely to receive as much pertinent information as others living closer in proximity to information sources such as Extension offices. Also, it is important to consider that an agricultural producer is not likely to consider information about BMPs valuable if they do not feel it relates to them personally, if they are unaware that there is an environmental problem, or of they are not convinced that they personally contribute to the problem.

Consider Ability-to-Act Factors:

One of the most important factors in the adoption decision-making process is the economic cost associated with adopting innovations. If potential adopters do not possess necessary economic resources to purchase innovations, then adoption will not occur (Napier et al., 2000a). Furthermore, individuals may sometimes be unable to adopt ideas, technologies, or farming techniques because they do not have the economic resources to implement what they may otherwise desire to do (Napier et al., 1984). Positive attitudes

are not useful for environmental change if landowners do not possess the resources to make changes (Hines et al., 1987). Two important factors affecting this are immediate financial constraint and long-term profitability of management options.

If funding (such as cost-sharing) for the adoption of best management practices and farm technologies is an option for agricultural producers, it would be advantageous for Extension to provide assistance to ensure that farmers are aware that these funding opportunities exist. Results from Rhodes et al. (2002) reveal that respondents who were aware that funding was available for BMP adoption were more likely to intend to adopt various BMPs within the next year, independent of their level of information. Furthermore, some landowners suggest that receiving subsidies/cost-sharing to help reduce the burden of implementing practices would help encourage the adoption of BMPs.

Another important factor affecting farmers' ability to adopt innovations is possession of requisite skills frequently required to effectively use technologies. The adoption of some technological innovations requires extensive technical knowledge or the potential benefits to be derived from adoption will not be realized. If potential adopters are aware that they do not possess the skills needed to effectively use innovations, they will not adopt (Napier et al., 2000a). Results from Rhodes et al. (2002) indicate that primary farm operators with higher levels of education were more likely to adopt BMPs. This is likely the case because farmers with higher levels of education also tend to be more familiar with advanced technologies and feel more competent using them.

Recognize Values and Attitudes Farmers have about the Environment:

In persuading agricultural producers to adopt conservation practices (BMPs), it is important that Extension agents and agricultural educators recognize that many farmers have an acute sense of environmental stewardship (Paolisso, 1999). Farmers are often resentful about the prevailing public opinion that they are polluters and are not environmentally concerned. Contrary to public opinion, there is a strong sense of environmentalism among farmers (Paolisso, 1999). Farmers tend to have a widely shared and strongly held belief that they are "real" environmentalists. While not dismissing the contributions that urban-based environmentalists and residents can make to protect the environment, farmers do feel that their environmentalism is unique and at a minimum, equally valid. Farmers' environmentalism is derived from daily interaction and dependence on the environment and natural resources to make a living (Paolisso, 1999).

While recognizing the sense of environmentalism of many farmers, it may be equally important to recognize that some agricultural producers do not value or do not feel concern towards the environment. Environmental attitudes influence farmers' decisions about whether to adopt certain farming practices. For example, if farmers do not value the physical environment, they are less likely to adopt conservation technologies (Napier et al., 1986). Consequently, Ohio farmers who believed environmental problems to be more important were more likely to adopt various conservation practices than those who did not feel environmental problems were important (Napier et al., 1986).

Additional research illustrates that farmers who farmed a larger number of acres tended to be less concerned about the environment (Napier et al., 1986). Farm size is just

one example of factors determining farmer environmentalism. Recognizing the complexities of modern farm management and valuing farmer environmentalism are essential components to a constructive dialogue and collaboration between farmers and representatives of Extension agencies charged with developing and implementing BMPs.

Consider Farmers' Perceived Risks of Adoption:

There are many risks associated with adopting alternative farming practices and risk orientations of farmers are important considerations to make when trying to persuade farmers to adopt innovative farm technologies or BMPs. In order to persuade agricultural producers to adopt conservation practices, Extension agents must convince farmers that the benefits of adopting BMPs outweigh the costs. If benefits associated with adopting an innovation are perceived to outweigh the costs associated with adoption, then serious consideration will be given to adopting the innovation (Napier et al., 2000a).

Midwest farmers indicate that they would expect to receive returns on conservation investments within five years if they were to adopt conservation practices (Napier et al., 2000a). If farmers feel they will receive no benefit from investing in conservation technologies, they will not adopt such practices. Research in several states has shown that farmers adopt new practices in the belief that the practices will produce benefits (Napier et al., 1986).

Other variables influencing adoption behavior include age and farming experience. Some research shows that older, more experienced farmers are more cautious and skeptical and, therefore, are less likely to adopt new practices and techniques (Napier et al., 1986). This is particularly the case if they do not feel the

technology will bring any benefit to younger family members intending to manage the farm in the future.

Furthermore, previous research suggests that primary farm operators can be influenced to adopt conservation practices if they perceive that their children will be operating their farms, and therefore, benefiting from their investments, in the future (Napier et al., 2000a). This "inter-generational transfer" of the farm was considered an added benefit to outweigh the original cost (and reduce the risk) of implementing the conservation practice. Many farmers reported that if they did not expect to derive profits in the near term and did not expect that their children would be operating the farm in the future (because they did not feel their children would benefit from the investment) farmers were hesitant to invest in conservation practices. This suggests that long-term protection of land resources may not be highly valued by all agricultural producers (Napier et al., 2000b).

Another component of risk that Extension agents should consider is the threat associated with the use of farm chemicals. For many farmers, the perceived risk of applying chemicals on crops is also an important consideration when determining whether to adopt conservation practices. For example, if a farmer were to perceive chemicals as not harmful to humans, livestock, water quality, etc., they would not be as inclined to adopt BMPs as would a farmer who perceived chemicals to be harmful (Napier et al., 2000a).

Take into Account the Relevance of BMPs or Farm Technologies to Farmer:

Not only must potential adopters of conservation practices become aware of the new technologies, they must also recognize the relevance of the technology to their farm operations and how the adoption of BMPs will resolve identified environmental problems. Potential adopters must become convinced that the adoption of BMPs and new farm technologies will benefit their particular farm in some manner. Not all BMPs and farm technologies are appropriate or relevant to particular agricultural producers. For example, some BMPs for riparian zones are inappropriate on certain farms because non-point source pollution requires site-specific responses (Rhodes et al., 2002). Emphasis also needs to be placed on issues such as topographic factors because the slope of land is a consideration in the adoption of some BMPs such as conservation tillage practices (Rhodes et al., 2002).

**Agricultural Landowners' Information Needs**

While little is known about farmers' perceptions about water quality as an issue, possibly even less is known about farmers' use of information sources regarding this environmental problem (Bruening, 1992). In 1988, Extension redefined its mission to focus on issues and needs of the clientele groups (Rasmussen, 1989). Agricultural Extension agents and communicators provide a wide variety of programs to farmers through a number of approaches and yet few studies have examined the communication strategies that farmers find most useful for gaining information about environmental issues (Bruening, 1991).

Previous research indicates that farmers must have a specific need for information before they will participate in an educational activity (Bruening, 1992). In a comprehensive study evaluating 75 years of Extension programs, clientele groups indicated that water quality was one of the eight key issues about which they desired more information (Rasmussen, 1989). Once Extension had determined the information needs of their clientele, they had only to identify which communication strategies and which human resources should be implemented to deliver the desired information to the clientele groups.

Few researchers have examined the relationship between farmers' demographic characteristics and their information needs (Rollins et al., 1991). In Missouri, significant differences between education levels and acres owned by farmers affected the importance of farmers' information needs (Okai, 1986). Results indicated that farmers with higher levels of education sought more professional information such as information from Extension specialists and commercial dealers as opposed to farmers with lower levels of education. In addition, farmers with large acreages relied more on newspapers and magazines when compared to farmers with small acreages. Furthermore, findings illustrated that farming experience (years of farming) was independent of the farmer's perceived importance of various information sources.

**Communication Strategy Preference of Agricultural Landowners**

Understanding how the public perceives, uses, and receives educational publications can improve Extension's stated mission of providing research-based information to the public (Scherer & Masiclat, 1990). It is important to understand not only how producers view different information sources, but also how factors or characteristics influence producers' attitudes toward various information sources (Gloy et al., 2002). For example, if certain factors or characteristics tend to influence preferences toward information from a specific information source, Extension agents and agricultural communicators can use this information to determine which communication strategies more effectively reach a targeted audience.

Extension educators and agricultural communicators need to identify the usefulness of particular information sources and the channels for disseminating information to farmers. Information relative to these sources and channels will not only help in identifying the information needs of farmers, but will also assist in developing educational programs to effectively communicate with agricultural landowners (Rollins et. al, 1991). Previous research recommends implementing "issues based programming" in outreach efforts (Bruening, 1991). "Issues-based programming" means that Extension must improve efficiency in their programming efforts and use appropriate communications methods for their clientele groups. Despite this recommendation, few studies focus simultaneously on issues-based programming and the communications methods needed to deliver this type of programming (Bruening, 1991).

However, a number of studies document the value of communication strategies used by Extension agents and agricultural communicators. For instance, North Carolina

farmers used newsletters, meetings, farm visits, telephone calls, and on-farm tests more often than 16 other Extension communication strategies (Richardson, 1989). Fairs, computers, exhibits and videotapes were used least often. Ohio farmers ranked meetings and clinics produced by Extension agents first, both in importance and confidence (Kramic, 1987). These farmers also ranked Extension bulletins and newsletters highest in confidence and content accuracy. However, more technological information delivery systems such as teleconferencing, video tapes, audio-cassettes, and cable television were not preferred by these farmers.

Additional research revealed a positive relationship between satisfaction and intensity of contact with local Extension offices. Results indicated that people who use Extension more intensively rate it higher than non-users (Lavis & Blackburn, 1990). Furthermore, Richardson (1993) discovered that six media were expected to be less important to agricultural producers in the future: meetings (-4%), newsletters (-8%), field days (-6%), telephone calls (-7%) and bulletins (-8%). Only two media were expected to become more important: computers (+20%) and videotapes (+9%). Table 1 summarizes the average mean ranks of the importance of various communication strategies to agricultural landowners in a number of related studies. Table 1 consists of previous research using Likert scales with mean rankings where 1= not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, and 5 = very important as an information source.

Table 1. The average mean ranks of the importance of communication strategies to agricultural landowners in previous studies.

| | Mean ranks of Importance of Communication Strategies | | |
|---|---|---|---|
| **Literature** | **Personal Sources of Information[a]** | **Written Sources of Information[b]** | **Technological Sources of Information[c]** |
| Bruening (1991) | 3.67 | 3.67 | 3.45 |
| Rollins et al. (1991) | 3.86 | 3.73 | 3.36 |
| Gamon et al. (1992) | 2.80 | 3.12 | 2.21 |
| Trede & Whitaker (1998) | 4.11 | 3.34 | 3.28 |
| Suvedi et al. (1999) | 2.64 | 2.88 | 2.04 |

[a] = On-farm consultations, demonstration tours, public meetings, trade shows, family, friends, and neighbors
[b] = Newspapers, newsletters, bulletins, manuals, brochures, fact sheets, charts, and photos
[c] = (Audio/Visual) Radio, television, Internet, web pages, video tapes, and audio tapes

**Preference for Traditional Communication Strategies**

Findings from previous research indicate that personal and written sources of information such as on-farm consultations, demonstrations, and newsletters and bulletins were more useful than computerized and technological sources of information to learn about environmental issues (Table 1). Public meetings, newsletters and magazines were also identified as useful sources of information (Rollins et. al, 1991). According to Gloy et al. (2002), farm publications are one of the most frequently used communication tools. Similarly, office calls, telephone calls, bulletins and newsletters were the methods used most often by Ohio Extension agents to deliver instruction to farmers (Bouare & Bowen, 1990). Methods least used were radio, television, magazines and teleconferencing. The most frequently used communications channels (meetings, newsletters, agent visits and telephone calls, field days and demonstrations) share the characteristics of immediacy and timeliness (Richardson, 1993). Except for newsletters, all channels offer farmers the

opportunity either to ask their own questions or to see something for themselves (Richardson, 1993).

**Preference for Computerized Communication Strategies**

Within the traditional stakeholder audiences of agricultural students and Cooperative Extension clientele, experience and perception of the Internet for educational communication purposes is still relatively limited (Irani, 2000). For example, in a three-year longitudinal study, although the percentage of respondents who used the Web to gain Extension-related information increased from 1.4% to 10%, the vast majority of respondents did not rely on that information source (Suvedi et al., 1999). In addition, farmers rated "cutting edge," Internet-delivered instructional technologies much lower than traditional instructional techniques, perhaps owing to lack of familiarity and prior experience with these technologies (Trede & Whitaker, 1998). Furthermore, the Internet, satellite dishes, and fiber optics networks were rated much lower than some of the more traditional instructional technologies (Trede and Whitaker, 1998). This may suggest a lack of familiarity of the respondents regarding the potential of these technologies as delivery methods for education.

"Historically, computers have been used by producers with larger farms. Limited-resource farmers (less than $25,000 household income and 50 acres) bypassed the technology because of its cost and their lack of knowledge about computer use in farming. (Findlay et al., 1993, p.22)." Gloy et al., (2002, p.18) suggests that:

> "Internet use tends to be associated with producers who have more favorable views of information sources. In five different models, Internet use increased the probability that producers had a favorable view of information sources. At this point, it appears that the Internet might be a compliment rather than a substitute for traditional information sources."

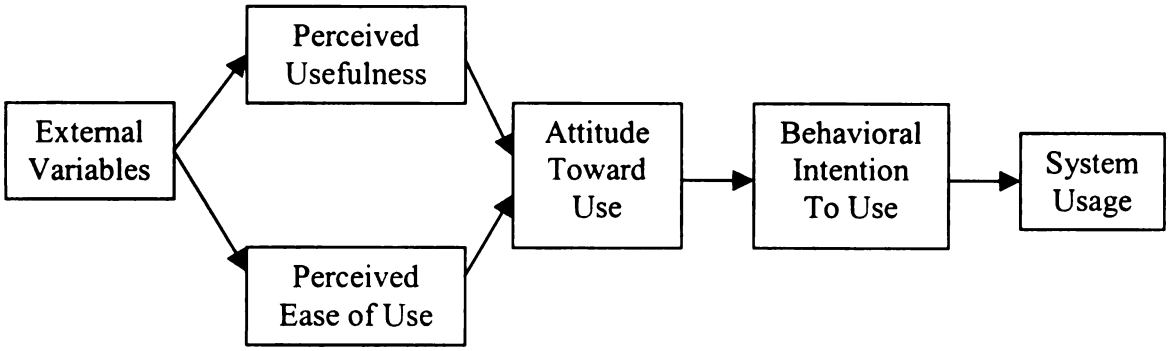
Several reasons explain why farmers express reluctance to adopt computers and fail to benefit from other technological innovations such as the Internet. These reasons include the cost of the computer (Findlay et al., 1993), cost of hardware and software (Dix, 1994), high telephone line charges incurred by distant participants (Dix, 1994), time required to learn how to use the technology (Findlay et al., 1993), lack of knowledge about the Internet's capabilities (Findlay et al., 1993), low computer literacy (Taylor et al., 1991; Iddings & Apps, 1990), lack of training to mitigate technophobia (Taylor et al., 1991), lack of on-line technical assistance for users (Dix, 1994), level of education of the farmers (Findlay et al., 1993), age (Dix, 1994), and size and type of farming operation (Findlay et al., 1993; and Taylor et al., 1991). In addition, many farmers have been slow to adopt computers and innovative technologies to obtain educational information (Iddings & Apps, 1992) due to variables such as income, limited time, education and access (Tavernier et al., 1996). Furthermore, the lack of computer related equipment and/or skills can disconnect rural clientele from enriching collaboration or information exchanges with universities, agencies, and other sources (Findlay et al., 1993).

Despite these findings, Internet use may increase in the future (Suvedi et al., 1999). By comparing survey responses from farmers in 1996 to 1999, the 1999 respondents were significantly more likely to rely on the World Wide Web and other sources of general farm-related computerized information than the 1996 respondents. In a related study, farmers suggested that computers (ranking 19$^{th}$ out of 23 media choices)

would increase to a ranking of 8th in future use (Richardson, 1989). Furthermore, as Extension agents turn to video tapes and computers to stretch their communications capabilities, they can be encouraged that both full-time and part-time farmers anticipated making greater use of these media (Richardson, 1993). Therefore, evidence exists to suggest that Cooperative Extension needs to continue to embrace the use of the Internet (Tennessen et al., 1997).

Based on previous direct experience research as well as the Technology Acceptance Model (TAM) and user acceptance studies focusing on individual differences (Irani, 2000), subjects with greater prior experience with a technology will more likely use it than those who lack experience. Previous research indicates that Internet experience and perceived usefulness were the strongest predictors of behavioral intent to use Internet communication tools (Irani, 2000). Therefore, understanding the factors which influence attitude and user perceptions toward technology is a critical need (Irani, 2000). The Technology Acceptance Model states that increased perceptions of ease of use and technology usefulness leads to increased computer/Internet use (See Figure 1).

Figure 1. The Technology Acceptance Model (Hubona & Geitz, 1999).




If Internet use is indicative of producers who are likely to seek out information, one would expect that Internet use would increase the probability that producers receive useful information from all sources (Gloy et al., 2002). On the other hand, Internet users might view the information received from the Internet as a substitute for information received from media sources such as radio, farm publications and direct mail. In this case, Internet use would reduce the probability of receiving useful information from media sources. However, it is expected that Internet use should positively relate to the usefulness of information received from personal sources (Gloy et al., 2002).

According to Wilde & Swatman (1996), the problems with the World Wide Web from the rural point of view are twofold. "Firstly, farmers do not have the equipment, time or money to make use of the services. Secondly, while the WWW is an information source of great potential for the unilateral use of the farmer, e-mail and conferencing require active participation by the community and thus may not usefully be adopted by a farmer unilaterally" (Wilde & Swatman, 1996, p. 7). In addition, if information technology and telecommunications are to satisfy the informational needs and extend the capabilities of the farmer, both the technology and the dissemination strategy must be

sufficiently flexible to adapt themselves to the farmers' way of working. (Wilde & Swatman, 1996). Furthermore, because Extension's long-range and ultimate task is to influence its clientele through education and to use the results of scientific technology to improve their quality of life, Extension should organize seminars, institutes, and workshops to train farmers in computer applications for agriculture (Findlay et al, 1993).

## Chapter Three: Methods

No comprehensive study of Michigan's agricultural landowners specifically addressing 1) farmers' attitudes towards watershed conservation issues, 2) farmers' information needs, 3) farmers' best management practice adoption behaviors, 4) farmers' communication strategy preferences, and 5) farmers' recommendations for improving web sites as a communication strategy has been previously conducted. In order to obtain this valuable information about Michigan's agricultural landowners, this study was conducted in two separate phases. Initially a random sample of residents from four agricultural watersheds was asked to complete a survey instrument entitled: A Survey of Landowner Watershed Information Needs (Appendix A). Once information needs and communication strategy preferences were determined, residents were recruited to participate in a focus group/hands-on website session to determine how web sites could better meet agricultural landowners' information needs.

### Survey Data Collection

In the Spring of 2001, 922 survey instruments were mailed to agricultural landowners in four agricultural watersheds within the state of Michigan: the Lake Macatawa, the Gun River, the North Branch Flint River, and the Upper Thornapple watershed. Watersheds were chosen based on their involvement in watershed conservation programs. The Lake Macatawa and Gun River watersheds served as the treatment sites as they included Total Maximum Daily Load (TMDL) and Clean Water Act Section 319 planning and implementation activities. The Upper Thornapple and North Branch Flint River watersheds served as control sites as little active watershed conservation activities occur in these watersheds. Names and addresses of landowners

were retrieved from county geographic information systems (GIS) or Equalization offices for each of these watersheds.

A mail survey was selected for data collection because of its low cost and advantageous uniform access to dispersed populations without interviewer bias (Salant and Dillman, 1994). A survey, including both open and closed ended questions, was developed with many question items derived from previous, peer-reviewed and field-tested studies from agricultural communication professionals. Once the survey questions were formulated, the survey instrument was peer reviewed by several Extension agents and water quality professionals before mailing the survey instrument to agricultural landowners.

Respondents completed and returned 403 of the 922 survey instruments providing an overall response rate of 43.7%. While a higher response rate facilitates greater generalizability, low response rates were expected due to the fact that farmers typically do not respond well to surveys (Lasley, 1985; Howe, 1997).

Survey methodology followed Dillman's Total Design Method (Salant & Dillman, 1994). The survey instrument was initially mailed to the sample of agricultural landowners in May of 2001. A reminder postcard was sent to the sample population approximately three weeks later. About four weeks following the second mailing, non-respondents were mailed a second copy of the questionaire. Although monetary incentives were not used in this study to increase response rate, the research team did use university sponsorship and stamped return postage instead of business reply, both of which tend to produce the largest increases in response rates according to Fox et al. (1988).

In the questionnaire, participants were asked to report demographic information such as age, education level, income, farm operation (whether respondents grew crops or raised livestock), farming status (whether respondents were full-time, part-time, or non-farmers), farm size, and gender (this demographic was largely excluded from analysis since the vast majority of respondents were male). Respondents were also asked how informed and satisfied they were about the water quality in their watersheds, how often they tried/adopted watershed conservation practices, and about which practices they desired more information. Respondents also identified how often they participated in Extension programs and which communication strategies they preferred to learn about watershed conservation issues. In addition, respondents provided information about where they have Internet access and how often they use the Internet for management decisions.

**Survey Data Analysis**

Data were analyzed using SPSS 10.0.7 statistical software for social statistics (SPSS, 2000). Statistical analysis consisted of Pearson's correlation (r), Pearson's Chi-square test of independence ($\chi^2$), and One-way Analysis of Variance (F-test). Relationships between two ordinal variables were analyzed using Pearson's correlation. Comparisons between means were examined using ANOVA while differences between proportions were assessed using Pearson's Chi-square test of independence.

Descriptive statistics, (including frequencies, percentages, means, and standard deviations) were also generated to gain an overall view of respondents' demographic characteristics and their attitudes and behaviors regarding various information

technologies or conservation practices. Descriptive statistics were used to obtain the standard deviations needed to calculate Cochran's C. Cochran's C detects the degree of heteroskedasticity in the sample and is used to determine if variances may be equal in the sample. The homogeneity of variance was then tested using Levene's statistic. In all cases, Levene's statistic was greater than 0.05 indicating that one would fail to reject the null hypothesis that the variances are equal and that ANOVA could be used. If differences between groups were detected using ANOVA, Bonferroni's Post Hoc test was used to determine which means differed significantly.

Non-response Bias

Since this study did not obtain a 100% response rate and because non-response error threatens the external validity of a study, it becomes necessary to attempt to assess non-response error. In their widely accepted and frequently cited article concerning non-response in survey research, Miller and Smith (1983) stated that Extension evaluators could use one of four general methods to control for non-response error. Evaluators could: ignore non-respondents, compare respondents to the population, compare respondents to non-respondents, or compare early to late respondents.

According to Miller and Smith (1983), the most widely accepted and empirically sound procedure to assess non-response error is to contact non-respondents to see how their responses compare to respondents. Due to time and financial constraints, the research team compared early respondents to late respondents. Results from procedures used to address non-response error provide evidence that the method of comparing early and late respondents is a defensible and generally accepted procedure for handling non-response error as a threat to external validity of research findings (Lindner, et al., 2001).

Lindner et al. (2001) explored how non-response has historically been handled in ten years of publications in the Journal of Agricultural Education. These authors discovered that of the 53.3% of articles that reported and attempted to control for non-response bias in ten years of publications, 31.3% compared early and late respondents while only 18.7% followed up with a sample of non-respondents.

The research team specifically compared early and late respondents on Likert scale items and demographic information. The post card reminder was sent on June 5th, and early respondents were classified as individuals who returned their survey instruments by June 7th (allowing a couple of days for the research team to receive survey instruments sent in the mail on June 4th or 5th ) and late respondents were defined as any individual who returned their survey instrument on June 8th or later. Since late respondents tend to be similar to non-respondents (Miller & Smith, 1983; Pace, 1939), demographic data and responses to Likert scale questions from early respondents were compared to data from late respondents. With late respondents assumed typical of nonrespondents, if no differences are found, then respondents are generalized to the sample (Miller & Smith, 1983).

**Focus Group Data Collection**

While the Internet has the potential to provide more effective information exchange, the specific effectiveness of the Internet and websites in informing agricultural landowners about watershed conservation issues and practices remains undetermined. A substantial amount of research exists that supports the use of computers and web sites as Extension communication tools; however, there is a need to determine the actual effectiveness of web sites as a communication strategy for informing agricultural

landowners about watershed conservation issues and practices. For this study, data from the landowner watershed information needs survey were combined with information regarding best management practices and water quality issues to develop a web site. Michigan State University's Institute of Water Research provided support for designing and assessing the web site.

To determine how to improve agricultural landowners' preference for web sites as a communication strategy, focus group participants (agricultural watershed residents within the targeted watersheds along with residents from the Stony Creek and Rice Creek watersheds) completed a one-hour web site session of the initial web site design in the winter of 2002. Upon completion of the web site session, participants engaged in a round-table discussion to provide suggestions about the site design and content (The script for the focus group/round table discussion can be found in Appendix B). Once suggestions were collected and implemented, an improved web site was created for landowners' use.

The four basic steps that guide focus group research are: planning, recruiting, moderating, and analysis and reporting (Morgan, 1993). Once the research team determined the purpose and desired outcome of the focus group discussions, the research team formulated a list of questions to determine participants' previous experience with web sites, their impressions of the web site, recommendations on how the site could be improved, and whether participants intended to use web sites to obtain information about water quality and watershed conservation issues in the future. Questions were designed in such a manner that they were clear, short, open-ended, free of jargon, and easy for the moderator to deliver in a conversational manner. Questions were ordered such that

general questions preceded those of a more specific nature as suggested by Kovacic (2001). After general background questions were addressed, questions of a positive nature (such as: "What did you specifically like about the web site?") were offered before questions of a more negative nature (such as: "What did you specifically dislike about the web site?"). The final questions asked of participants pertained to recommendations and suggestions they had on how the web site could be improved.

Once focus group questions were formulated and reviewed by the project team, the team decided on locations, dates, and times for each of the focus group sessions. Local Extension agents involved with the project then recruited participants. The research team decided to hold as many focus group sessions as they felt necessary to reach "theoretical saturation" (Morgan, 1998). Once four focus group sessions were performed and the project team ceased to gather new thoughts and information, the team was able to assume that saturation had been achieved and additional focus group sessions were not necessary.

In order to perform the focus groups, the research team decided to have one primary moderator and one assistant moderator. The responsibility of the primary moderator was to direct the flow of the conversation within the group by asking questions, probing for answers, ensuring that all participants were involved in the discussion, and taking enough field notes to track the conversation. The assistant moderator had the responsibility of taking comprehensive notes, controlling the physical environment to reduce or eliminate distractions, and asking clarifying questions and summarizing key points during the final stage of the discussion. A tape recorder was used to document feedback from the focus group sessions and was used to supplement

field notes taken by both the interviewer and the primary note-taker. The tape recorder was placed in the center of the group in plain sight of all participants. Permission to tape the discussions was secured from participants preceding the dialogue.

The process of data analysis and interpretation began immediately at the end of the first focus group session. Once notes from the primary and assistant moderator were compiled, the data was coded. The project team carefully reviewed field notes looking for patterns, comparisons, or categories consistent between and among the different focus groups. Coding was used to identify themes and consolidate the evidence to support the findings.

## Chapter Four: Results

### Watershed Demographics

Table 2 demonstrates the demographics of each watershed.

Table 2. Summary of watershed demographics.

| | Watersheds | | | |
|---|---|---|---|---|
| **Watershed Characteristics** | **N. Branch Flint River** | **Gun River** | **Lake Macatawa** | **Upper Thornapple** |
| **Watershed Size** | 147,200 acres 59,570 ha* | 72,960 acres 29,526 ha* | 112,000 acres 45,325 ha* | 145,280 acres 58,793 ha* |
| **Total Area Owned by Respondents** | 11,323 acres 4,587 ha* | 9,174 acres 3,713 ha* | 11,844 acres 4,793 ha* | 6,198 acres 2,508 ha* |
| **Total Area Rented by Respondents** | 5,598 acres 2,265 ha* | 2,145 acres 868 ha* | 7,551 acres 3,056 ha* | 2,692 acres 1,089 ha* |
| **% of Respondents who Own the Property they Farm** | 62.7 | 65.1 | 69.6 | 29.6 |
| **% of Respondents who Rent the Property they Farm** | 26.3 | 32.6 | 29.6 | 8.16 |
| **Average Property Size Owned by Respondents who Own Property** | 131.7 acres 53.0 ha* | 327.6 acres 133.0 ha* | 136.1 acres 55.0 ha* | 213.7 acres 87.0 ha* |
| **Average Property Size Rented by Respondents who Rent Property** | 155.6 acres 63.0 ha* | 153.2 acres 62.0 ha* | 204.1 acres 83.0 ha* | 336.5 acres 136.0 ha* |
| **% of Watershed Owned by Respondents** | 7.7 | 12.6 | 10.6 | 4.3 |
| **% of Watershed Rented by Respondents** | 3.8 | 2.9 | 6.7 | 1.9 |
| **% of Watershed Managed by Respondents** | 11.5 | 15.5 | 17.3 | 6.2 |

*ha=hectares

**Overall Survey Respondent Demographics**

The average age of respondents was 57 years old. The majority (79.2%) of respondents were male. More than 56% of respondents obtained more than a high school education while the average gross annual income for survey respondents was between $35,000 and $50,000 per year. While a substantial proportion (36.9%) of respondents claimed to have no farming experience, the majority of farming respondents claimed cultivated crops as their primary farming operation. The average farm size (both owned and rented acreages) was 228 acres (Table 3).

Table 3. Summary of survey respondent demographics

| Demographic Variable | Demographic Characteristics | % of Respondents |
|---|---|---|
| **Age** | Between 20-40 years old | 10.9 |
| | Between 41-60 years old | 45.5 |
| | Greater than 60 years old | 43.7 |
| **Gender** | Male | 79.2 |
| | Female | 20.8 |
| **Highest Level of Education** | Grade school education | 5.1 |
| | Some high school education | 9.2 |
| | High school graduate | 29.7 |
| | Vocational or trade school | 7.7 |
| | Some college | 24.6 |
| | College graduate | 11.8 |
| | Post graduate work or degree | 12.0 |
| **Gross Annual Income Level** | $15,000-$25,000 | 18.1 |
| | $25,001-$35,000 | 17.2 |
| | $35,001-$50,000 | 20.2 |
| | $50,001-$75,000 | 20.5 |
| | $75,000+ | 23.9 |
| **Farming Status** | Non-farmers | 36.9 |
| | Part-time farmers | 44.4 |
| | Full-time farmers | 18.7 |
| **Primary Farming Operation*** | Cultivated crops | 60.1 |
| | Confined or pastured livestock/poultry | 10.5 |
| | Both crops and livestock | 29.4 |
| **Farm Size (Owned or Rented Acreage)** | Less than 228 acres (average farm size) | 73.5 |
| | 228+ acres | 26.5 |

* Note: there was an option for respondents to choose other farming operation and these were combined into the crops or livestock categories as appropriate. Examples of other farming operations included blueberries, greenhouses, and Christmas trees.

## Survey Respondent Demographics by Watershed

Overall, respondents from the Upper Thornapple watershed were least likely to return completed survey instruments to the research team (Table 4). There is a statistically significant difference in mean age level among watershed respondents at the p=0.05 level (F=3.403, p=0.018). Watersheds also differed significantly based on respondents' gender ($\chi^2$=10.56, p=0.014), respondents' gross annual income level

($\chi^2$=24.27, p=0.019), respondents' level of education ($\chi^2$=32.46, p=0.019), and respondents' farm residence ($\chi^2$=35.71, p=0.000) (Table 4).

Table 4. Summary of survey respondent demographics by watershed.

| | Watersheds | | | | Statistics | | |
|---|---|---|---|---|---|---|---|
| **Respondent Demographics** | **North Branch Flint River** | **Gun River** | **Lake Macatawa** | **Upper Thorn-apple** | **$\chi^2$** | **F-test** | **p-value** |
| **# of Respondents** | 137 | 43 | 125 | 98 | -- | -- | -- |
| **Response Rate (%)** | 48 | 49 | 48 | 34 | -- | -- | -- |
| **Average Age (years)** | 60.1 | 51.9 | 57.1 | 54.3 | -- | 3.403 | 0.018* |
| **% Male** | 79.1 | 90.5 | 83.3 | 68.8 | 10.56 | -- | 0.014* |
| **% Gross Annual Income less than $50,000** | 51.0 | 57.5 | 51.5 | 43.2 | 24.27 | -- | 0.019* |
| **% Earned at Most a High School Degree** | 60.0 | 34.9 | 56.2 | 30.8 | 32.46 | -- | 0.019* |
| **% Reside on Farm** | 60.7 | 67.5 | 70.4 | 31.1 | 35.71 | -- | 0.000** |

*=Statistically significant result at the p=0.05 level
**=Statistically significant result at the p=0.01 level

Farming Operations (by Watershed)

Table 5 illustrates that there is no significant difference in farming respondents having only crops or only livestock as their primary farming operations ($\chi^2$=11.257, p=0.081). For the purposes of this study, "crops" is defined by cultivated crops, hayland, fruit trees, Christmas trees, and greenhouse plants. Any farmer with only one or a combination of these crops as their primary farming operation (and no livestock) fits in the "crops" category. "Livestock" is defined by pastured livestock and confined livestock/poultry. Any farmer with pastured livestock and/or confined livestock/poultry

(and no crops) fits in the livestock category. All farming respondents claiming to have both livestock and crops as their primary farming operation were excluded from this analysis because the survey instrument specifically requested the one category that best represents the respondents' primary farming operation. Farmers from all four watersheds had crops as their predominant farming operation.

Table 5. Respondents' primary farming operations by watershed.

| | Watersheds | | | | Statistics | |
|---|---|---|---|---|---|---|
| **Farming Operations** | **North Branch Flint River (%)** | **Gun River (%)** | **Lake Macatawa (%)** | **Upper Thornapple (%)** | **$\chi^2$** | **p-value** |
| **Crops** | 79.3 | 79.3 | 79.6 | 74.2 | 11.257 | 0.081 |
| **Livestock** | 41.9 | 31.0 | 38.7 | 19.4 | 11.257 | 0.081 |

Farming Status (by Watershed)

Table 6 demonstrates that of the 403 individuals responding from all four watersheds, 28.9% identified themselves as full-time farmers. There is a significant difference in farming status between watersheds at the p=0.01 and p=0.05 levels as the Upper Thornapple watershed had a significantly greater amount of non-farmers and a significantly smaller number of both part-time and full-time farmers than the other three watersheds ($\chi^2$=37.329, p=0.000).

Table 6. Farming status of survey respondents by watershed.

| | Watersheds | | | Statistics | | |
|---|---|---|---|---|---|---|
| **Farming Status** | **North Branch Flint River (%)** | **Gun River (%)** | **Lake Macatawa (%)** | **Upper Thornapple (%)** | **$X^2$** | **p-value** |
| **Non-Farmers** | 31.3 | 28.6 | 26.2 | 63.0 | 37.329 | 0.000** |
| **Part-time Farmers** | 48.5 | 47.6 | 50.0 | 29.3 | 37.329 | 0.000** |
| **Full-time Farmers** | 20.1 | 23.8 | 23.8 | 7.6 | 37.329 | 0.000** |

*=Statistically significant result at the p=0.05 level.
**=Statistically significant result at the p=0.01 level.

Farm Size (by Watershed)

There was no statistical difference in farm size owned or rented by respondents between watersheds at the p=0.01 or p=0.05 levels (Table 7).

Table 7. Number of acres in each watershed owned or rented by survey respondents.

| | Watersheds | | | | Statistics | |
|---|---|---|---|---|---|---|
| **Farm Size and Ownership** | **North Branch Flint River (%)** | **Gun River (%)** | **Lake Macatawa (%)** | **Upper Thornapple (%)** | **$X^2$** | **p-value** |
| **Own 158+ acres[a]** | 46.2 | 56.7 | 38.5 | 53.1 | 4.097 | 0.251 |
| **Rent 74+ acres[b]** | 19.6 | 23.3 | 23.4 | 25.0 | 0.617 | 0.893 |

[a] = the average farm size owned by survey respondents
[b] = the average farm size rented by survey respondents

**Summary of Findings for Differences Among Watersheds**

North Branch Flint River Watershed

The main differences between the North Branch Flint River watershed and the other three watersheds are that the North Branch Flint River watershed: (1) was the

largest watershed in the study, (2) had the greatest number of survey respondents (however, not the greatest response rate), (3) had the highest mean age of survey respondents, (4) had the lowest mean ranking for respondents' education level, and (5) had the greatest percentage of respondents who had only livestock as their primary farming operation.

Gun River Watershed

The main differences between the Gun River watershed and the other three watersheds are that the Gun River watershed: (1) had the highest proportion of male survey respondents, (2) had the highest response rate, (3) had the lowest mean ranking of income level, and (4) had the largest amount of acreage owned by survey respondents.

Lake Macatawa Watershed

The main differences between the Lake Macatawa watershed and the other three watersheds are that the Lake Macatawa watershed: (1) had the largest percentage of acreage managed (owned and rented) by survey respondents, (2) had the highest percentage of respondents who lived on a farm, (3) had the greatest percentage of respondents who had crops as their primary farming operation, and (4) had the least amount of acreage owned by survey respondents.

Upper Thornapple Watershed

The main differences between the Upper Thornapple watershed and the other three watersheds are that the Upper Thornapple watershed: (1) had the lowest survey response rate, (2) had the greatest mean ranking for respondent income level, (3) had the highest mean ranking for respondents education level, (4) had the lowest proportion of

individuals living on a farm, (5) had the greatest percentage of non-farmers, and (6) had the highest percentage of female respondents.

**Non-response Bias**

Comparison of Early and Late Respondents

Of the 29 variables tested, only 2 came out significant between early and late respondents at the p=0.05 or p=0.01 levels (Table 8 & Table 9). The two variables that came out significant were: frequency of cover crop use and frequency of spreading manure on the same field every 2-4 years. When correlating respondents' farming practices with the date they returned their survey, one discovers that the more often a respondent uses cover crops and the less often a respondent spreads manure on the same field every 2-4 years, the more likely they are to turn in their survey before receiving a postcard reminder (r=0.245, p=0.005 and r=0.195, p=0.028, respectively).

Table 8. Comparisons of early and late respondents' responses to survey questions to determine non-response bias.

| | Statistics | |
|---|---|---|
| **Difference Between Early and Late Respondents** | **F test** | **p-value** |
| Satisfaction with water quality | 0.633 | 0.427 |
| Level of feeling informed about watershed conservation issues | 0.309 | 0.579 |
| Importance of watershed conservation issues | 3.502 | 0.062 |
| Frequently use cover crops | 8.239 | 0.005** |
| Frequently keep written records of manure applications | 0.731 | 0.394 |
| Frequently spread manure on the same fields each year | 1.861 | 0.175 |
| Frequently spread manure on the same field no more than every 2-4 years | 4.935 | 0.028* |
| Frequently use book values of manure to plan land application rates | 0.063 | 0.802 |
| Frequently use manure tests to determine manure application rates | 2.094 | 0.151 |
| Frequently use nitrate soil tests to determine N fertilizer rates | 0.180 | 0.672 |
| Frequently use soil tests to determine which fields to spread manure | 0.043 | 0.836 |
| Frequently reduce starter fertilizer on manured ground | 0.214 | 0.644 |
| Frequently receive complaints on manure handling/odor | 0.217 | 0.642 |
| Frequently use buffer strips or observe a safe distance from surface water when fertilizing | 1.712 | 0.193 |
| Frequently have an agronomist make recommendations about manure nutrients | 0.003 | 0.953 |
| Frequently spread manure on haylage fields | 3.375 | 0.069 |
| Prefer information from print sources | 0.101 | 0.751 |
| Prefer information from electronic sources | 0.068 | 0.794 |
| Prefer information from organizational events | 1.027 | 0.312 |
| Prefer information from personal sources | 3.267 | 0.072 |
| Highest level of education | 0.054 | 0.817 |
| Gross annual income level | 0.862 | 0.354 |

*=Statistically significant result at the p=0.05 level
**=Statistically significant result at the p=0.01 level

Table 9. Additional comparisons of early and late respondents' responses to survey questions to determine non-response bias.

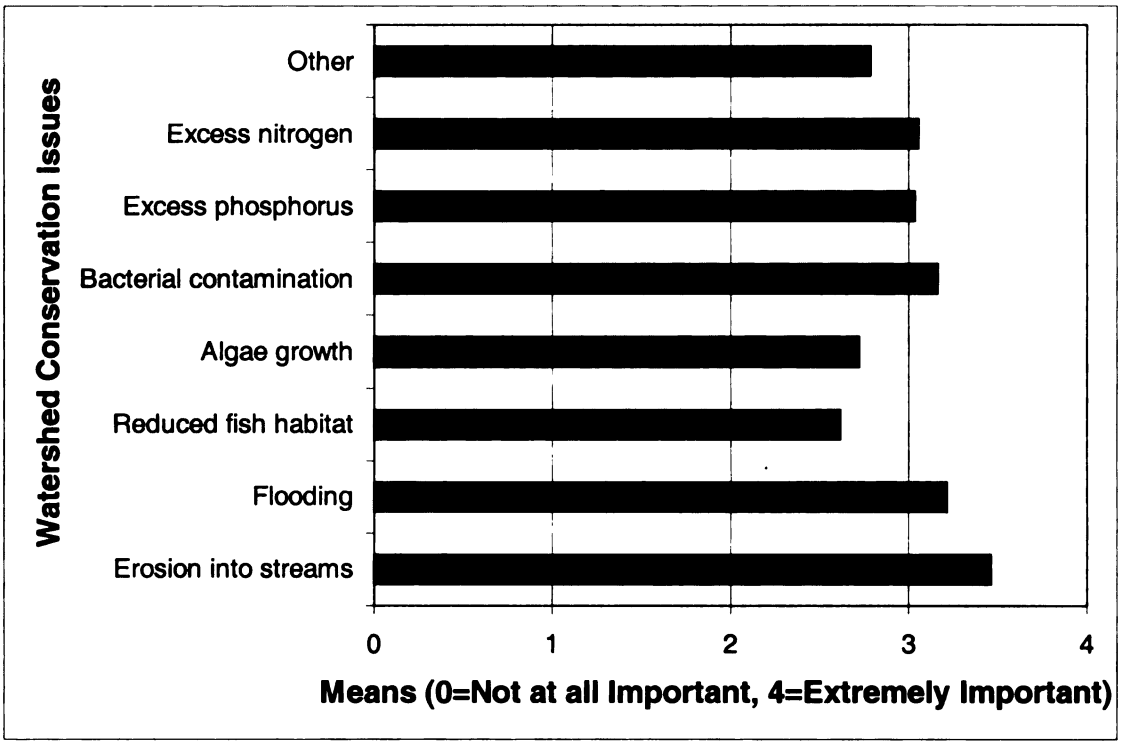
| | Statistics | |
|---|---|---|
| **Difference Between Early and Late Respondents** | $\chi^2$ | **p-value** |
| Tried/adopted crop conservation practices | 0.138 | 0.711 |
| Tried/adopted livestock conservation practices | 0.134 | 0.715 |
| Tried/adopted erosion conservation practices | 0.208 | 0.648 |
| Tried/adopted wildlife habitat conservation practices | 0.113 | 0.737 |
| Farming status (Full-time, Part-time, or Non-farmer) | 1.834 | 0.409 |
| Age (20-40, 41-60, or 61+ years old) | 1.354 | 0.508 |
| Gender (male or female) | 0.035 | 0.851 |

**Research Question 1a: How Important are Watershed Conservation Issues to Survey Respondents?**

Summary

Overall, survey respondents are most concerned about flooding (mean=3.21) and erosion into streams (mean=3.46) and are least concerned about reduced fish habitat (mean=2.61) and algae growth (mean=2.72) (Figure 2). Results from this portion of the study indicate that level of education has the highest significant and positive effect on landowners' level of concern for watershed conservation issues (Table 11). Age (Table 10) and farming status (Table 12) also have significant effects while income (Table 13), farm size (Table 14), primary farming operation (Table 15), and watershed residence (Table 16) have no significant effect on agricultural landowners' level of concern for watershed conservation issues.

Figure 2. Overall mean importance of various watershed conservation issues to survey respondents.




Demographics that have a Significant Effect on the Importance of Watershed Conservation Issues

*Age*

There was a significant difference in how concerned the different age groups were about reduced fish habitat (r=-0.136, p=0.013) and excess phosphorus (r=-0.116, p=0.035). Specifically, as respondents' age increases, they tend to be less concerned about fish habitat and excess phosphorus in the watershed. In general, respondents were least concerned about reduced fish habitat and algae growth and were most concerned about flooding and soil erosion into streams regardless of age (Table 10).

Table 10. The effect of respondents' age on the importance of watershed conservation issues.

| | Age of Respondent | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Watershed Conservation Issues** | **18-40 years old (n=42)** | **41-50 years old (n=89)** | **51-60 years old (n=87)** | **61-70 years old (n=90)** | **71+ years old (n=79)** | **Pearson's correlation (r)** | **p-value** |
| **Erosion into streams** | 3.44 | 3.52 | 3.72 | 3.29 | 3.40 | -0.044 | 0.418 |
| **Flooding** | 3.55 | 3.08 | 3.56 | 3.08 | 2.95 | -0.091 | 0.089 |
| **Reduced fish habitat** | 2.72 | 2.71 | 3.07 | 2.32 | 2.30 | -0.136 | 0.013* |
| **Algae growth** | 2.58 | 2.62 | 3.04 | 2.64 | 2.68 | 0.013 | 0.815 |
| **Bacterial contamination** | 3.43 | 3.11 | 3.54 | 2.94 | 2.93 | -0.100 | 0.067 |
| **Excess phosphorus** | 3.17 | 3.14 | 3.29 | 2.81 | 2.78 | -0.116 | 0.035* |
| **Excess nitrogen** | 3.29 | 3.11 | 3.22 | 2.88 | 2.85 | -0.105 | 0.058 |
| **Other** | 3.33 | 2.40 | 3.45 | 1.75 | 3.00 | -0.069 | 0.567 |

*=Statistically significant result at the p=0.05 level
**=Statistically significant result at the p=0.01 level

*Level of Education*

Education level has a significant positive effect on respondents' level of concern for most but not all watershed conservation issues (Table 11). As respondents' level of education increases, so does their level of concern about reduced fish habitat (r=0.1870, p=0.001), algae growth (r=0.117, p=0.032), bacterial contamination (r=0.122, p=0.025), excess nitrogen (r=0.123, p=0.026), and other watershed conservation practices (r=0.285, p=0.015).

Table 11. The effect of respondents' level of education on the importance of watershed conservation issues.

| | Respondents' Highest Level of Education | | | | | | | Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| **Watershed Conservation Issues** | **Grade School Education (n=20)** | **Some High School Education (n=36)** | **High School Graduate (n=116)** | **Trade School Education (n=30)** | **Some College Education (n=96)** | **College Graduate (n=46)** | **Post Graduate (n=47)** | **Pearson's correlation (r)** | **p-value** |
| **Erosion into streams** | 3.17 | 2.90 | 3.68 | 3.30 | 3.51 | 3.83 | 3.33 | 0.051 | 0.339 |
| **Flooding** | 3.38 | 2.68 | 3.47 | 3.11 | 3.18 | 3.51 | 2.95 | -0.018 | 0.744 |
| **Reduced fish habitat** | 1.79 | 2.36 | 2.58 | 2.48 | 2.54 | 3.08 | 3.02 | 0.180 | 0.001** |
| **Algae growth** | 2.63 | 2.36 | 2.68 | 2.73 | 2.57 | 3.23 | 2.95 | 0.117 | 0.032* |
| **Bacterial contamination** | 3.07 | 2.97 | 3.14 | 2.80 | 3.00 | 3.85 | 3.48 | 0.122 | 0.025* |
| **Excess phosphorus** | 2.87 | 2.93 | 3.00 | 2.46 | 3.01 | 3.65 | 3.14 | 0.103 | 0.060 |
| **Excess nitrogen** | 2.69 | 2.93 | 3.01 | 2.63 | 3.01 | 3.65 | 3.19 | 0.123 | 0.026* |
| **Other** | 1.80 | 1.29 | 3.00 | 3.44 | 2.15 | 3.75 | 3.50 | 0.285 | 0.015* |

Means: 0=Not at all Important, 4=Extremely Important (these variables were all reversed coded from how they originally appeared in the survey instrument).

*=Statistically significant result at the p=0.05 level
**=Statistically significant results at the p=0.01 level

*Farming Status*

Farming status significantly affected the level of importance respondents associated with soil erosion into streams (F=3.60, p=0.028) and other watershed conservation issues (F=3.73, p=0.029). Specifically, non-farmers expressed significantly less concern about soil erosion into streams than full-time farmers (Bonferroni post hoc, p=0.032). In addition, non-farmers expressed significantly less concern about other watershed conservation issues than did part-time farmers (Bonferroni post hoc, p=0.032). Overall, these findings suggest that farming status does not have a significant effect on agricultural landowners' level of concern for most watershed conservation issues (Table 12).

Table 12. The effect of respondents' farming status on the importance of watershed conservation issues.

| | Respondents' Farming Status | | | Statistics | |
|---|---|---|---|---|---|
| **Watershed Conservation Issues** | **Non-Farmers (n=144)** | **Part-time Farmers (n=173)** | **Full-time Farmers (n=73)** | **F test** | **p-value** |
| **Erosion into streams** | 3.21[a] | 3.52[a,b] | 3.75[b] | 3.60 | 0.028* |
| **Flooding** | 3.18 | 3.13 | 3.43 | 0.991 | 0.372 |
| **Reduced fish habitat** | 2.69 | 2.58 | 2.60 | 0.247 | 0.781 |
| **Algae growth** | 2.80 | 2.64 | 2.79 | 0.547 | 0.582 |
| **Bacterial contamination** | 3.15 | 3.12 | 3.24 | 0.168 | 0.845 |
| **Excess phosphorus** | 2.96 | 3.03 | 3.09 | 0.219 | 0.803 |
| **Excess nitrogen** | 2.98 | 3.04 | 3.06 | 0.096 | 0.909 |
| **Other** | 2.04[a] | 3.20[b] | 3.25[a,b] | 3.73 | 0.029* |

Means: 0=Not at all Important, 4=Extremely Important
*=Statistically significant result at the p=0.05 level
[a,b]=letters indicate similar groups

Demographics that do not have a Significant Effect on the Importance of Watershed Conservation Issues

Gross annual income level (Table 13), farm size (Table 14), primary farming operation (Table 15), and watershed residence (Table 16) have no significant effect on agricultural landowners' level of concern for watershed conservation issues.

Table 13. The effect of respondents' gross annual income level on the importance of watershed conservation issues.

| | Respondents' Gross Annual Income Level | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Watershed Conservation Issues** | **$15,000-$25,000 per year (n=60)** | **$25,001-$35,000 per year (n=57)** | **$35,001-$50,000 per year (n=67)** | **$50,001-$75,000 per year (n=68)** | **$75,001+ per year (n=79)** | **Pearson's correlation (r)** | **p-value** |
| **Erosion into streams** | 3.31 | 3.47 | 3.69 | 3.66 | 3.36 | 0.016 | 0.785 |
| **Flooding** | 2.85 | 3.23 | 3.45 | 3.50 | 3.13 | 0.061 | 0.288 |
| **Reduced fish habitat** | 2.26 | 3.87 | 2.70 | 2.83 | 2.81 | 0.100 | 0.089 |
| **Algae growth** | 2.52 | 3.08 | 2.88 | 2.76 | 2.80 | 0.015 | 0.798 |
| **Bacterial contamination** | 2.67 | 3.40 | 3.21 | 3.49 | 3.21 | 0.094 | 0.111 |
| **Excess phosphorus** | 2.72 | 3.16 | 3.19 | 3.28 | 3.14 | 0.084 | 0.154 |
| **Excess nitrogen** | 2.90 | 3.22 | 3.16 | 3.32 | 3.07 | 0.031 | 0.604 |
| **Other** | 2.81 | 3.07 | 2.80 | 3.87 | 2.28 | 0.021 | 0.925 |

Means: 0=Not at all Important, 4=Extremely Important

Table 14. The effect of respondents' farm size on the importance of watershed conservation issues.

| | Farm Size (Acres Owned and Rented) | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Watershed Conservation Issues** | **0-150 (n=141)** | **151-300 (n=29)** | **301-450 (n=14)** | **451-600 (n=14)** | **601+ (n=21)** | **Pearson's correlation (r)** | **p-value** |
| **Erosion into streams** | 3.52 | 3.34 | 4.07 | 4.00 | 3.86 | 0.114 | 0.092 |
| **Flooding** | 3.06 | 3.30 | 4.00 | 3.36 | 3.48 | 0.127 | 0.061 |
| **Reduced fish habitat** | 2.58 | 2.68 | 2.15 | 2.43 | 2.35 | -0.071 | 0.306 |
| **Algae growth** | 2.72 | 2.64 | 2.43 | 2.57 | 2.65 | -0.038 | 0.582 |
| **Bacterial contamination** | 3.15 | 2.93 | 3.08 | 3.79 | 2.90 | 0.002 | 0.973 |
| **Excess phosphorus** | 3.06 | 2.63 | 3.00 | 3.64 | 3.05 | 0.039 | 0.567 |
| **Excess nitrogen** | 3.07 | 2.66 | 2.92 | 3.57 | 3.10 | 0.038 | 0.583 |
| **Other** | 3.27 | 2.50 | 2.33 | 0.00 | 3.67 | -0.019 | 0.899 |

Means: 0=Not at all Important, 4=Extremely Important

Table 15. The effect of respondents' primary farming operation on the importance of watershed conservation issues.

| | Respondents' Primary Farming Operation | | Statistics | |
|---|---|---|---|---|
| **Watershed Conservation Issues** | **Crops (n=143)** | **Livestock (n=25)** | **F test** | **p-value** |
| **Erosion into streams** | 3.43 | 3.74 | 0.995 | 0.320 |
| **Flooding** | 3.03 | 3.52 | 2.362 | 0.127 |
| **Reduced fish habitat** | 2.35 | 2.75 | 2.095 | 0.150 |
| **Algae growth** | 2.57 | 2.71 | 0.231 | 0.632 |
| **Bacterial contamination** | 3.06 | 3.17 | 0.109 | 0.741 |
| **Excess phosphorus** | 2.91 | 3.13 | 0.592 | 0.443 |
| **Excess nitrogen** | 2.90 | 3.08 | 0.473 | 0.493 |
| **Other** | 2.82 | 3.67 | 0.546 | 0.466 |

Means: 0=Not at all Important, 4=Extremely Important

Table 16. The effect of respondents' watershed residence on the importance of watershed conservation issues.

| | Respondents' Watershed of Residence | | | | Statistics | |
|---|---|---|---|---|---|---|
| **Watershed Conservation Issues** | **North Branch Flint River (n=120)** | **Gun River (n=42)** | **Lake Macatawa (n=115)** | **Upper Thornapple (n=88)** | **F test** | **p-value** |
| **Erosion into streams** | 3.38 | 3.43 | 3.57 | 3.44 | 0.379 | 0.768 |
| **Flooding** | 3.15 | 3.28 | 3.22 | 3.24 | 0.140 | 0.952 |
| **Reduced fish habitat** | 2.65 | 2.86 | 2.37 | 2.74 | 1.911 | 0.128 |
| **Algae growth** | 2.75 | 2.83 | 2.59 | 2.78 | 0.512 | 0.674 |
| **Bacterial contamination** | 3.10 | 3.36 | 3.10 | 3.22 | 0.447 | 0.720 |
| **Excess phosphorus** | 2.82 | 3.33 | 3.19 | 2.94 | 2.257 | 0.082 |
| **Excess nitrogen** | 2.90 | 3.37 | 3.08 | 3.02 | 1.283 | 0.280 |
| **Other** | 2.81 | 3.91 | 2.40 | 2.47 | 1.986 | 0.124 |

Means: 0=Not at all Important, 4=Extremely Important

## Research Question 1b: How Satisfied are Survey Respondents with the Water Quality in their Watershed?

Summary

Overall, survey respondents were moderately satisfied with the water quality in their watersheds. Of all respondents, 7.0% stated that they were not at all satisfied, 8.6% claimed they were slightly satisfied, 48.4% stated they were moderately satisfied, 30.6% claimed they were very satisfied, and 5.4% of survey respondents stated that they were extremely satisfied with the water quality in their watershed (Figure3). Results indicated that age (Table 17), education level (Table 18), gross annual income level (Table 19), farming status (Table 20), farm size (Table 21), primary farming operation (Table 22),

and watershed residence (Table 23) have no significant effect on agricultural landowners' level of satisfaction with the water quality in their watershed.

Figure 3. Respondents' level of satisfaction with the water quality in their watershed.

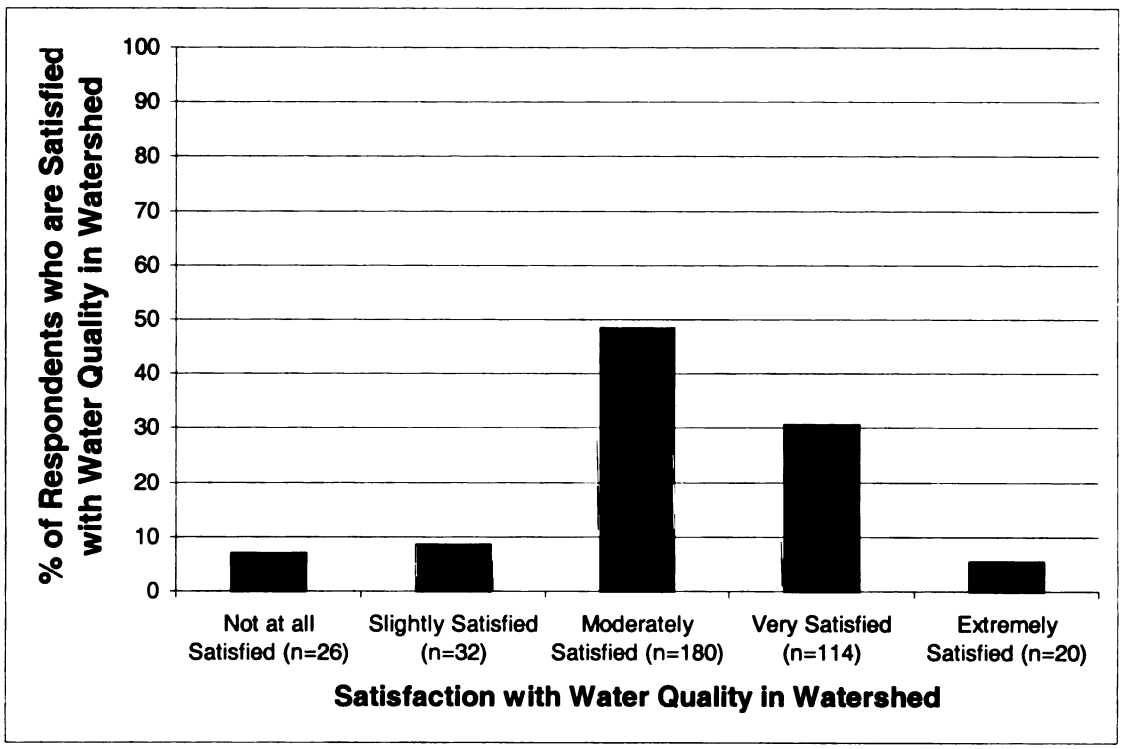



Table 17. The effect of age on respondents' level of satisfaction with the water quality in their watershed.

| | The Effect of Age on Respondents' Level of Satisfaction | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Age of Landowner** | **18-40 years (n=41)** | **41-50 years (n=86)** | **51-60 years (n=80)** | **61-70 years (n=82)** | **71+ years (n=69)** | **Pearson's correlation (r)** | **p-value** |
| **Mean Level of Satisfaction** | 3.12 | 3.15 | 3.25 | 3.34 | 3.07 | 0.011 | 0.836 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

Table 18. The effect of education level on respondents' level of satisfaction with the water quality in their watershed.

| | The Effect of Education Level on Respondents' Level of Satisfaction | | | | | | | Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| **Respondents' Level of Education** | **Grade school (n=17)** | **Some high school (n=31)** | **High school graduate (n=109)** | **Trade school (n=27)** | **Some college (n=86)** | **College graduate (n=41)** | **Post graduate (n=47)** | **Pearson's correlation (r)** | **p-value** |
| **Mean Level of Satisfaction** | 2.82 | 2.97 | 3.17 | 3.41 | 3.31 | 3.22 | 3.17 | 0.074 | 0.135 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

Table 19. The effect of gross annual income on respondents' level of satisfaction with the water quality in their watershed.

| | The Effect of Gross Annual Income on Respondents' Level of Satisfaction | | | | Statistics | | |
|---|---|---|---|---|---|---|---|
| **Respondents' Level of Income** | **$15,000-$25,000 (n=53)** | **$25,001-$35,000 (n=53)** | **$35,001-$50,000 (n=62)** | **$50,001-$75,000 (n=64)** | **$75,001+ (n=75)** | **Pearson's correlation (r)** | **p-value** |
| **Mean Level of Satisfaction** | 3.08 | 3.23 | 3.29 | 3.14 | 3.20 | 0.021 | 0.709 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

Table 20. The effect of farming status on respondents' level of satisfaction with the water quality in their watershed.

| | **The Effect of Farming Status on Respondents' Satisfaction** | | | **Statistics** | |
|---|---|---|---|---|---|
| **Respondents' Farming Status** | **Non-farmer (n=132)** | **Part-time Farmer (n=160)** | **Full-time Farmer (n=169)** | **F test** | **p-value** |
| **Mean Level of Satisfaction** | 3.20 | 3.10 | 3.38 | 2.188 | 0.114 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

Table 21. The effect of farm size on respondents' level of satisfaction with the water quality in their watershed.

| | The Effect of Farm Size (Acres Rented and Owned) on Agricultural Landowners' Satisfaction | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Landowners' Farm Size** | **0-150 (n=152)** | **151-300 (n=29)** | **301-450 (n=14)** | **451-600 (n=14)** | **601+ (n=21)** | **Pearson's correlation (r)** | **p-value** |
| **Mean Level of Satisfaction** | 3.11 | 3.07 | 3.50 | 3.29 | 3.48 | 0.125 | 0.058 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

Table 22. The effect of primary farming operation on respondents' level of satisfaction with the water quality in their watershed.

| | The Effect of Farming Operation on Respondents' Satisfaction | | Statistics | |
|---|---|---|---|---|
| **Respondents' Farming Operation** | **Crops (n=143)** | **Livestock (n=25)** | **F test** | **p-value** |
| **Mean Level of Satisfaction** | 3.09 | 3.29 | 0.919 | 0.340 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

Table 23. The effect of watershed residence on respondents' level of satisfaction with the water quality in their watershed.

| | The Effect of Watershed Residence on Respondents' Satisfaction | | | | Statistics | |
|---|---|---|---|---|---|---|
| **Respondents' Watershed of Residence** | **North Branch Flint River (n=125)** | **Gun River (n=44)** | **Lake Macatawa (n=113)** | **Upper Thornapple (n=90)** | **F test** | **p-value** |
| **Mean Level of Satisfaction** | 3.21 | 3.36 | 3.10 | 3.19 | 0.911 | 0.436 |

Means: 0=Not at all Satisfied, 4=Extremely Satisfied

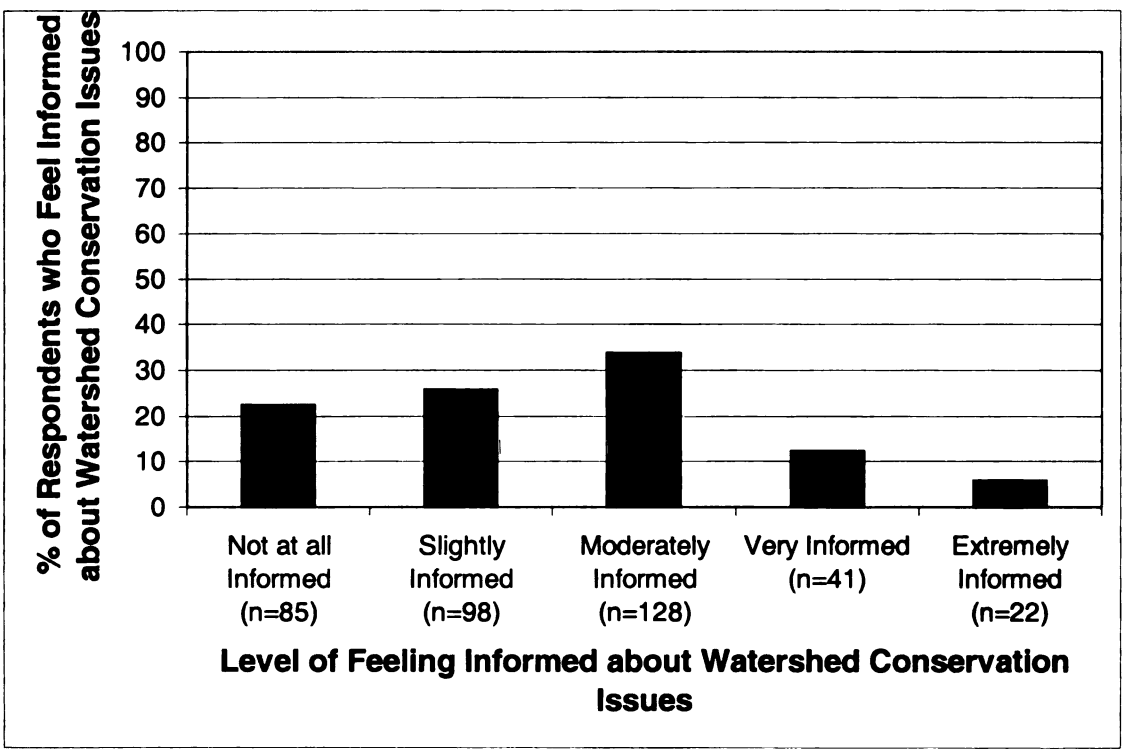
**Research Question 1c: How Informed do Survey Respondents Feel they are About Watershed Conservation Issues?**

Summary

In general, respondents felt slightly to moderately informed about watershed conservation issues. 22.4% of survey respondents felt not at all informed, 25.8% felt slightly informed, 33.7% felt moderately informed, 12.4% felt very informed, and 5.8% of survey respondents felt extremely informed about watershed conservation issues (Figure 4). Results from this portion of the study reveal that farming status (Table 24),

farm size (Table 25), and watershed residence (Table 26) all have a significant effect on how informed respondents felt they were about watershed conservation issues. In contrast, age (Table 27), level of education (Table 28), gross annual income level (Table 29), and primary farming operation (Table 30) had no significant effect on how informed agricultural landowners felt they were about watershed conservation issues. Full-time farmers felt significantly more informed than both part-time and non-farmers, farmers farming larger parcels of land felt significantly more informed than farmers farming smaller parcels of land, and respondents from the Upper Thornapple watershed felt significantly less informed about watershed conservation issues than respondents from both the Lake Macatawa and Gun River watersheds (the two active watersheds of the study).

Figure 4. The level that respondents feel informed about watershed conservation issues.



Demographics that have a Significant Effect on how Informed Respondents Feel they are about Watershed Conservation Issues

*Farming Status*

There is a statistical difference in how informed respondents feel they are about watershed conservation issues among the various farming levels (F=12.507, p=0.000). Specifically, full-time farmers expressed significantly higher levels of feeling informed about watershed conservation issues than both part-time (mean difference=0.5918, p=0.001) and non-farmers (mean difference=0.8274, p=0.000) (Table 24).

Table 24. The effect of farming status on how informed respondents feel they are about watershed conservation issues.

| | **The Effect of Farming Status on Respondents' Level of Feeling Informed** | | | **Statistics** | |
|---|---|---|---|---|---|
| **Respondents' Farming Status** | **Non-farmers (n=137)** | **Part-time farmers (n=163)** | **Full-time farmers (n=67)** | **F test** | **p-value** |
| **Mean Level of Feeling Informed** | 2.29[a] | 2.53[a] | 3.12[b] | 12.507 | 0.000** |

Means: 0=Not at all informed, 4=Extremely informed
**=Statistically significant result at the p=0.01 level
[a,b]=letters indicate similar groups

*Farm Size*

There is a statistical difference in how informed respondents feel they are about watershed conservation issues between farm sizes (F=20.930, p=0.000). Specifically, the

level of feeling informed about watershed conservation issues increases as landowners' farm size increases (Table 25).

Table 25. The effect of farm size on how informed respondents feel they are about watershed conservation issues.

| | **The Effect of Farm Size (Acres Owned and Rented) on Respondents' Level of Feeling Informed** | | | | | **Statistics** | |
|---|---|---|---|---|---|---|---|
| **Respondents' Farm Size** | **0-150 acres (n=165)** | **151-300 acres (n=32)** | **301-450 acres (n=14)** | **451-600 acres (n=14)** | **601+ acres (n=22)** | **Pearson's Correlation (r)** | **p-value** |
| **Mean Level of Feeling Informed** | 2.46 | 3.07 | 3.21 | 2.93 | 3.60 | 0.304 | 0.000** |

Means: 0=Not at all informed, 4=Extremely informed
**=Statistically significant result at the p=0.01 level

*Watershed Residence*

There is a statistical difference in how informed respondents feel they are about watershed conservation issues among watersheds (F=4.197, p=0.006). Specifically, respondents from the Upper Thornapple watershed felt significantly less informed than both respondents from the Gun River watershed (Bonferroni post hoc, p=0.011) and the Lake Macatawa watershed (Bonferroni post hoc, p=0.035). Results indicate that watershed residence in the Upper Thornapple watershed has a significant effect on agricultural landowners' level of feeling informed about watershed conservation issues (Table 26).

Table 26. The effect of watershed residence on how informed respondents feel they are about watershed conservation issues.

| | The Effect of Watershed Residence on Respondents' Level of Feeling Informed | | | | Statistics | |
|---|---|---|---|---|---|---|
| **Respondents' Watershed of Residence** | **North Branch Flint River (n=128)** | **Gun River (n=43)** | **Lake Macatawa (n=117)** | **Upper Thornapple (n=92)** | **F test** | **p-value** |
| **Mean Level of Feeling Informed** | $2.56^{a,b,c}$ | $2.86^{a,b}$ | $2.64^{a,b}$ | $2.21^{a,c}$ | 4.197 | 0.006** |

Means: 0=Not at all Informed, 4=Extremely Informed
**=Statistically significant result at the p=0.01 level
$^{a,b,c}$=letters indicate similar groups

Demographics that do not have a Significant Effect on how Informed Respondents Feel they are about Watershed Conservation Issues

There is no statistical difference in how informed respondents feel they are about watershed conservation issue among respondents' age (Table 27), level of education (Table 28), gross annual income level (Table 29), and primary farming operation (Table 30) at the p=0.05 or p=0.01 levels.

Table 27. The effect of age on how informed respondents feel they are about watershed conservation issues.

| | The Effect of Age on Respondents' Level of Feeling Informed | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Age of Respondent** | **18-40 years (n=41)** | **41-50 years (n=86)** | **51-60 years (n=80)** | **61-70 years (n=82)** | **71+ years (n=69)** | **Pearson's Correlation (r)** | **p-value** |
| **Mean Level of Feeling Informed** | 2.26 | 2.64 | 2.59 | 2.58 | 2.59 | 0.043 | 0.410 |

Means: 0=Not at all informed, 4=Extremely informed

Table 28. The effect of education level on how informed respondents feel they are about watershed conservation

| | The Effect of Education Level on Respondents' Level of Feeling Informed | | | | | | | Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| **Respondents' Level of Education** | **Grade school education (n=18)** | **Some high school education (n=31)** | **High school graduate (n=111)** | **Trade school education (n=29)** | **Some college education (n=92)** | **College graduate (n=42)** | **Post graduate education (n=46)** | **Pearson's correlation (r)** | **p-value** |
| **Mean Level of Feeling Informed** | 2.11 | 2.48 | 2.59 | 2.62 | 2.61 | 2.33 | 2.70 | 0.043 | 0.414 |

issues.

Means: 0=Not at all informed, 4=Extremely informed

Table 29. The effect of gross annual income level on how informed respondents feel they are about watershed conservation issues.

| | The Effect of Gross Annual Income Level on Respondents' Level of Feeling Informed | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Respondents' Gross Annual Income Level** | **$15,000-$25,000 (n=52)** | **$25,001-$35,000 (n=56)** | **$35,001-$50,000 (n=62)** | **$50,001-$75,000 (n=66)** | **$75,001+ (n=67)** | **Pearson's correlation (r)** | **p-value** |
| **Mean Level of Feeling Informed** | 2.19 | 2.79 | 2.53 | 2.53 | 2.54 | 0.062 | 0.273 |

Means: 0=Not at all informed, 4=Extremely informed.

Table 30. The effect of primary farming operation on how informed respondents feel they are about watershed conservation issues.

| | The Effect of Farming Operation on Respondents' Level of Feeling Informed | | Statistics | |
|---|---|---|---|---|
| **Respondents' Farming Operation** | **Crops (n=116)** | **Livestock (n=24)** | **F test** | **p-value** |
| **Mean Level of Feeling Informed** | 2.59 | 2.92 | 1.561 | 0.214 |

Means: 0=Not at all informed, 4=Extremely informed

Water Quality Information Needs of Respondents

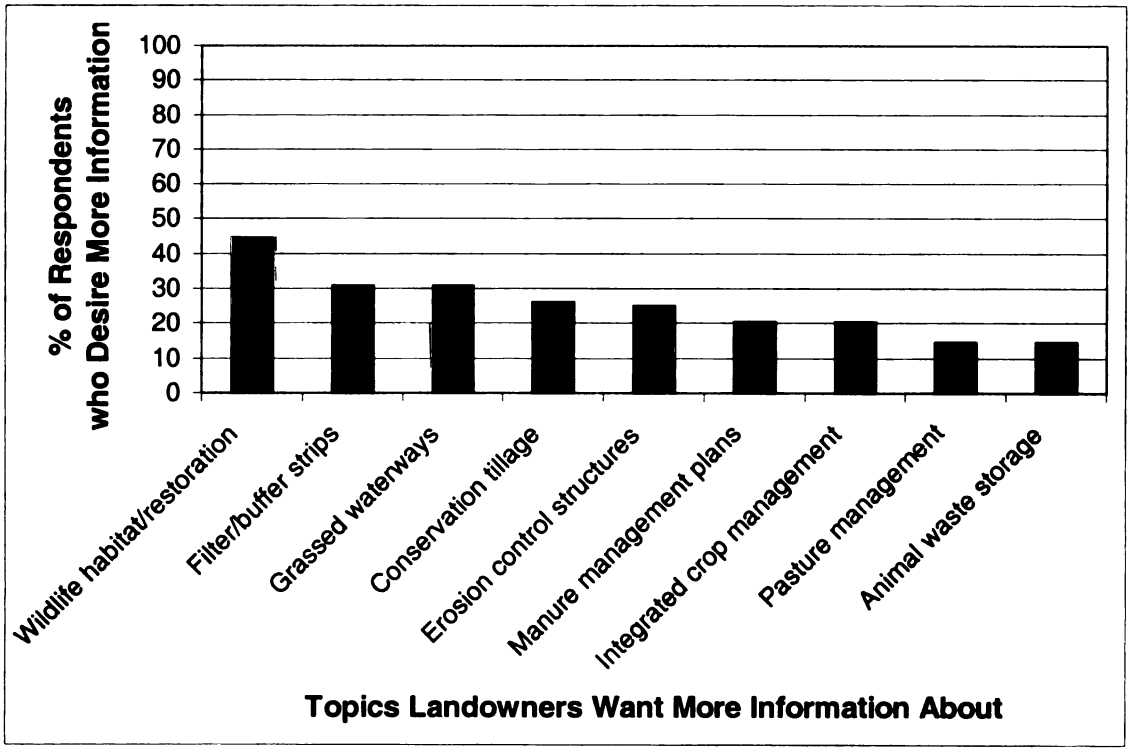
*Respondents' Familiarity with Conservation Practices*

The conservation practices that respondents express the least familiarity with are: pasture management/livestock exclusion, streamside buffer/filter strips, integrated crop management, manure management plans, and animal waste storage (Table 31). Overall, 44.7% of the respondents from the survey population specifically requested information about wildlife habitat/wetland restoration, 30.9% of all farmers desired information about filter strips, 30.9% wanted information on grassed waterways, 26.3% requested information about conservation tillage, 25.5% desired information about erosion control structures, 20.5% wanted information on manure management plans, 20.4% wanted to know more about integrated crop management, 14.5% wanted information on pasture management and 14.5% of all survey farmers wanted to know more about animal waste storage (Figure 5).

Table 31. Percentage of respondents who are unfamiliar with various conservation practices.

| Conservation Practice | Sample Size | % of Respondents who are Unfamiliar with Practice |
|---|---|---|
| Pasture mgmt/livestock exclusion | 59 | 29.6 |
| Buffer/filter strips | 61 | 27.0 |
| Integrated crop management | 56 | 25.8 |
| Manure management plans | 54 | 25.5 |
| Animal waste storage | 51 | 25.0 |
| Erosion control structures | 47 | 21.5 |
| Grassed waterways | 37 | 17.5 |
| Wildlife habitat/Wetland restoration | 27 | 12.5 |
| Conservation tillage | 28 | 12.4 |

Figure 5. The percentage of respondents who requested more information about specific watershed conservation practices.



*The Effect of Watershed Residence on Respondents' Request for Information about Various Conservation Practices*

In general, each watershed differed regarding requests for information for various watershed conservation issues. However, results indicate that watershed residence only had a significant effect on how frequently agricultural landowners requested information about wildlife habitat and restoration (Table 32) and that watershed residence had no significant effect on how often landowners requested information pertaining to crops (Table 33), livestock (Table 34), or erosion and water quality (Table 35). Specifically, Lake Macatawa residents expressed less interest in wildlife habitat and restoration.

Table 32. The percentage of respondents from each watershed who requested information pertaining to wildlife habitat and restoration.

| % of Respondents who Requested Information Pertaining to Wildlife Habitat and Restoration | | | | | |
|---|---|---|---|---|---|
| Watersheds | | | | Statistics | |
| North Branch Flint River (%) | Gun River (%) | Lake Macatawa (%) | Upper Thornapple (%) | $\chi^2$ | p-value |
| 52.6 | 61.1 | 28.3 | 50.0 | 9.448 | 0.024* |

*=Statistically significant result at the p=0.05 level

Table 33. The percentage of respondents from each watershed who requested information pertaining to crops.

| % of Respondents who Requested Information Pertaining to Crops | | | | | |
|---|---|---|---|---|---|
| Watersheds | | | | Statistics | |
| North Branch Flint River (%) | Gun River (%) | Lake Macatawa (%) | Upper Thornapple (%) | $\chi^2$ | p-value |
| 36.8 | 33.3 | 30.2 | 37.5 | 0.678 | 0.878 |

Table 34. The percentage of respondents from each watershed who requested information pertaining to livestock.

| % of Respondents who Requested Information Pertaining to Livestock | | | | | |
|---|---|---|---|---|---|
| Watersheds | | | | Statistics | |
| North Branch Flint River (%) | Gun River (%) | Lake Macatawa (%) | Upper Thornapple (%) | $\chi^2$ | p-value |
| 35.7 | 27.8 | 26.4 | 20.8 | 2.181 | 0.536 |

Table 35. The percentage of respondents from each watershed who requested information pertaining to erosion and water quality.

| % of Respondents who Requested Information Pertaining to Erosion and Water Quality | | | | | |
|---|---|---|---|---|---|
| Watersheds | | | | Statistics | |
| North Branch Flint River (%) | Gun River (%) | Lake Macatawa (%) | Upper Thornapple (%) | $\chi^2$ | p-value |
| 51.8 | 44.4 | 64.2 | 62.5 | 3.180 | 0.365 |

*The Effect of Seeking Advise on Respondents' Level of Feeling Informed about Watershed Conservation Issues*

The vast majority of respondents (64.6%) never sought advice from an agency or organization in the past year (Table 36). Furthermore, the number of times respondents sought advice from agencies and organizations did not have a significant effect on how informed respondents felt they were about watershed conservation issues (Table 37). Although results are not statistically significant, it is meaningful to mention that respondents who sought advise three or more times were at least three times more likely

than individuals only seeking advise zero to two times to feel extremely informed about watershed conservation issues.

Table 36. The number of times respondents sought advise from an agency or organization in the last year.

| Times Respondents Sought Advice in Last Year | Sample Size | % of Respondents |
|---|---|---|
| 0 times | 146 | 64.6 |
| 1 time | 27 | 11.9 |
| 2 times | 27 | 11.9 |
| 3 times | 10 | 4.5 |
| 4-5 times | 10 | 4.5 |
| 6+ times | 6 | 2.6 |

Table 37. The effect frequency of seeking advice has on how informed respondents feel they are about watershed conservation issues.

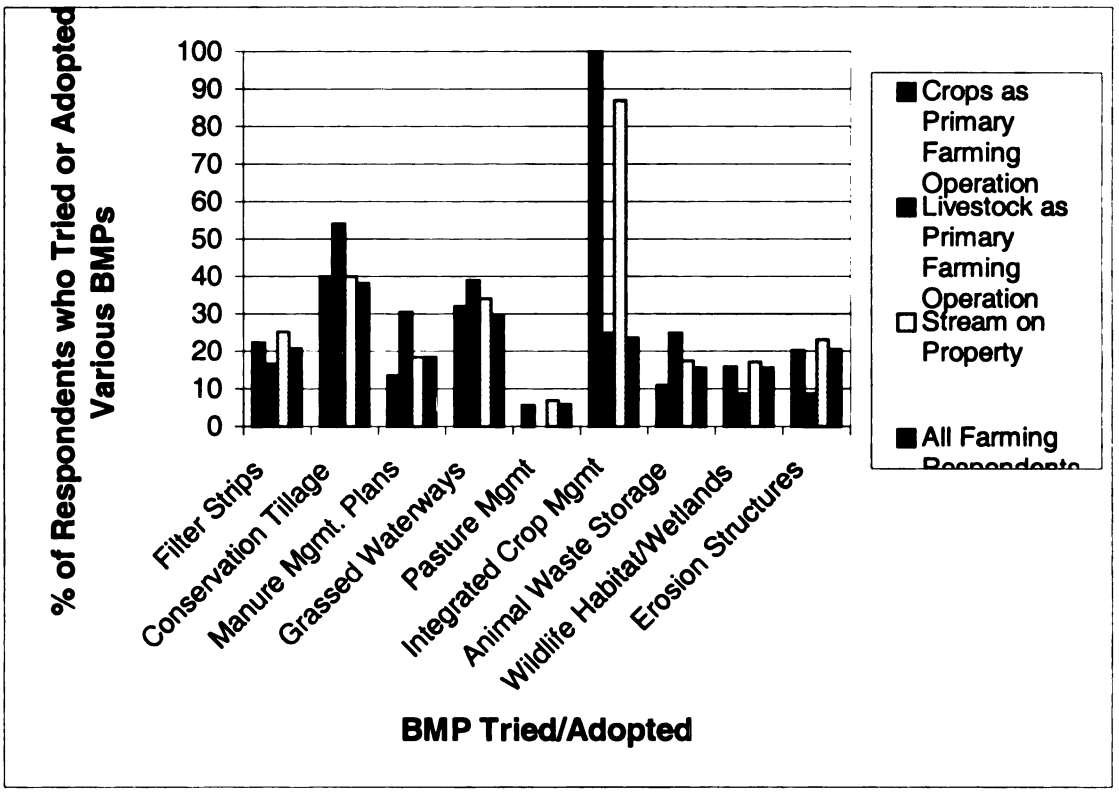
| | The Effect Frequency of Seeking Advice has on how Informed Respondents Feel they are about Watershed Conservation Issues | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **# of Times Respondents Sought Advise in Last Year** | **Not at all Informed (%)** | **Slightly Informed (%)** | **Moderately Informed (%)** | **Very Informed (%)** | **Extremely Informed (%)** | **F test** | **p-value** |
| **0** | 22.5 | 23.2 | 33.3 | 15.2 | 5.8 | 2.253 | 0.063 |
| **1-2** | 11.1 | 22.2 | 46.3 | 16.7 | 3.7 | 2.226 | 0.066 |
| **3+** | 20.0 | 20.0 | 32.0 | 12.0 | 16.0 | 2.239 | 0.064 |

**Research Question 2a: What Percentage of Survey Respondents Adopts Best Management Practices?**

Effective Adoption Rate of BMPs

Of the survey respondents having crops as their primary farming operation, 40.0% adopted conservation tillage practices while 100.0% adopted integrated crop management (crop scouting, pest and fertilizer management, etc). Of the survey respondents having livestock as their primary farming operation, 25.0% had adopted animal waste storage systems, 30.4% had adopted manure management plans, and 0.0% had adopted pasture management (livestock exclusion and stream crossings). Worth mentioning is that 17.2% of respondents with livestock as their primary farming operation had a stream on their property and potentially could have adopted pasture management practices. In addition, of the respondents who had a stream on their property, 25.1% adopted streamside filter or buffer strips, and 34.1% of these respondents adopted grassed waterways. Furthermore, of all farming respondents, 20.5% adopted erosion control structures while 15.7% tried wildlife habitat management or wetland restoration practices (Figure 6).

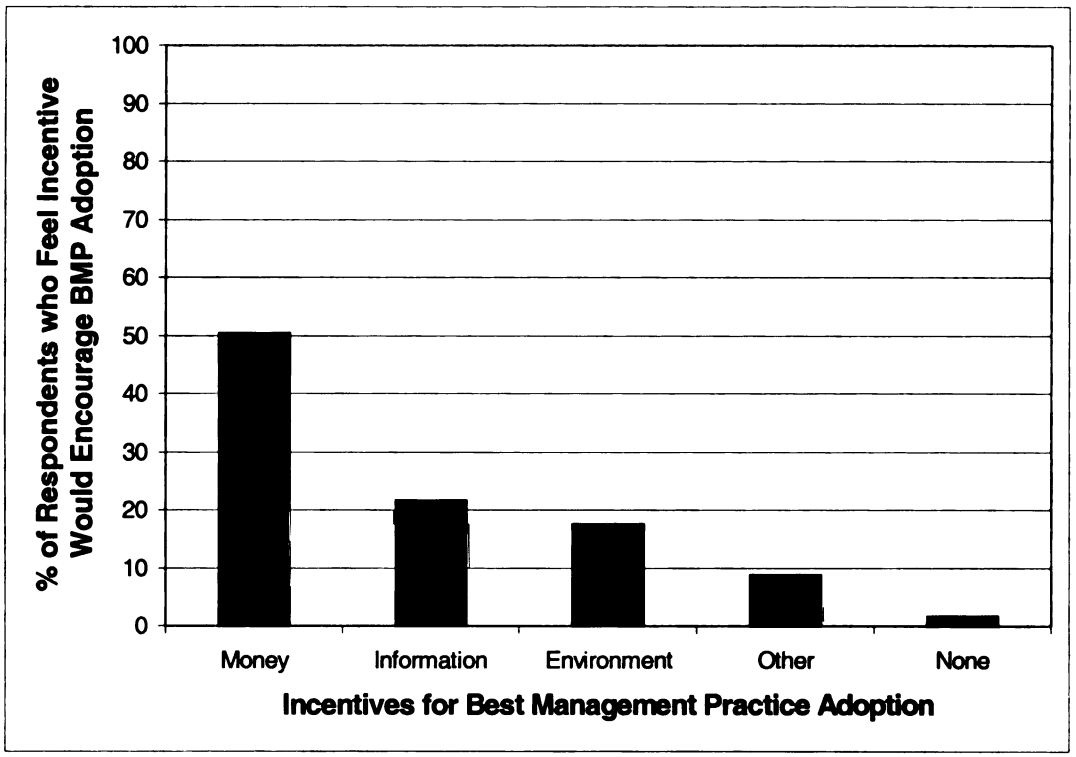
Figure 6. The effective adoption rate of various best management practices




What Incentives would Encourage Respondents' Adoption of Best Management Practices?

Figure 7 demonstrates the incentives respondents suggested would help encourage BMP adoption. Financial assistance such as cost-share programs and tax credits (50.4%), information, training, and/or assistance with the implementation of conservation practices (21.6%), and improved environment and water quality (17.6%) were the three most prominent incentives recognized by agricultural landowners.

Figure 7. The percentage of respondents who feel various incentives would encourage their adoption of best management practices.

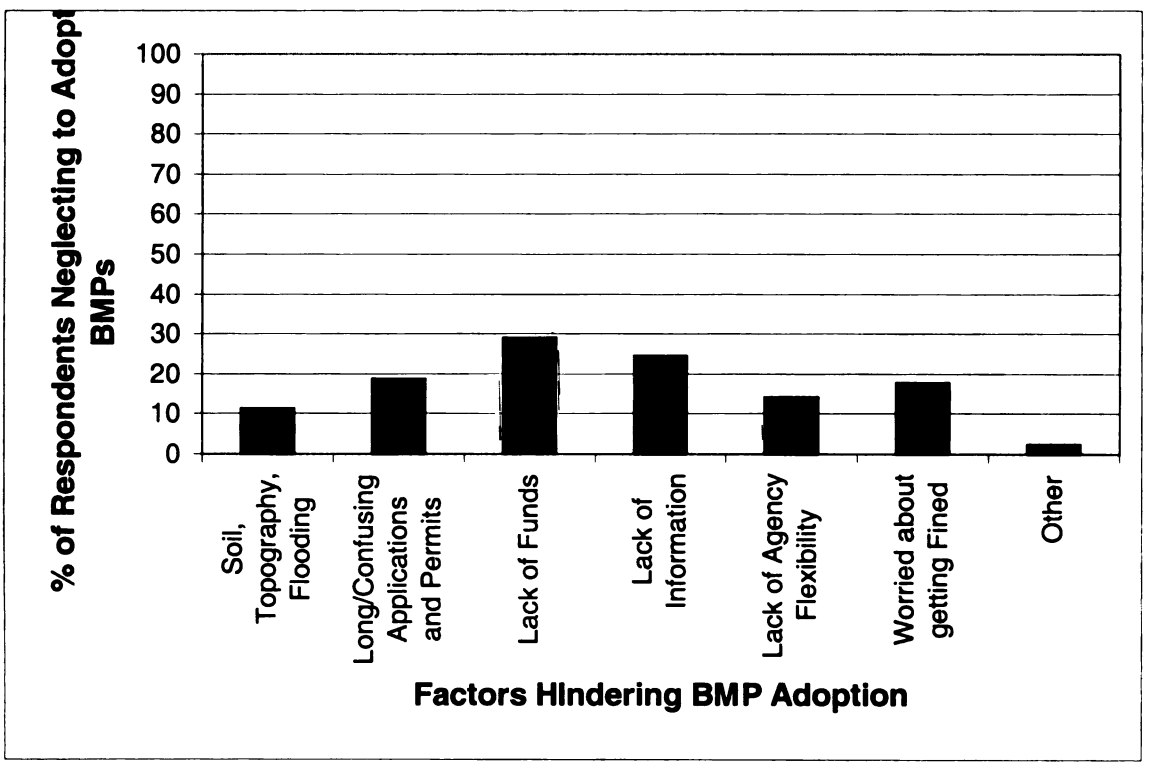



What Factors would Hinder Respondents' Adoption of Best Management Practices?

Of all farming respondents, 11.3% were reluctant to implement conservation practices because they felt the soils or topography of their property were inappropriate for the implementation of the watershed conservation practice. Another 18.7% of farmers did not implement conservation practices because they felt hindered by long or confusing applications and permits. An additional 29.1% of farmers did not implement conservation practices because they felt they did not have the appropriate funds to do so. Furthermore, 24.4% of farmers felt hindered by a lack of information about conservation practices and 14.3% felt hindered by a lack of agency flexibility. An additional 17.7% of

farming respondents neglected to implement watershed conservation practices because they were worried about getting fined. Lastly, 2.5 % of farming respondents mentioned other reasons for not adopting best management practices. Other reasons farmers mentioned that prevented them from implementing watershed conservation practices were that they felt the practices were unnecessary, they had problems with their neighbors, they thought the implementation of conservation practices was too much effort, they felt they were too old or lacked sufficient time to implement practices, or they simply acknowledged that they did not care about watershed conservation practices (Figure 8).

Figure 8. The percentage of respondents who feel various factors would hinder their adoption of best management practices.




*Note: Percentages add up to more than 100% because respondents were asked to choose all of the factors that prevented or hindered them from implementing BMPs.

**Research Question 2b: How does the Importance of Watershed Conservation Issues Affect Survey Respondents' Willingness to Adopt Best Management Practices?**

Results indicate that importance of watershed conservation issues did not significantly effect respondents' effective adoption of the various best management practices (Table 38). Effective adoption reflects the rate at which landowners adopt conservation practices relevant to their farm or primary farming operations.

Table 38. The effect of importance of watershed conservation issues on respondents' effective adoption of best management practices

| | The Effect of Importance of Watershed Conservation Issues on Respondents' Adoption of BMPs | | | Statistics | |
|---|---|---|---|---|---|
| **BMPs Adopted by Respondents** | **Respondents who Felt Issues were Not at All to Slightly Important (% who Adopted BMP)** | **Respondents who Felt Issues were Moderately Important (% who Adopted BMP)** | **Respondents who Felt Issues were Very to Extremely Important (% who Adopted BMP)** | **$\chi^2$** | **p-value** |
| **Streamside Filter/Buffer Strips[c]** | 2.1 | 29.8 | 68.1 | 5.464 | 0.065 |
| **Conservation Tillage[a]** | 8.6 | 38.6 | 52.9 | 1.008 | 0.604 |
| **Manure Management Plans[b]** | 4.2 | 50.0 | 45.8 | 0.608 | 0.738 |
| **Grassed Waterways[c]** | 5.0 | 40.0 | 55.0 | 1.176 | 0.556 |
| **Pasture Management [b/c]** | 0.0 | 28.6 | 71.4 | 2.145 | 0.342 |
| **Integrated Crop Management[a]** | 4.9 | 36.6 | 58.5 | 2.860 | 0.239 |
| **Animal Waste Storage Systems[b]** | 0.0 | 52.4 | 47.6 | 2.302 | 0.316 |
| **Wildlife Habitat Management[d]** | 5.9 | 29.4 | 64.7 | 2.219 | 0.330 |
| **Erosion Control Structures[d]** | 6.7 | 31.1 | 62.2 | 2.692 | 0.260 |

[a]=Survey respondents with crops as their primary farming operation
[b]=Survey respondents with livestock as their primary farming operation
[c]=Survey respondents with stream(s) on the property they farm
[d]=All farming survey respondents

**Research Question 2c: How does Survey Respondents' Satisfaction with the Water Quality in their Watershed Influence their Willingness to Adopt Best Management Practices?**

Table 39 indicates that respondents who were not at all to slightly satisfied with the water quality in their watershed were significantly less likely to adopt conservation tillage practices than landowners who felt moderately to extremely satisfied with the water quality in their watershed ($\chi^2$=7.745, p=0.005). However, satisfaction with water quality in the watershed does not have a significant effect on the adoption of all other best management practices.

Table 39. The effect of satisfaction with water quality on respondents' effective adoption of best management practices

| | The Effect of Satisfaction with Water Quality on Respondents' Adoption of BMPs | | | Statistics | |
|---|---|---|---|---|---|
| **BMPs Adopted by Respondents** | **Respondents who Felt Not at All to Slightly Satisfied (% who Adopted BMP)** | **Respondents who Felt Moderately Satisfied (% who Adopted BMP)** | **Respondents who Felt Very to Extremely Satisfied (% who Adopted BMP)** | **$\chi^2$** | **p-value** |
| **Streamside Filter/Buffer Strips[c]** | 23.4 | 46.8 | 29.8 | 4.123 | 0.127 |
| **Conservation Tillage[a]** | 5.8 | 46.4 | 47.8 | 9.745 | 0.009** |
| **Manure Management Plans[b]** | 8.3 | 37.5 | 54.2 | 0.933 | 0.627 |
| **Grassed Waterways[c]** | 15.3 | 37.3 | 47.5 | 4.704 | 0.095 |
| **Pasture Management [b/c]** | 14.3 | 42.9 | 42.9 | 0.022 | 0.989 |
| **Integrated Crop Management[a]** | 9.8 | 41.5 | 48.8 | 3.123 | 0.210 |
| **Animal Waste Storage Systems[b]** | 14.3 | 23.8 | 61.9 | 3.960 | 0.138 |
| **Wildlife Habitat Management[d]** | 17.6 | 58.8 | 23.5 | 2.393 | 0.302 |
| **Erosion Control Structures[d]** | 17.8 | 46.7 | 35.6 | 0.215 | 0.898 |

[a]=Survey respondents with crops as their primary farming operation
[b]=Survey respondents with livestock as their primary farming operation
[c]=Survey respondents with stream(s) on the property they farm
[d]=All farming survey respondents
**=Statistically significant result at the p=0.01 level

**Research Question 2d: What Effect does Feeling Informed about Watershed Conservation Issues have on Survey Respondents' Willingness to Adopt Best Management Practices?**

In general, respondents who felt most informed about watershed conservation issues tended to be more likely to adopt best management practices. Table 40 illustrates how respondents who felt moderately to extremely informed about watershed conservation issues were significantly more likely to adopt streamside filter/buffer strips ($\chi^2$=8.853, p=0.012), grassed waterways ($\chi^2$=6.007, p=0.050), and integrated crop management ($\chi^2$=10.361, p=0.010) than respondents who felt not at all or slightly informed about watershed conservation issues. Level of feeling informed about watershed conservation issues did not have a significant effect on respondents' adoption of conservation tillage practices, manure management plans, pasture management, animal waste storage systems, wildlife habitat management, or erosion control structures.

Table 40. The effect of feeling informed about watershed conservation issues on respondents' effective adoption of best management practices

| | The Effect of Feeling Informed about Watershed Conservation Issues on Respondents' Adoption of BMPs | | | Statistics | |
|---|---|---|---|---|---|
| **BMPs Adopted by Respondents** | **Respondents who Felt Not at All to Slightly Informed (% who Adopted BMP)** | **Respondents who Felt Moderately Informed (% who Adopted BMP)** | **Respondents who Felt Very to Extremely Informed (% who Adopted BMP)** | $\chi^2$ | **p-value** |
| **Streamside Filter/Buffer Strips**[c] | 19.1 | 42.6 | 38.3 | 8.853 | 0.012* |
| **Conservation Tillage**[a] | 34.3 | 34.3 | 31.4 | 2.905 | 0.234 |
| **Manure Management Plans**[b] | 20.8 | 50.0 | 29.2 | 1.188 | 0.552 |
| **Grassed Waterways**[c] | 25.0 | 41.7 | 33.3 | 6.007 | 0.050* |
| **Pasture Management** [b/c] | 42.9 | 42.9 | 14.3 | 0.580 | 0.748 |
| **Integrated Crop Management**[a] | 24.4 | 34.1 | 41.5 | 10.361 | 0.010** |
| **Animal Waste Storage Systems**[b] | 19.0 | 42.9 | 38.1 | 4.085 | 0.130 |
| **Wildlife Habitat Management**[d] | 33.3 | 42.4 | 24.2 | 1.010 | 0.603 |
| **Erosion Control Structures**[d] | 29.5 | 36.4 | 34.1 | 4.276 | 0.118 |

[a]=Survey respondents with crops as their primary farming operation
[b]=Survey respondents with livestock as their primary farming operation
[c]=Survey respondents with stream(s) on the property they farm
[d]=All farming survey respondents
*=Statistically significant result at the p=0.05 level
**=Statistically significant result at the p=0.01 level

**Summary of Research Question 2**

While all farmers with crops as their primary farming operation adopted integrated crop management practices, adoption rates of all other BMPs are not particularly high and should be increased. Results of this portion of the study indicate that the more satisfied respondents were with the water quality in their watershed, the more likely they were to adopt conservation tillage practices. In addition, the more informed respondents felt they were about watershed conservation issues, the more likely they were to adopt streamside filter/buffer strips, grassed waterways, and integrated crop management practices. Results indicate that the importance of watershed conservation issues has no significant effect on respondents' adoption of BMPS and that level of feeling informed about watershed conservation issues seems to have the biggest impact on whether respondents decide to implement BMPs.

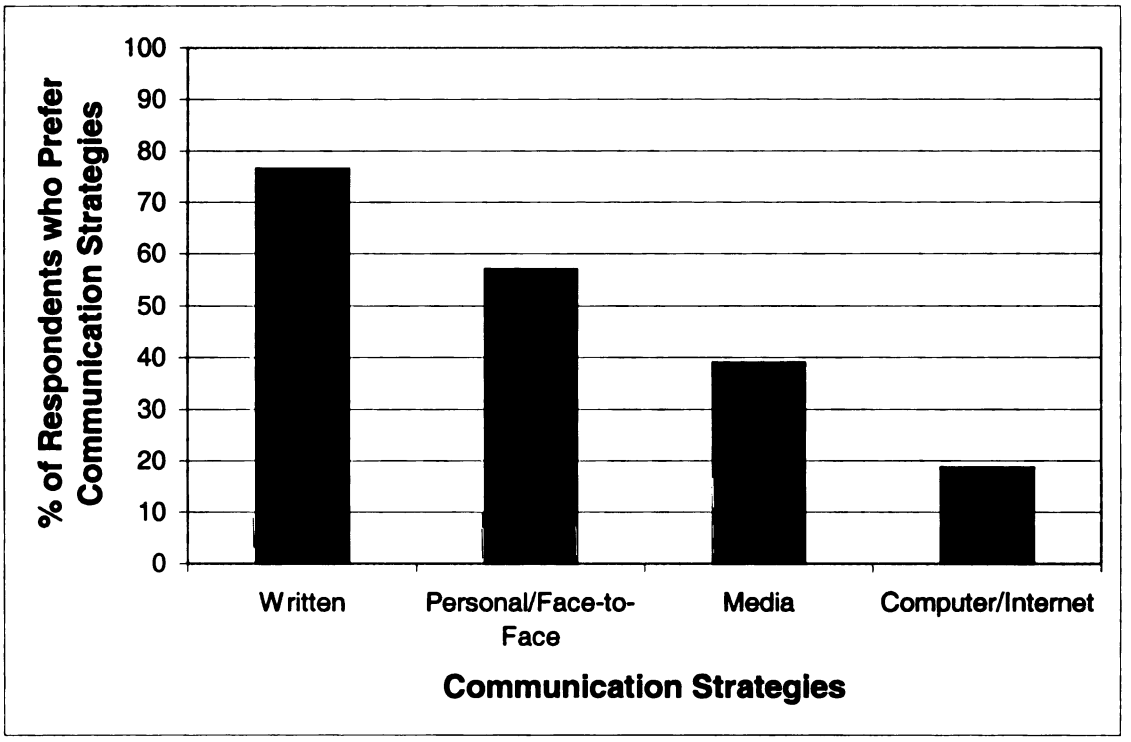
**Research Question 3a: Do Survey Respondents Prefer Traditional or Technological Communication Strategies?**

Summary

Overall, the most preferred communication strategies were written methods such as newsletters/mailers and printed bulletins/fact sheets while the least preferred communication strategies were computer/Internet methods such as computer software, e-mail, and World Wide Web pages. Of all the communication strategies presented to respondents, 76.6% of respondents preferred written communication strategies such as

newsletters/mailers and printed bulletins/fact sheets to learn more about watershed conservation. In addition, 57% of respondents preferred personal/face-to-face communication strategies such as farm meetings/workshops, field days/demonstration tours, visits to resource offices (extension or conservation district), personal visits to their homes by resource persons, and visits to a university to learn more about watershed conservation. Furthermore, 39% of respondents preferred media sources (such as newspapers, televisions, radios, and video tapes) to learn more about watershed conservation while 18.7% of respondents preferred computer or Internet sources (such as computer software packages, e-mail, and World Wide Web pages) to learn more about watershed conservation (Figure 9).

Figure 9. Survey respondents' preference for traditional or technological communication strategies to learn about watershed conservation practices.




Note: Percentages add up to more than 100% because respondents were asked to indicate all communication strategies that applied.

**Research Question 3b: What Effect does Watershed Residence have on Respondents' Preference for Communication Strategies?**

Summary

Overall, respondents from all four watersheds had a higher preference for written materials than all other communication strategies. However, results indicate that watershed residence had no significant effect on agricultural landowners' preference for

communication strategies. There is no statistical difference in preference for communication strategies among watersheds at the p=0.05 or p=0.01 levels (Table 41).

Table 41. The effect of watershed residence on respondents' preference for communication strategies.

| | Watersheds | | | | Statistics | |
|---|---|---|---|---|---|---|
| **Communication Strategies** | **North Branch Flint River (%)** | **Gun River (%)** | **Lake Macatawa (%)** | **Upper Thornapple (%)** | **$\chi^2$** | **p-value** |
| **Written** | 78.4 | 75.0 | 78.0 | 70.0 | 0.997 | 0.802 |
| **Personal or Face-to-Face** | 62.2 | 39.3 | 57.3 | 60.0 | 4.503 | 0.212 |
| **Media** | 41.9 | 28.6 | 42.7 | 33.3 | 2.401 | 0.493 |
| **Computer or Internet** | 12.2 | 32.1 | 19.5 | 20.0 | 5.480 | 0.140 |

**Research Question 4a: Is Computer and Internet Preference Related to Age, Level of Education, Gross Annual Income, Farming Status, Farm Size, or Farming Operation?**

Summary

Results indicate that respondents' preference for computers and the Internet as a communication strategy to learn about watershed conservation practices is related to respondents' age, level of education, and gross annual income level. Respondents from the youngest age category (20-40 years old) had the highest preference for computers and the Internet as communication strategies while respondents from the oldest age category (individuals more than 60 years old) had the least amount of preference for this communication strategy. Furthermore, a positive correlation exists between both respondents' level of education and gross annual income and their preference for computers and the Internet to learn about watershed conservation issues. The younger,

more educated, and more affluent a respondent is, the more likely they are to prefer computers and the Internet as a communication strategy. Furthermore, face-to-face communication strategies are preferred by full-time farmers and farmers who operate large parcels of land.

## Demographics that have an Effect on Respondents' Preference for Computers and the Internet

### *Age*

Table 42 demonstrates the influence of age on communication strategy preference. There is a statistical difference between age groups and preference for written communication strategies, media, and computer or Internet methods of learning about watershed conservation issues. Results specifically indicate that age has a significant effect on respondents' preference for computers and Internet for learning about watershed conservation issues.

Table 42. The effect age has on respondents' preference for communication strategies.

| | The Effect of Age on Respondents' Preference for Communication Strategies | | | Statistics | |
|---|---|---|---|---|---|
| **Communication Strategies** | **20-40 years old (%)** | **41-60 years old (%)** | **61+ years old (%)** | $\chi^2$ | **p-value** |
| **Written** | 75.0 | 84.8 | 68.2 | 7.306 | 0.026* |
| **Personal or Face-to-Face** | 62.5 | 57.0 | 56.6 | 0.295 | 0.863 |
| **Media** | 58.3 | 42.4 | 30.7 | 6.787 | 0.034* |
| **Computer or Internet** | 41.7 | 24.2 | 5.7 | 20.312 | 0.000** |

*=Statistically significant result at the p=0.05 level
**=Statistically significant result at the p=0.01 level

*Education Level*

Table 43 demonstrates the influence of respondents' education level on respondents' preference for communication strategies to learn about watershed conservation issues. A statistically significant relationship exists between respondents' levels of education and preference for media and computers/Internet as communication strategies to learn about watershed conservation issues.

Table 43. The effect education level has on respondents' preference for communication strategies.

| | The Effect of Education Level on Respondents' Preference for Communication Strategies | | | | | | | Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| **Communication Strategies** | **Grade school (%)** | **Some high school (%)** | **High school graduate (%)** | **Vocational or trade school (%)** | **Some college (%)** | **College graduate (%)** | **Post Graduate Degree or Work (%)** | $\chi^2$ | **p-value** |
| **Written** | 60.0 | 82.4 | 81.1 | 71.4 | 71.4 | 85.7 | 80.8 | 4.862 | 0.562 |
| **Personal or Face-to-Face** | 60.0 | 58.8 | 58.1 | 35.7 | 73.5 | 47.6 | 46.2 | 10.102 | 0.120 |
| **Media** | 60.0 | 47.1 | 41.9 | 35.7 | 22.4 | 66.7 | 30.8 | 15.723 | 0.015* |
| **Computer or Internet** | 0.0 | 11.8 | 9.5 | 14.3 | 20.4 | 38.1 | 42.3 | 21.756 | 0.001** |

*=Statistically significant result at the p=0.05 level.
**=Statistically significant result at the p=0.01 level.

*Gross Annual Income Level*

Table 44 demonstrates the effect gross income level has on respondents' preference for communication strategies to learn about watershed conservation issues. A statistically significant relationship exists between respondents' level of income and preference for written communication strategies to learn about watershed conservation issues.

Table 44. The effect gross annual income level has on respondents' preference for communication strategies.

| | The Effect of Gross Annual Income on Respondents' Preference for Communication Strategies | | | | | Statistics | |
|---|---|---|---|---|---|---|---|
| **Communication Strategies** | **$15,000-$25,000 per year (%)** | **$25,001-$35,000 per year (%)** | **$35,001-$50,000 per year (%)** | **$50,000-$75,000 per year (%)** | **$75,000+ per year (%)** | $\chi^2$ | **p-value** |
| **Written** | 65.5 | 80.5 | 94.3 | 82.5 | 69.8 | 10.556 | 0.032* |
| **Personal or Face-to-Face** | 51.7 | 56.1 | 57.1 | 65.0 | 58.1 | 1.345 | 0.854 |
| **Media** | 44.8 | 39.0 | 34.3 | 42.5 | 32.6 | 1.669 | 0.432 |
| **Computer or Internet** | 6.9 | 14.6 | 14.3 | 22.5 | 27.9 | 6.448 | 0.138 |

*=Statistically significant result at the p=0.05 level

Demographics that do not have an Effect on Respondents' Preference for Computers and the Internet

Results indicate that farming status (Table 45), farm size (Table 46), and primary farming operation (Table 47) do not have a significant effect on respondents' preference for computers and the Internet. However, farming status and farm size do have a significant effect on respondents' preference for personal or face-to-face communication strategies and the p=0.01 level. Specifically, full-time farmers and farmers farming larger parcels of land have a strong preference for face-to-face communication strategies such as visits to Extension offices or on-farm demonstration tours.

Table 45. The effect farming status has on respondents' preference for communication strategies.

| | **The Effect of Farming Status on Respondents' Preference for Communication Strategies** | | **Statistics** | |
|---|---|---|---|---|
| **Communication Strategies** | **Part-time Farmer (%)** | **Full-time Farmer (%)** | **$\chi^2$** | **p-value** |
| **Written** | 79.9 | 69.6 | 5.878 | 0.053 |
| **Personal or Face-to-Face** | 46.0 | 79.7 | 22.121 | 0.000** |
| **Media** | 38.8 | 42.0 | 0.857 | 0.652 |
| **Computer or Internet** | 19.4 | 17.4 | 4.368 | 0.113 |

**=Statistically significant result at the p=0.01 level

Table 46. The effect farm size has on respondents' preference for communication strategies.

| | The Effect of Farm Size on Respondents' Preference for Communication Strategies | | Statistics | |
|---|---|---|---|---|
| **Communication Strategies** | **Farm 0-228 Acres (%)** | **Farm 229+ Acres (%)** | **$\chi^2$** | **p-value** |
| **Written** | 79.3 | 71.7 | 1.429 | 0.232 |
| **Personal or Face-to-Face** | 48.7 | 80.0 | 17.231 | 0.000** |
| **Media** | 40.0 | 35.0 | 0.452 | 0.501 |
| **Computer or Internet** | 17.3 | 18.3 | 0.030 | 0.864 |

**=Statistically significant result at the p=0.01 level

Table 47. The effect farming operation has on respondents' preference for communication strategies.

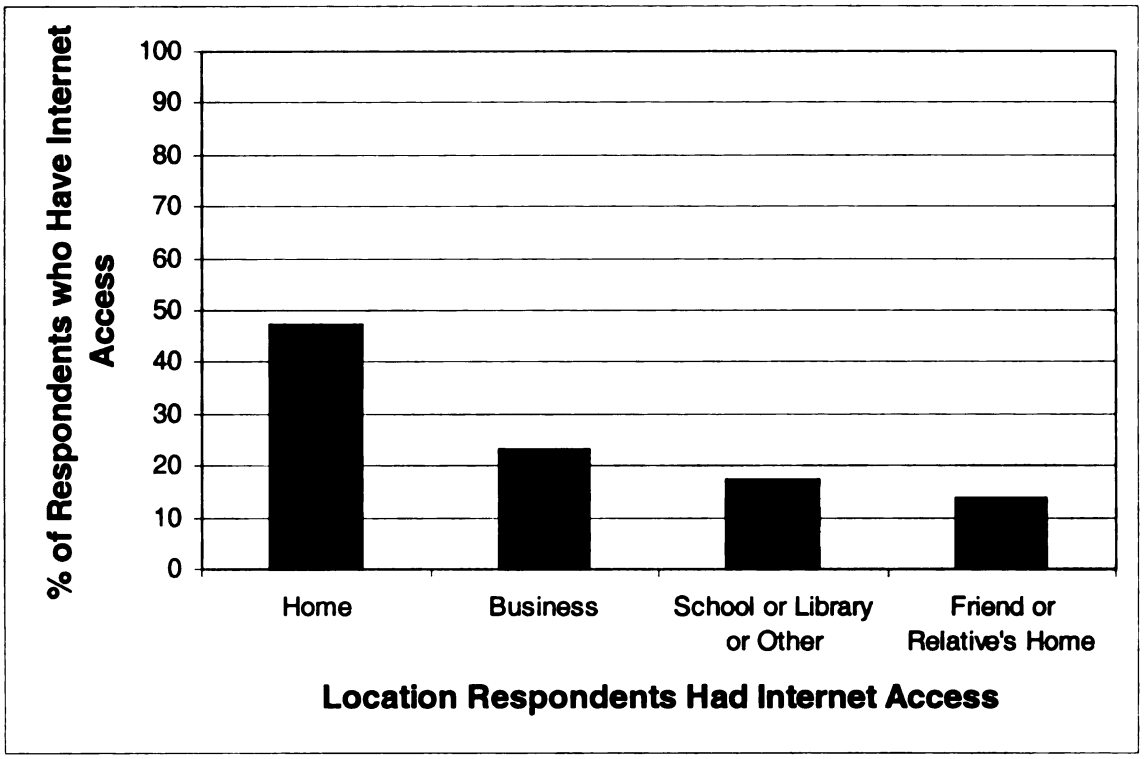
| | The Effect of Farming Operation on Respondents' Preference for Communication Strategies | | Statistics | |
|---|---|---|---|---|
| **Communication Strategies** | **Crops (%)** | **Livestock (%)** | **$\chi^2$** | **p-value** |
| **Written** | 73.8 | 66.7 | 1.532 | 0.465 |
| **Personal or Face-to-Face** | 53.3 | 66.7 | 3.186 | 0.203 |
| **Media** | 39.3 | 23.8 | 1.876 | 0.391 |
| **Computer or Internet** | 15.9 | 23.8 | 1.213 | 0.545 |

**Research Question 4b: Does Internet Access Influence Survey Respondents' Preference for the Internet as a Communication Strategy to Learn about Watershed Conservation Issues?**

Summary

Of all survey respondents, 32.2% claimed they did not have Internet access. Of all respondents who did have Internet access, 47.4% of them had Internet access in their home, 23.2% of respondents had Internet access at their business, 17.5% of respondents had Internet access at a local school or library, and 13.6% of respondents had Internet access at a friend's or relative's home (Figure 10). Regardless of respondents' access to the Internet, the majority of respondents still preferred written methods of communication. However, access to the Internet significantly impacts respondents' preference for computers and the Internet as survey respondents with Internet access had a significantly higher preference computers and the Internet than did landowners without Internet access. In addition, results indicate that the location of Internet access has a significant effect on respondents' preference for the Internet as a communication strategy.

Figure 10. The location where survey respondents have Internet access.




* Note: Percentages add to more than 100% because respondents were requested to indicate all locations where they had Internet access.

What Effect does Internet Access have on Respondents' Preference for the Internet?

Regardless of Internet access, the majority of respondents (74.6% of respondents with Internet access and 77.8% of respondents without Internet access) still preferred written materials such as newsletters/mailers and printed bulletins/fact sheets than the other communication strategies. While no significant differences existed between preferences for written, personal/face-to-face, or media methods of communication among landowners with or without Internet access, a significant difference existed between preference for computers or the Internet among respondents with and without

Internet access. Survey respondents with Internet access had a significantly higher preference for computers and the Internet than did landowners without Internet access. Results indicate that access to the Internet significantly impacts respondents' preference for computers and the Internet as communication strategies (Table 48).

Table 48. The effect Internet access has on respondents' preference for the Internet as a communication strategy.

| | **The Effect of Internet Access on Respondents' Preference for Communication Strategies** | | **Statistics** | |
|---|---|---|---|---|
| **Communication Strategies** | **Respondents with Internet Access (%)** | **Respondents without Internet Access (%)** | $\chi^2$ | **p-value** |
| **Written** | 74.6 | 77.8 | 0.232 | 0.630 |
| **Personal or Face-to-Face** | 59.2 | 50.8 | 1.242 | 0.265 |
| **Media** | 41.5 | 34.9 | 0.802 | 0.370 |
| **Computer or Internet** | 27.5 | 1.6 | 18.607 | 0.000** |

**=Statistically significant result at the p=0.01 level

What Effect does Location of Internet Access have on Respondents' Preference for the Internet as a Communication Strategy?

Table 49 demonstrates the effect location of Internet access has on respondents' preference for the Internet as a communication strategy. Results indicate that the location of Internet access has a significant effect on respondents' preference for the Internet as a communication strategy. Specifically, a significantly higher percentage of respondents preferring the Internet had Internet access in their homes, their business, or at a local

library or school than did respondents who did not prefer the Internet as a communication strategy.

Table 49. The effect location of Internet access has on respondents' preference for the Internet as a communication strategy.

| | The Effect of Location of Internet Access on Respondents' Preference for the Internet as a Communication Strategy | | Statistics | |
|---|---|---|---|---|
| **Location of Internet Access** | **% of Respondents who Prefer the Internet as a Communication Strategy** | **% of Respondents who did not Prefer the Internet as a Communication Strategy** | **$\chi^2$** | **p-value** |
| **Home** | 94.7 | 45.2 | 16.948 | 0.000** |
| **Business** | 52.6 | 21.0 | 9.502 | 0.002** |
| **Library or School** | 31.6 | 12.9 | 4.813 | 0.028* |
| **Friend or Relative's Home** | 15.8 | 18.3 | 0.072 | 0.788 |

*=Statistically significant result at the p=0.05 level
**=Statistically significant result at the p=0.01 level

**Research Question 5a: What Factors Influence Focus Group Participants' Use of the Internet and Web Sites to Learn More about Watershed Conservation Issues and Best Management Practices?**

Background Information of Focus Group Participants

Table 50. Background information of focus group participants.

| Background Information | % of Focus Group Participants Matching Criteria |
|---|---|
| **Highest Obtained Education = Grade School** | 0.0 |
| **Highest Obtained Education = Some High School** | 0.0 |
| **Highest Obtained Education = High School Diploma** | 5.9 |
| **Highest Obtained Education = Vocational/Trade School** | 5.9 |
| **Highest Obtained Education = Some College** | 29.4 |
| **Highest Obtained Education = College Degree** | 17.6 |
| **Highest Obtained Education = Graduate Work/Degree** | 35.3 |
| **Non-farmer** | 64.7 |
| **Part-time Farmer** | 11.8 |
| **Full-time Farmer** | 23.5 |
| **Internet Access at Home** | 94.1 |
| **Internet Access at Business** | 70.6 |
| **Internet Access at Library or School** | 29.4 |
| **Internet Access at Friend's or Relative's Home** | 35.3 |
| **Internet Access at Other Location** | 0.0 |
| **No Internet Access** | 5.9 |
| **Frequently or Occasionally Use Internet for Management Decisions** | 76.5 |
| **Rarely or Never Use Internet for Management Decisions** | 23.5 |
| **Use Internet Once/Day** | 82.4 |
| **Use Internet Once/Week** | 5.9 |
| **Use Internet Once/Month** | 5.9 |
| **Use Internet Once/Every Few Months** | 0.0 |
| **Never Use Internet** | 5.9 |

Focus Group Participants' Overall Impression of the Project Web Site

Overall, the 17 focus group participants liked the web site, found the site to be user-friendly, and indicated that it was very likely that they would use the Internet in the future to retrieve information about water quality. However, one respondent indicated that in order for them to use it, they would have to be able to find it on a search engine. Other participants recognized the web site as a great educational tool and were excited to see how the condition of their watershed might improve by informing other watershed residents through the web site.

Positive Attributes of a Web Site

Table 51 indicates that participants specifically appreciated the local pictures, base maps, and watershed maps included in the site to provide orientation and a local context. Many participants valued the "clean and easy" web site lay out and considered the site to be user-friendly and relatively easy to navigate. Participants also appreciated links to other relevant sites, the inclusion of a text/graphics option to accommodate users with slow modems, and graphs containing scientific results of the study. Several participants thought the site was very informative, answering questions they did not realize they had.

Table 51. Focus group participants' most preferred aspects of the project web site.

| Aspects of Web Site Most Preferred by Focus Group Participants | % of Participants who Support Opinion |
|---|---|
| **Local Photos and Watershed and GIS Maps for Orientation** | 47.1 |
| **Easy Navigation and User-friendly Lay-out** | 41.2 |
| **Links to Other Relevant Web Sites** | 29.4 |
| **Text/Graphics Option to Accommodate Slow Modems** | 23.5 |
| **Inclusion of Survey Results from Study** | 11.8 |

Negative Attributes of a Web Site

The biggest complaint participants had about the project web site was that it did not include enough specific information (Table 52). Participants were particularly interested in targeting historical information about specific watersheds (e.g., size of watershed, number of hog and dairy farms, etc.), manure management plans, the condition of the watershed, specific pollutants in the water, agriculture's contribution to water pollution, wildlife issues (e.g., the type and abundance of each species that existed in their watershed), and what individuals could specifically do to improve the condition of their watershed.

Focus group participants also suggested that they did not like the wrapping/scrolling text and drifting menu bar. The wrapping/scrolling text resulted from complications with computer monitor resolution. The resolution of the computer monitor that the web site was originally designed on differed from the resolution of the monitors focus group participants used during the focus group session. The drifting menu bar can be best described as a menu bar that moved across the computer screen in coordination with the cursor of the mouse.

A number of participants were also frustrated with "inappropriate terminology." For example, respondents did not know what "n=..." meant on the graphs and thought it should be defined or omitted. Some individuals mentioned that some terms did not make sense, that there was a need for a glossary, and that the acronyms included in the site were confusing and distracting. Three participants expressed aversion to having to sort through what they considered to be irrelevant information while two individuals simply felt the project team should have chosen brighter colors for the web site.

Table 52. Focus group participants' least preferred aspects of the project web site.

| Aspects of Web Site Least Preferred by Focus Group Participants | % of Participants who Support Opinion |
|---|---|
| Lack of Specific Information | 41.2 |
| Drifting Menu Bar and Wrapping/Scrolling Text | 29.4 |
| Inappropriate terminology | 23.5 |
| Irrelevant Information from Other Web Sites | 17.6 |
| Overall Appearance (Unattractive Colors) | 11.8 |

**Research Question 5b: What would Focus Group Participants Specifically Recommend to Improve Web Site Content and Usability?**

Many suggestions were made as to how the web site developers could improve the site (Table 53). The most prevalent suggestions were that the site should include more specific information and that the site should include links to other relevant sites. Participants were interested in the condition of the water and what kind of pollutants exist in the watershed. Respondents suggested that the web site include specific numbers for

the levels of nitrogen, phosphorus, E. coli, etc. Other specific information that individuals suggested should be included in the web site was information regarding manure management plans, cost share information, information on financial assistance, wetlands, farming practices related to livestock, historical information about watersheds, wildlife issues, and specifics on agriculture's contribution to water quality. Participants specifically want to know what they can personally do to help improve the condition of the Stony Creek watershed.

Several individuals (23.5% of participants) recommended that the project team update the site constantly (at least monthly) and that we highlight the information that was updated. The same proportion of participants also suggested that the web site needs to have a more user-friendly approach and that web site designers should provide a frequently asked questions section and a glossary for individuals without a great deal of knowledge about water quality issues. In addition, 11.8% of participants indicated a need for an events calendar, local contact people, and articles with a local flavor. Furthermore, 23.5% of participants suggested that successful conservation practices should be shown and web site designers should include images of people doing good things for the watershed.

Participants suggested that major water bodies should be included in the maps for orientation and that the drifting menu bar should be omitted. One suggestion was to include a minimal amount of photos with links to other photos to accommodate those with slower Internet connections. There was also interest in having a print option for graphs and one individual recommended incorporating "under construction" notices when information is not available.

Table 53. Specific suggestions focus group participants had for improving the project web site

| Specific Suggestions Provided by Focus Group Participants | % of Participants who Provided Suggestion |
|---|---|
| Specific Information | 58.8 |
| Links to Other Relevant Web Sites | 41.2 |
| Include Historical Info, Maps, and Articles with a Local Flavor | 29.4 |
| Update Web Site Constantly | 23.5 |
| Show Successful Conservation Practices in Watershed | 23.5 |
| Eliminate Scrolling Text and Resolution Issues | 23.5 |
| Provide a Glossary and a Frequently Asked Questions Section | 23.5 |
| Provide an Events Calendar and List of Local Contact People | 17.6 |
| Include All Survey Results and Have Print Option for Graphs | 17.6 |
| Minimize the Amount of Photos to Accommodate Slow Modems | 11.8 |
| Include "Under Construction" Notices when Site is Being Updated | 5.9 |

**Examples of Specific Quotes from Participants on how Web Site Designers Could Improve Web Site Content and Usability**

" I would like to see an events calendar, local contact people (with updated area codes), and articles with a local flavor. I also want to see people participating in local activities."

"There is not enough information about wetlands."

"Don't just focus on problems (politicizing)-also mention what good has been done. Mention what good things farmers are doing. Mention successful activities going on in the watershed. Show other side of the story. There needs to be a balance."

"Web sites need to be updated constantly (no less than monthly) or we won't use them."

"Site should be updated at least quarterly. I like the way field days are arranged but add future events. I won't go back to old sites."

"There is a navigation issue-that floating/scrolling menu bar-get rid of it!"

"I don't want to scroll left/right and up/down to view graphs. I want to see them entirely on the screen."

"You definitely need to have a good, fast computer for this...you need to accommodate slow computers."

"I would like a print option for graphs and survey results."

"You need a search option."

"Color-wise, it's not so attractive. The lack of color wouldn't affect me from using it though."

## Overall Chapter Summary of Results

Attitudes about Water Quality and Watershed Conservation Issues

Table 54 provides a summary of respondents' demographic characteristics that significantly influence the level of importance respondents associate with watershed conservation issues, the level of satisfaction respondents have with the water quality in their watershed, the degree to which respondents feel informed about watershed conservation issues, and the communication strategy preferences of survey respondents. The importance respondents associate with watershed conservation issues is influenced by respondents' age, level of education, and farm status as full-time, part-time, or non-farmers. How informed respondents feel they are about watershed conservation issues depends on the farm status of respondents, the size of the farm operated by the respondents, and the watershed in which the respondents reside.

Incentives for BMP Adoption

The vast majority of respondents have not adopted conservation practices relevant to their primary farming operation. However, the highest rates of effective adoption were for integrated crop management, conservation tillage, and grassed waterways. Financial assistance, information, training, and/or assistance with the implementation of conservation practices, and improved environment and water quality were the three most prominent incentives survey respondents mentioned would help them implement

conservation practices. Furthermore, lack of funds and lack of information were the two most predominant factors hindering respondents' adoption of best management practices.

Effect of Attitudes on BMP Adoption

Results indicate that the more informed a respondent is, the more likely they are to adopt streamside buffer/filter strips, grassed waterways, and integrated crop management practices. The more satisfied with water quality a respondent is, the more likely they are to adopt conservation tillage practices. Level of importance had no significant effect on respondents' adoption of BMPs. Therefore, the level of feeling informed about watershed conservation issues has a greater impact on respondents' adoption rate of BMPs than does importance of water quality issues or respondents' level of satisfaction with the water quality in their watershed.

Communication Strategy Preferences

Overall, respondents tend to prefer traditional, written communication strategies over technological/computerized methods of communication. Results indicate that respondents' preference for the media is determined by education level while preference for written communication strategies is determined by gross annual income level. In addition, respondents' preference for computers and the Internet as a communication strategy is determined by the age and education level of the respondent. Furthermore, regardless of Internet access, all respondents still demonstrated a preference for written materials. However, access to the Internet does have a significant effect on respondents' preference for the Internet as a communication strategy as survey respondents with

Internet access had a significantly higher preference for the Internet than respondents without Internet access. Also, a significantly higher percentage of respondents preferring the Internet had access in their home, business, local library, or local school than those who did not prefer the Internet as a communication strategy.

Website Design

According to focus group participants, an effective web site would: be updated constantly, include specific information, be easy to navigate, contain contact information for local people, include articles and photos with a local flavor, provide relevant links to other web sites and show successful conservation practices and mention the good things people are doing in the watershed.

Table 54. Summary of demographic characteristics having a significant effect on: level of importance respondents give to watershed conservation issues, respondents' satisfaction with the water quality in their watershed, respondents' level of feeling informed about water quality issues, and respondents' preferences for communication strategies.

| | Demographic Characteristics of Respondents | | | | | | |
|---|---|---|---|---|---|---|---|
| **Dependent Variables** | **Age** | **Level of Education** | **Gross Annual Income Level** | **Farm Status** | **Farm Size** | **Primary Farming Operation** | **Watershed of Residence** |
| **Importance of Watershed Conservation Issues** | X | X | | X | | | |
| **Satisfaction with Water Quality in the Watershed** | | | | | | | |
| **Level of Feeling Informed about Watershed Conservation Issues** | | | | X | X | | X |
| **Preferences for Communication Strategies** | X | X | X | | | | |

Note: X indicates which demographic characteristics have a significant effect on the dependent variables (importance of watershed conservation issues, satisfaction with water quality, level of feeling informed about water quality issues, and preferences for communication strategies).

## Chapter 5: Discussion and Conclusions

### Limitations of the Study

Generalizability:

Some general limitations of this study should be noted. The sampling frame of this study consisted of agricultural watersheds differing in their involvement in active watershed conservation programs such as the Total Maximum Daily Load and Section 319 programs. Since the purpose of this study was to compare active versus inactive watersheds, the data only represent a restricted sample and results are not intended to be and should not be generalized to all Michigan agricultural watersheds.

Over-sampling Bias:

Furthermore, the surveys were addressed to both the male and female residents if the name of the female resident was known, but in many cases, we only had access to the name of the male landowner of each parcel of land. Therefore, the majority of surveys were completed by the individual the surveys were addressed to (usually a male), and as a result, we received a significantly higher proportion of males than females in our sample. Therefore, males were over-sampled in this study and the results are biased towards male respondents. A limitation of this study is that it did not adequately capture the opinions, information needs, and BMP adoption behaviors of female agricultural landowners.

Non-response Bias:

Another limitation of this study is that only a moderate response rate of 44% was achieved which may result in non-response bias. For example, if environmentally concerned farmers are more likely to respond to the survey than unconcerned farmers,

results will be skewed toward the responses of environmentally concerned farmers. Response rate was adversely affected due to the fact the research team received an inadequate sample from Eaton County geographic information systems (GIS) and Equalization offices. The research team received the names and addresses of individuals owning various parcels of land within the targeted watersheds. However, since it is quite common for a single landowner to own numerous parcels of land, many respondents received multiple copies of our survey instrument (as many as three or four instruments). In some cases, respondents filled-out and returned one copy of the survey instrument while expressing their disappointment in receiving multiple copies. A potential result is that a number of potential respondents did not complete and return the survey instruments because our sampling method resulted in lost credibility.

To help counter part of this limitation, it is possible that response rates could be increased by offering financial incentives to survey recipients. According to a meta-analysis performed by Fox et al., (1988), a financial incentive of $0.25 roughly increases response rate by 16% on average, while an incentive of $1.00 roughly adds about 31% on average to the response rate. In order to address this limitation statistically, early respondents were compared to late respondents since "non-respondents tend to be similar to late respondents" (Miller & Smith, 1983; Pace, 1939). This comparison of data enabled the project team to get an indication of discrepancies existing between early and late/non-respondents. Results from procedures used to address non-response error provide evidence that the method of comparing early and late respondents is a defensible and generally accepted procedure for handling non-response error as a threat to external validity of research findings (Lindner, et al., 2001).

Of the 29 variables compared between early and late respondents to determine non-response bias, only 2 variables came out statistically significant and it is questionable whether they are meaningfully or substantively significant. Results indicated that the less likely respondents were to use cover crops and spread manure on the same field every 2-4 years, the more likely they were to be late respondents, responding after the postcard reminder was sent out. Since, in general, results revealed that there was not a significant difference between late and early respondents, the results are presumed to be generalizable to the four watersheds studied and are representative of the population of interest.

Self-reported Data:

Self-reported data may present threats to the reliability and validity of some measures of the study, and may limit inferences made about causal relationships among some variables. For instance, results indicated that agricultural landowners' adoption of BMPs was influenced by how informed respondents felt they were about watershed conservation issues. Since the data is self-reported, we are only measuring how informed one feels or claims they feel they are about watershed conservation issues and we are not measuring actual knowledge about watershed conservation issues. Therefore, discretion should be used when drawing conclusions that level of feeling informed about watershed conservation issues influences farmers' adoption of BMPs since we can not be certain how informed respondents actually are about watershed conservation issues since the data we collected is based on impressions and self-reported data. Another threat to reliability and validity is that farmers may be tempted to exaggerate their environmental

awareness and frequency of conservation practice adoption in order to avoid conflict or reprimand from environmental advocacy organizations.

In spite of these limitations, the overall response rate (44 %) and the variance in landowner responses were adequate to address the research questions, improve our understanding of the effectiveness of Extension in informing farmers about watershed conservation issues and best management practices, and aid in the refinement of questions requiring further research. Within the limitations of this study, a discussion and interpretation of the results follows.

**Discussion of Background Information from Survey Respondents**

The main difference between watersheds in this study is that the Gun River and Lake Macatawa watersheds were sites where active watershed conservation programs currently exist, while the North Branch Flint River and Upper Thornapple watersheds were sites void of active watershed conservation programs. Because only the Gun River and Lake Macatawa watersheds were involved in Total Maximum Daily Load (TMDL) and Section 319 programs, one might expect that these watersheds would have more active and effective Extension programs than the control watersheds, and that respondents would be better informed about watershed conservation issues than respondents from the North Branch Flint River and Upper Thornapple watersheds. One would also expect that BMPs would be adopted more frequently in these watersheds, and that as a result, respondents from the Gun River and Lake Macatawa watersheds may feel a higher level of satisfaction with the water quality in their watershed than would respondents from the control watersheds. However, one could also argue, that the reason

active watershed conservation programs exist in the Gun River and Lake Macatawa watersheds, is that water quality is particularly impaired in these watersheds to begin with and that respondents may feel more pessimistic about the condition of their watershed than would respondents from watersheds not involved in the TMDL or Section 319 programs.

The two active watersheds had nearly identical response rates as the North Branch Flint River watershed but all three watersheds had considerably higher response rates than the Upper Thornapple watershed. This is likely largely due to the fact that the Upper Thornapple watershed had a significantly smaller percentage of both full-time and part-time farmers than the other three watersheds. In addition, the Upper Thornapple watershed had a substantially smaller percentage of respondents owning and renting farmland than the other three watersheds, and only 31.1% of the respondents from the Upper Thornapple watershed reside on a farm whereas between 60% and 70% of respondents from the other three watersheds claimed to reside on a farm. Furthermore, the Upper Thornapple watershed differed from the other three watersheds in that it had the highest percentage of female respondents and respondents tended to have higher levels of education and higher levels of gross annual incomes than respondents from the other watersheds.

**Factors Influencing Survey Respondents' Attitudes and Perceptions about Watershed Conservation Issues and the Water Quality in their Watersheds**

Effect of Demographics on Importance of Watershed Conservation Issues

Overall, survey respondents feel that watershed conservation issues are moderately important which is consistent with results obtained from a previous study conducted in Maryland, New York, and Pennsylvania by Lichtenberg and Zimmerman (1999). Results from this previous study reveal that farmers feel that water quality problems were moderately serious and that "farmers express on average a middle-of-the-road level of concern toward most water quality related issues" (Lichtenberg & Zimmerman, 1999, p. 235). Respondents from the Gun River and Upper Thornapple watersheds had the two lowest mean scores for age and the two highest mean scores for education while the Upper Thornapple watershed respondents had a significantly higher proportion of non-farmers than the other three watersheds in the study suggesting that age, level of education and farming status influence farmers' level of concern about watershed conservation issues. Indeed, results indicate that level of education, age, and farming status all have a significant effect on agricultural landowners' level of concern for the various watershed conservation issues.

According to Lichtenberg and Zimmerman (1999), both attitudes toward the environment and importance of information are likely to be determined by the same underlying factors such as personal values, economic and personal stakes, education, and prior experience. Therefore, in this case, higher levels of education or previous experience (age and previous farming experience) may be required for respondents to be able to recognize the evidence and implications of reduced fish habitat and algae growth

while a significant level of understanding may not be necessary for respondents to determine whether flooding or erosion into streams has occurred. As a result, a greater proportion of respondents is able to recognize the effects of erosion and flooding while perhaps part-time and full-time farmers, older respondents, and individuals with lower levels of education may not be able to recognize the importance of less easily recognized and understood watershed conservation issues such as reduced fish habitat and algae growth.

Other Potential Factors Influencing Respondents' Level of Concern for Watershed Conservation Issues

Survey respondents' concern about flooding and erosion into streams may be partially explained by the fact that the effects of flooding and erosion are more easily recognized and understood detriments to the environment while other watershed conservation issues such as reduced fish habitat may not be as apparent to all individuals. Furthermore, one might expect respondents to be more concerned about flooding and erosion into streams as both of these issues directly affect farming practices while neither reduced fish habitat nor algae growth interfere with a farmers' duties. In addition, the importance given to watershed conservation issues may be determined by how satisfied an individual is with the water quality in their watershed. In other words, if an individual feels very satisfied with the water quality in their watershed (if they feel environmental problems do not exist within their watershed), they may be less apt to feel that watershed conservation issues are very important.

Factors Other than Demographics Potentially Influencing Respondents' Level of Satisfaction with the Water Quality in their Watershed

While level of satisfaction with the water quality in their watershed may impact how important respondents feel watershed conservation issues are, respondents' level of satisfaction with the water quality in their watershed may be determined by how important watershed conservation issues are to the individual. For instance, if an individual feels that watershed conservation issues are very or extremely important, they may likely be less satisfied with the water quality in their watershed. Since respondents tended to feel that watershed conservation issues were moderately important, it seems logical that they also feel moderately satisfied with the water quality in their watershed.

Even though there was not a statistical difference between watersheds, respondents from the Lake Macatawa watershed demonstrated the least amount of satisfaction with water quality in their watershed despite the fact that it had been involved in the Total Maximum Daily Load (TMDL) program longer than the Gun River watershed. However, it is important to recognize that this may simply indicate that the water quality in this watershed was particularly unsatisfactory in comparison to the other watersheds involved in this study and is likely the reason it became a site of active watershed conservation programs before the other watersheds.

The Lake Macatawa watershed was recognized as a "problem watershed" in 1971 and was relatively well-known throughout the state of Michigan as having a very hyper-eutrophic lake with extremely high phosphorus and chlorophyll a levels, excessive turbidity with visibility less than one foot, periodic nuisance algal blooms, low dissolved oxygen concentrations, and a high rate of sediment deposition (Kettelle & Uttermark,

1971). More recently, Gary Brower, an editor from the Holland Sentinel (2002) informed citizens that from 1993 until 1997, the water of Lake Macatawa was tested more than 60 times and in all but 5 tests, the lake received a grade of E-the worst score possible, indicating the water in Lake Macatawa is of "poorest water quality." Furthermore, the mere fact that the Lake Macatawa watershed was chosen as a site for watershed conservation programs can result in a preconceived notion about the condition of the watershed. An agricultural landowner in the Lake Macatawa watershed would only need to read a local newspaper article and they would soon recognize that phosphorus, sedimentation, and a number of other detrimental attributes were a problem, and this realization would likely cause them to feel unsatisfied with the water quality in their watershed.

Respondents from the Gun River watershed (the other active watershed) had the highest level of satisfaction with water quality in their watershed perhaps indicating that these watershed conservation programs had recently resulted in improved water quality. One might expect respondents from this watershed to be more satisfied with water quality than respondents from the other targeted watershed since longer organized and concerted efforts have been made in the Gun River watershed to reduce water pollution. Also worth mentioning is the fact that Gun Lake (the water source of Gun River) is a highly valued recreational lake which may also contribute to landowners' overall satisfaction with the Gun River watershed.

Effect of Demographics on Respondents' Level of Feeling Informed about Watershed Conservation Issues

Few researchers have examined the relationship between farmers' demographic characteristics and their information needs (Rollins et al., 1991). Results from this study indicate that farming status, farm size, and watershed residence had a significant effect on how informed respondents felt they were about watershed conservation issues. Full-time farmers and farmers farming on larger parcels of land felt significantly more informed than part-time farmers, non-farmers, and farmers farming smaller parcels of land. This finding may be the result of Extension targeting the larger farming operations in their counties.

Full-time farmers and farmers farming larger parcels of land may also feel more informed than part-time farmers, non-farmers, and farmers farming small parcels of land because they may feel they have a greater impact on the water quality in their watershed and may be more apt to actively seek out information to lessen the detrimental impacts of their farming practices. Also, one might expect non-farmers to feel less informed about watershed conservation issues since many of these issues (such as bacterial contamination and excess nutrients) would seem irrelevant to non-farmers whereas farmers are more likely to understand the relevance of these issues since they result from farming activities. Furthermore, full-time farmers and farmers with larger farming operations may simply have more resources (monetary, computerized, and personal information sources) through which to obtain information about watershed conservation issues. Similarly, Okai (1986) found a significant difference between number of acres owned by farmers and the importance of information needs. In Okai's study, farmers

who farmed larger parcels of land were more likely to use more sources of information (such as newspapers, magazines, radio, TV, friends, neighbors, and Extension specialists) than farmers with smaller parcels of land.

Results from this study also indicate that respondents from active watersheds (the Gun River and Lake Macatawa watersheds) felt more informed than the respondents from inactive watersheds (the North Branch Flint River and Upper Thornapple watersheds). This information might suggest that Extension, and other education and conservation efforts have been effective in the targeted watersheds where watershed conservation programs are currently undergoing.

Other Potential Factors Influencing Respondents' Level of Feeling Informed about Watershed Conservation Issues

How important survey respondents feel watershed conservation issues are and how satisfied respondents are with the water quality in their watershed may be highly dependent upon how informed they feel they are about watershed conservation issues. For instance, respondents from this study generally felt only slightly to moderately informed about watershed conservation issues which may hinder their ability to accurately assess the importance of watershed conservation issues as well as the quality of the water within their watershed.

One must also consider that the level of satisfaction one feels with the water quality in their watershed and how important an individual feels watershed conservation issues are may also affect how informed a person feels they are about watershed conservation issues. For instance, if an individual is very satisfied with water quality and does not feel that watershed conservation issues are very important, one might reasonably

conclude that the individual would be less likely to actively seek out information about watershed conservation issues and therefore remain relatively uninformed about these issues. On the other hand, an individual who is very unsatisfied with the water quality in their watershed and is very concerned about watershed conservation issues, may be far more likely to seek out information about watershed conservation issues thus increasing their knowledge about these conservation issues.

Overall, survey respondents were unfamiliar with a number of watershed conservation practices (such as pasture management/livestock exclusion, buffer/filter strips, integrated crop management, manure management plans, and animal waste storage systems) suggesting that Extension has not been effective in teaching agricultural landowners about these watershed conservation practices. Respondents most unfamiliar with watershed conservation issues may either be completely naïve to water quality problems or they may simply not be concerned enough about the issues to actively seek out information and advice from agencies or organizations. For example, respondents from this study generally preferred to learn about watershed conservation issues via written materials and did not generally have a high preference for learning about conservation issues by actively seeking information from agency or organization offices. Since it requires greater effort to actively seek information than it does to be a passive receiver of pamphlets or other written materials, it may only be the highly motivated learners that would visit an agency or organization to obtain specific information about watershed conservation issues and best management practices.

## Factors Influencing Survey Respondents' Effective Adoption Rate of Best Management Practices

Respondents' Overall Effective Adoption Rate of Best Management Practices

Previous research led the project team to predict that respondents' adoption rates of BMPs would be highly dependent upon how important watershed conservation issues were to farmers, how satisfied farmers felt they were with the water quality in their watershed, how informed farmers felt they were about watershed conservation issues, as well as a number of demographic factors such as age, education level, and farming status. Napier et al., (1986) described how farmers most concerned about environmental problems were more likely to adopt conservation practices while Feather & Amacher (1994) discovered that satisfaction with water quality motivated farmers' adoption of BMPs. Previous research conducted by Napier et al. (1986), and Lichtenberg and Zimmerman (1999) also supports the project teams' prediction that farmers must first feel adequately informed about watershed conservation issues before they will adopt BMPs. Napier et al., (1986) suggests that farmers must first be informed of the advantages of implementing a specific conservation practice before they will adopt the innovation while Lichtenberg and Zimmerman (1999) suggest that farmers interacting with public information sources about BMPs are significantly more likely to adopt those practices. In addition, research conducted by Napier et al. (1986), Napier et al., (2000a), Hines et al. (1987), and Rhodes et al. (2002) suggest that various demographics and "ability to act" factors contribute to farmers' decision to implement conservation practices. Overall, the vast majority of survey respondents have not adopted or tried any of the mentioned BMPs relevant to their farming operation or property features (such as having a stream or steep

slope on land) suggesting that Extension has "room for improvement" in the four watersheds examined in this study.

The fact that conservation tillage, grassed waterways, and integrated crop management practices were adopted/tried most frequently is logical since all watersheds had a substantially higher proportion of farmers with crops (cultivated crops or hayland) than farmers with livestock (pastured livestock or confined livestock/poultry) as their primary farming operation. Additionally, conservation practices related to crops, such as conservation tillage, are often viewed as profitable production technologies that also have conservation benefits (Jolly et al., 1983). This being the case, farmers may be more likely to adopt BMPs related to crops as the implementation of these practices are perceived to have less financial cost and perhaps greater benefit (both ecological and financial) than conservation practices related to livestock. Furthermore, farmers may be more likely to adopt conservation practices related to crops because these practices play a role in reducing flooding and erosion which are the two watershed conservation issues of most concern to farmers in this study.

Factors Other than Demographics Potentially Influencing Respondents' Effective Adoption Rates of BMPs

The three most prominent incentives that survey respondents mentioned would encourage them to adopt best management practices were: (1) financial assistance, (2) information/training/assistance with the implementation of conservation practices, and (3) improved environment and/or water quality. In addition, lack of funds, and lack of information were the two most prominent factors hindering respondents' adoption of BMPs.

In support of these findings, previous research indicates that access to information and the economic cost associated with adopting innovations are the two most important factors in farmers' decisions to adopt BMPs. According to Napier et al., 1986, once farmers are informed of the advantages of using specific conservation practices, they will adopt the innovations. Furthermore, farmers who have interacted with public information sources about BMPs are significantly more likely to use these practices (Lichtenberg & Zimmerman, 1999). In addition, if potential adopters do not possess necessary economic resources to purchase innovations, then adoption will not occur (Napier et a., 2000a). Furthermore, individuals may sometimes be unable to adopt ideas, technologies or farming techniques because they do not have the economic resources to implement what they may otherwise desire to do (Napier et al., 1984). Most importantly, Extension and agricultural educators should keep in mind that positive attitudes are not useful for environmental change if landowners do not possess the resources to make changes (Hines et al., 1987).

Effect of Importance of Watershed Conservation Issues on Respondents' Effective Adoption Rate of Best Management Practices

In order to determine how to improve agricultural landowners' adoption rates of best management practices, it is important to determine what effect importance of watershed conservation issues has on landowners' willingness to try or adopt conservation practices. In general, respondents from this study who felt watershed conservation issues were moderately to extremely important were more likely to adopt BMPs than respondents who felt watershed conservation issues were not at all to slightly

important. However, results conclude that level of concern for watershed conservation issues does not significantly influence respondents' adoption of BMPs. Nevertheless, since respondents who are most concerned about watershed conservation issues are generally most likely to adopt BMPs, Extension must keep in mind that they may have to convince agricultural landowners that watershed conservation issues are important before they can expect agricultural landowners to adopt BMPs to improve water quality.

Supporting this notion, previous research indicates that the more concerned farmers are about watershed conservation issues, the more likely they will be to adopt conservation practices. For instance, Napier et al. (1986) found that Ohio farmers who believed environmental problems were very important were more likely to adopt conservation practices such as crop rotation, retirement of erodible land, grassed waterways, and filter strips. Similarly, Lynne, et al. (1988) discovered that farmers with a stronger conservation ethic exerted greater conservation effort than farmers without strong conservation ethics as measured by the number of different conservation practices adopted.

Effect of Satisfaction with Water Quality on Respondents' Effective Adoption Rate of Best Management Practices

In order to improve agricultural landowners' adoption rate of best management practices, one ought to first determine if landowners' satisfaction with the water quality in their watershed affects their willingness to try or adopt BMPs. In general, survey respondents who were most satisfied with the water quality in their watershed were more likely to adopt best management practices than respondents feeling least satisfied with the

water quality in their watershed. Respondents' satisfaction with the water quality in their watershed may in some instances serve as motivation for farmers to make efforts to ensure the water quality remains satisfactory and does not worsen over time. Results indicate that satisfaction with water quality has a significant effect only on agricultural landowners' adoption of conservation tillage practices and that satisfaction with water quality does not significantly affect landowners' adoption rate of all other best management practices.

Effect of Feeling Informed about Watershed Conservation Issues on Respondents' Effective Adoption Rate of Best Management Practices

In order to determine how to improve agricultural landowners' adoption rates of best management practices, it is important to determine the effect of how informed landowners feel they are about watershed conservation issues on how likely they are to try or adopt conservation practices. The relationship between information and farmers' beliefs about environmental quality (and thus farmers' implementation of environmental protection measures) is complex (Lichtenberg & Zimmerman, 1999). Rhodes et al. (2002) claims that the ultimate objective of providing information to farmers is to foster change in behavior or practice, rather that attitudes or beliefs, because only the former has the potential to benefit the environment. Therefore, access to information is among the most important predictive factors associated with BMP adoption behavior. According to Napier et al. (1986), once farmers are informed of the advantages of using specific conservation practices, they will adopt the innovations. Furthermore, farmers who have

interacted with public information sources about best management practices are significantly more likely to use these practices (Lichtenberg & Zimmerman, 1999).

Results from this study indicate that in general, respondents who felt more (moderately to extremely) informed about watershed conservation issues were more likely to adopt best management practices than respondents feeling less (not at all to slightly) informed about conservation issues. This general trend seems to indicate that the more informed farmers are about conservation issues, the more important they consider them to be, and hence, the more likely they are to act by adopting BMPs. Results specifically indicate that the most informed respondents were significantly more likely to adopt streamside buffer or filter strips, grassed waterways, and integrated crop management practices.

## Factors Influencing Survey Respondents' Preference for Computerized Communication Strategies

### Survey Respondents' Overall Preference for Communication Strategies

While "little is known about farmers' perceptions about water quality as an issue," possibly even less is known about farmers' use of information sources regarding this agricultural problem (Bruening, 1992, p.43). Although studies indicate that increased amounts of information encourage adoption, it is essential that the type of information and the method of delivery match the social context of watershed residents (Norman et al., 1997). "The modern use of technology as a communication strategy has the potential to greatly influence the efficiency of individual practitioners, but, what will be the gain if the users of the information do not prefer and therefore, can not or will not

utilize the advanced resources" (Riesenberg and Gor, 1989, p.7)? While in some cases the Internet has proven to be an effective communication strategy (Bowen and Escolome, 1990; Findlay et al., 1993), there is still a need to determine the present day farmers' preference for this information source.

Overall, survey respondents preferred traditional/written communication strategies such as newsletters/mailers and printed bulletins/fact sheets. These findings are supported by research conducted by Gloy et al. (2002, p.1) indicating that "farm publications are one of the most frequently used communication tools." In addition, respondents had the least amount of preference for computerized communication strategies such as computers, e-mail and the Internet. These findings are consistent with results by Tavernier et al. (1996) which indicate that there was little preference by farmers for modern technology. Lichtenberg and Zimmerman (1999, p.235) offer an explanation for farmers' preference for traditional and written communication strategies by suggesting that "overall, the greater the degree to which information is processed before reaching the farmer, the more 'second-hand' the information is, and the less importance farmers tend to attach to it."

Effect of Demographics on Survey Respondents' Preference for Computerized Communication Strategies

Results from this study indicated that survey respondents do not have a considerable preference for computerized communication strategies such as computers and the Internet. However, Extension should also know whether preference for innovative communication strategies is related to farmers' demographic characteristics.

Results indicate that respondents' preference for computers and the Internet as communication strategies to learn about watershed conservation issues is related to respondents' age, level of education, and gross annual income level. According to Riesenberg and Gor (1989), younger, more educated farmers will have a greater appreciation for modern sources of information. Since the youngest respondents had a significantly higher preference for computers and the Internet than older respondents, and because one would expect younger farmers to be more inclined to utilize modern technology (Tavernier, et al., 1996), one could argue that while farmers currently prefer traditional written communication strategies over computers and the Internet to learn about watershed conservation issues, farmers may prefer computerized communication strategies in the future.

In support of these findings, Suvedi et al. (2000) illustrated that farmers' use of Internet sources in Michigan increased from 1.4% to 10.0% between the years 1996 and 1999. Results from this study are also consistent with previous research conducted by Riesenberg and Gor (1989) and Richardson and Mustian (1994). Younger farmers, aged 20 to 35 years, tend to prefer computer-assisted instruction and home study more than the farmers aged 66 and older (Riesenberg & Gor, 1989), while middle-aged clientele prefer printed materials such as a bulletin or pamphlet more than other communication strategies (Richardson & Mustian, 1994).

Overall, the oldest respondents in this study had the least amount of preference for all communication strategies. Previous research conducted by Schnitkey et al. (1992) and Gloy et al. (2002) provides suitable explanations. Schnitkey et al. (1992) argues that age is related to farming experience and that farmers with more experience should have less

demand for external information. Also, according to Gloy et al. (2002), it may be expected that age will be negatively related to the usefulness of information received from media information sources.

Results from this study indicate that level of education is positively correlated with respondents' preference for written materials and computers/Internet, and that level of education is negatively correlated with respondents' preference for media and personal or face-to-face communication strategies. According to Gloy et al. (2002), higher levels of education are expected to be positively related to the usefulness of information received from all information sources. In addition, "higher levels of education should increase the usefulness of information received from the sources that deliver the most sophisticated information" (Gloy et al., 2002). Results from this study corroborate results from studies performed by Richardson and Mustian (1994) and Bowen and Escolme (1990). According to Richardson and Mustian (1994), college graduates were found to have a significantly higher preference for method demonstration and video tapes than did persons who have less than a college education. Bowen and Escolme (1990) discovered that three-fourths of farmers who used computers had at least some college education.

Findings from this study also reveal that gross annual income levels are positively correlated with respondents' preference for computers and the Internet. These results are consistent with previously conducted research performed by Tavernier et al. (1996). According to Tavernier et al. (1996), farmers with high gross annual incomes (more than $100,000/year) were more likely to adopt computer technology. This can be explained in part by the suggestion that farmers that are more profitable than others have a greater capacity to purchase the latest, and in some cases, the most expensive

technology (Tavernier, et al., 1996). According to Findlay et al., (1993), limited resource farmers are willing to learn more about computers and one should expect that there will be a desire among farmers to have access to computers and web sites in order to learn about the watershed in which they live.

## Other Potential Factors Influencing Survey Respondents' Preference for Computerized Communication Strategies

### *Internet Access*

Not only is farmers' preference for computers and Internet related to farmer demographics such as income and education level, farmers have also been reluctant to adopt computers and innovative technologies to obtain educational information due to lack of or inconvenient Internet access (Iddings & Apps, 1992; Tavernier et al., 1996). Regardless of whether respondents had Internet access, the majority of respondents (74.6% of landowners with Internet access and 77.8% of landowners without Internet access) still preferred written materials more than the Internet to learn about watershed conservation issues. These results suggest that even if agricultural landowners have Internet access, they will likely still have a higher preference for more traditional or written communication strategies. However, having access to the Internet does significantly increase one's preference for the Internet as a communication strategy.

In addition, results indicate that the location of Internet access has a significant effect on respondents' preference for the Internet as a communication strategy. A substantial percentage of respondents preferring the Internet had Internet access in their homes, business, or local library or school. Nearly all of the respondents preferring the

Internet as a communication strategy had Internet access in their home suggesting that the more convenient the access, the more likely agricultural landowners are to prefer the Internet as a communication strategy to learn about watershed conservation issues.

*Cost, Time, and Knowledge Limitations*

Several studies have identified why farmers are generally reluctant to adopt computers and benefit from other computerized innovations such as the Internet. For the most part, the cost of computerized innovations and knowledge limitations are the two factors that limit farmers' adoption of computers and Internet the most. Specifically, previous research indicates that the cost of the computer, cost of hardware and software, high telephone line charges incurred by distant participants, time required to learn how to use the Internet, lack of knowledge about the Internet's capabilities, low computer literacy, lack of training to mitigate technophobia, lack of on-line technical assistance for users, level of education of farmers, age, and size and type of farming operation all influence farmers' reluctance to implement computers and the Internet (Findlay et al., 1993; Taylor et al., 1991; Dix, 1994; and Iddings & Apps, 1990).

## Factors Influencing Survey Respondents' Use of the Internet to Learn about Watershed Conservation Issues and Best Management Practices

Indicators of web site success include the ability of users to retrieve targeted information, user satisfaction, user confusion or fatigue, and user task load (Spool and Scalon, 1997). Wilde and Swatman (1996) suggest that there may be both technological and motivational/task inhibitors which prevent farmers from adopting the Internet.

Technological inhibitors relate to computer hardware and software and the available telecommunication systems more specifically, while motivational and task inhibitors relate to individuals within the rural community. Factors include user conservatism, resistance to change, and lack of confidence. Furthermore, potential benefits from and relevance of involvement in the virtual community are not seen by the farming community as clearly worth their cost. This study corroborates the findings of Spool and Scalon (1997) and Wilde and Swatman (1996) by revealing that factors influencing Michigan's agricultural landowners' use of the Internet and web sites to learn more about watershed conservation issues are: ease of use; modem speed; topic relevance; local context; inclusion of specific information, and reliability. Ease of use, modem speed, and reliability could all be considered technological inhibitors while topic relevance, local context, and inclusion of specific information could be considered motivational and task inhibitors relating to individuals within the rural community.

## Recommendations

### Increasing Agricultural Landowners' Level of Concern for Watershed Conservation Issues

Younger, more educated, non-farming landowners are more likely to feel watershed conservation issues are very to extremely important. Therefore, if Extension and agricultural educators desire to increase the overall level of importance landowners give to watershed conservation issues, they should target older, less educated, part and full-time farmers. Extension and agricultural educators need to increase their effectiveness in helping farmers to recognize reduced fish habitat and algae growth as

legitimate environmental concerns. Respondents' failure to recognize the importance of these two conservation issues should provide incentive and rationale for why education and Extension experts should focus their efforts on these issues in addition to the issues farmers are most concerned about (i.e. flooding and erosion into streams).

Previous research indicates that while agricultural producers generally believe that soil erosion and water quality degradation are problems, farmers often hesitate to admit that there is any relationship between their farming practices and water quality problems (Christenson & Norris, 1983). This is an important notion for Extension to consider when attempting to teach agricultural landowners about the importance of watershed conservation issues. In addition to informing agricultural landowners about watershed conservation issues, Extension must also be effective in convincing farmers that their particular farming practices, in many cases, may directly contribute to the impaired condition of the watershed. In the same way, Extension must also be effective in convincing farmers that the adoption of BMPs will result in improved water quality within their watersheds.

Increasing Agricultural Landowners' Level of Feeling Informed about Watershed Conservation Issues

Landowners residing within the active watersheds exhibited higher levels of feeling informed about watershed conservation issues suggesting that watershed conservation efforts have been successful in targeted watersheds. In order to increase respondents' level of feeling informed, residents of non-targeted watersheds should be exposed to similar watershed conservation programs promoted in the target watersheds of this study. Also, since full-time farmers farming larger parcels of land tend to feel more

informed than other watershed residents, watershed conservation programs should specifically target part-time farmers, and those farming smaller parcels of land.

In addition, farmers must have a specific need for information before they will participate in an educational activity (Bruening, 1992). Therefore, Extension could improve their effectiveness by determining agricultural producers' information needs. Once Extension has determined the information needs of the clientele, they have only to determine which communication strategies should be implemented to deliver the desired information to the various clientele groups.

The most effective way to increase present day farmers' knowledge (or at least their perception of being informed) is to communicate with farmers through traditional, written communication strategies such as newsletters and bulletins. However, since results indicate that younger respondents had the highest preference for computers and the Internet, one can argue that, under different financial circumstances, younger farmers may demonstrate an even higher preference for computers and the Internet and that preference may simply be limited by the fact that younger farmers probably can not afford such equipment (Abbott & Yarbrough, 1992). Extension should be aware that the Internet may be a preferred and useful communication strategy in the future but currently, the cost and initial investment of a computer may hinder some farmers' use and preference for computerized communication strategies to learn about watershed conservation issues.

In addition, since the preference for computers and the Internet increase as respondents' level of education increases, Extension agents should be discouraged from relying on computerized communication strategies when targeting an audience with

lower levels of education. Furthermore, because gross annual income is positively correlated with respondents' preference for computers and the Internet, Extension agents ought to refrain from relying on computerized communication strategies when targeting landowners with lower gross annual income levels.

Improving Agricultural Landowners' Adoption Rates of Best Management Practices

To improve agricultural landowners' adoption rates of best management practices, one must take into consideration individual's farm size, primary farming operation, and involvement with watershed conservation programs. Results from this study indicated that individuals with larger farms were more likely to adopt BMPs generally, and that individuals were more likely to adopt specific BMPs directly related to their primary farming operation. In addition, individuals with the greatest exposure to watershed conservation programs tended to adopt BMPs more frequently than individuals who had not been involved in active watershed conservation programs. Furthermore, offering incentives such as financial assistance, improved water quality/environment, and information, training, and/or assistance with the implementation of conservation practices should be effective in promoting agricultural landowners' adoption rates of BMPs.

Roger's "Innovation Decision Process theory" (1995) applies to agricultural landowner's adoption of best management practices. If Extension and education professionals intend to increase farmers' adoption of various conservation practices, farmers must first learn about the innovation/conservation practice; second, they must be persuaded of the value of the innovation/conservation practice; then the farmer must make the decision to adopt the innovation/conservation practice. After the adoption of the BMP has taken place, the innovation/conservation practice must then be

implemented. Finally, to increase farmers' adoption of BMPs, the farmer's decision to implement an innovation/conservation practice must be reaffirmed or rejected (Rogers, 1995).

Ajzen and Fishbein's (1980) Theory of Reasoned Action implies that the most important determinant of an individual's behavior is behavior intent (see Figure 11). In addition, the Theory of Reasoned Action suggests that both attitude toward the behavior and subjective norms influence behavioral intentions. For instance, if a farmer values good water quality and perceives that the outcome of implementing conservation practices on his farm is positive and will result in improved water quality, that farmer will have a positive attitude about adopting BMPs and will most likely adopt the conservation practices. Furthermore, if the farmers' neighbors and peers have positive attitudes about adopting conservation practices and intend to adopt these practices, the farmer will be even more inclined to adopt the BMPs. Therefore, if Extension professionals and other agricultural educators can convince environmentally concerned agricultural landowners that the implementation of BMPs will have positive implications on the water quality in the farmers' watershed, the farmer will develop a positive attitude about adopting BMPs, will intend to adopt conservation practices and will more than likely succeed in doing so.

Agricultural landowners' level of concern about watershed conservation issues and level of satisfaction with the water quality in their watershed have a limited impact on encouraging farmers' adoption of BMPs. However, high levels of satisfaction with water quality will positively affect farmers' adoption rates of conservation tillage practices. Increasing agricultural landowners' level of feeling informed is a more efficient way to increase agricultural landowners' adoption rates of BMPs as landowners

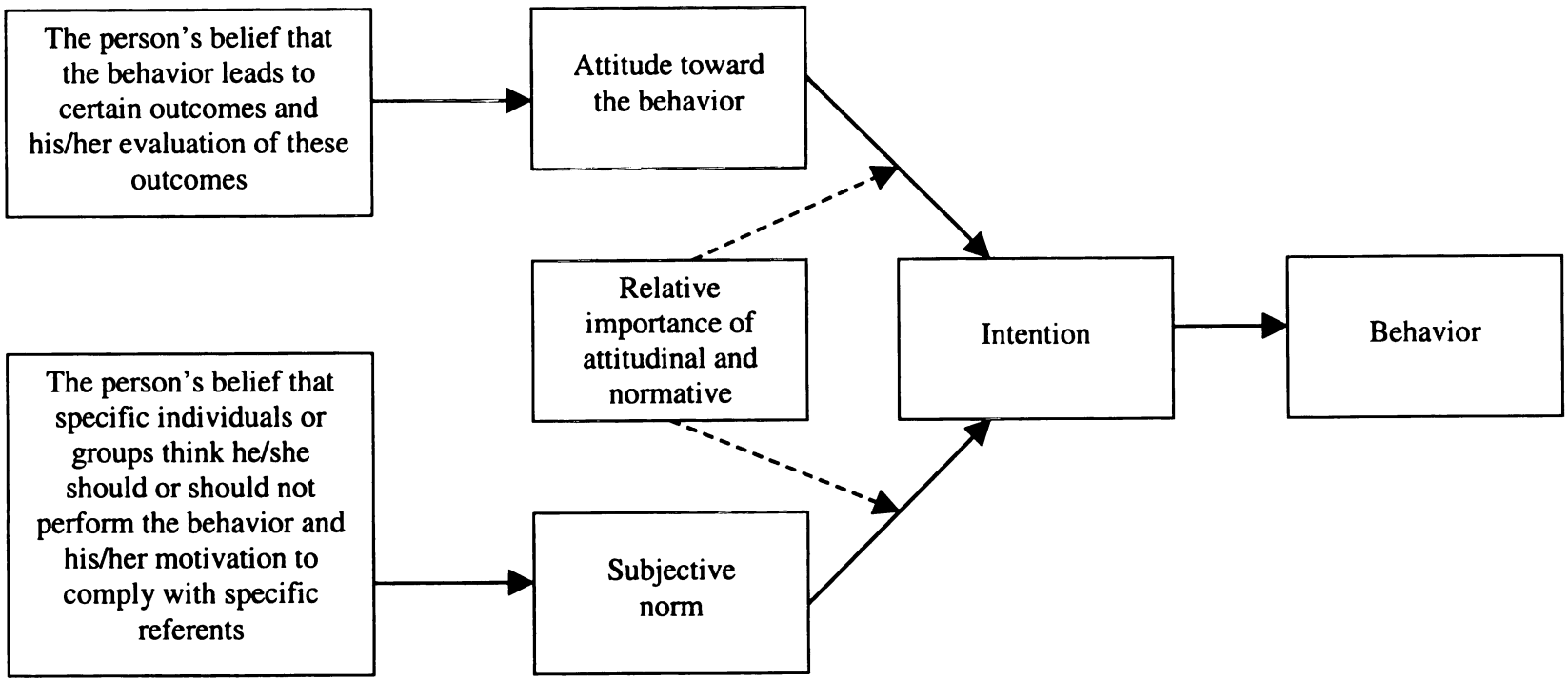
who felt more informed about watershed conservation issues were more inclined to adopt streamside buffer/filter strips, grassed waterways, and integrated crop management practices.

In addition to increasing farmers' level of feeling informed about watershed conservation issues, Extension agents and agricultural educators need to be able to convince agricultural producers that they are directly responsible for impaired water quality and environmental degradation. Before farmers will react to an environmental dilemma, research illustrates that many agricultural producers will need to be convinced that their farming practices are directly responsible for impairing water quality. Not only awareness of the existence of a problem, but also knowledge of appropriate strategies to address the predicament are essential for action to be taken (Hines et al., 1987). In addition, farmers are more likely to adopt BMPs if they believe that such practices will improve water quality (Feather & Amacher, 1994). Therefore, Extension must be effective in convincing farmers of the specific advantages and beneficial implications the implementation of BMPs will have for water quality.

Since BMP adoption depends on how informed respondents feel they are about watershed conservation issues (Napier et al, 1986; Lichtenberg & Zimmerman, 1999), and because a significant portion of farmers feel relatively uninformed about watershed conservation issues, it is important that Extension and agricultural educators determine the most effective and preferred means of informing agricultural landowners about watershed conservation issues and BMPs. Due to Michigan farmers expressing little preference for cutting edge technologies as a delivery method, and because "computer-based information has still not become a common method of participation in Extension

activities" (Suvedi et al., 1999, p. 41), Extension should be aware that the current strong emphasis in developing Internet-based watershed information may not achieve the desired informational delivery outcomes and that Extension should primarily rely on written communication strategies to inform agricultural landowners about watershed conservation issues and BMPs.

Figure 11: Theory of Reasoned Action (Ajzen and Fishbein, 1980)



Increasing Agricultural Landowners' Preference for the Internet as a Communication Strategy

In order to encourage agricultural landowners' use of the Internet as a communication strategy, Extension should see that farmers have adequate access to a computer. Furthermore, if farmers have Internet access in their home, business, or local library or school, they may be somewhat more likely to utilize the Internet to learn more about watershed conservation practices. However, Extension would be wise to keep in mind that at this point in time, farmers, regardless of whether or not they have access to the Internet do not generally prefer the Internet as a communication strategy. Extension should rely heavily on written materials to inform farmers about watershed conservation issues and BMPs until more farmers have convenient access to computers and modems.

Due to many farmers' hesitation to adopt or implement cutting-edge technologies such as the Internet and web sites as a delivery method, Extension and agricultural educators should develop programs and information that explain the use of the Internet, World Wide Web (WWW), on-line computer services, and other instructional technologies (Trede and Whitaker, 1998). Extension and educators should provide potential audiences with trouble-free and enjoyable opportunities to experience the Web since prior positive experience leads to increased willingness to try other Internet experiences (Trede and Whitaker, 1998). In addition, Extension professionals and educators need to promote the Internet and other innovative technologies in non-threatening, low-risk, easy-access settings in order to obtain better use of the site. Previous research efforts have discovered that computer instruction

should be included in future adult education programs (Bowen and Escolme, 1990). Because Extension's long-range and ultimate task is to influence its clientele through education and to use the results of scientific technology to improve their quality of live, Extension educators should organize seminars, institutes, and workshops to train limited-resource farmers in computer applications for agriculture (Findlay et al., 1993).

In order to promote farmers' use of the Internet as a communication strategy, Extension staff and agricultural educators must better understand Internet users and must be able to allow users to have an influence on the design of the web sites that are intended to benefit them. For example, inconsistency between site developers and rural users with respect to computerized hardware and software may impact the usefulness of web sites (Samson, 1998). Furthermore, even though technology has greatly simplified the construction of complicated web sites, the end user may not be able to successfully utilize the full, computerized capabilities of the sites, particularly in rural locations with limited connectivity capabilities (Samson, 1998).

According to focus group participants, an appealing website would: be user-friendly (easy navigation); include local photos and local contact phone numbers with updated area codes, maps with major water bodies for orientation; be informative and contain links to relevant information; contain historical information about the watershed; contain appropriate terminology; include a search engine; include an "under construction" notice when information is not available; include a print option for graphs; and should accommodate slow modems by limiting graphics or by making them optional (such as having a text only version of the web site). Unappealing

features of a web site are: wrapping text and other resolution issues; drifting menu bars; lack of specific information about topics such as best management practices, cost share information, and agriculture's contribution to water pollution; unnecessary scientific text; and links that do not connect to the intended web site.

# Chapter 6: Implications

## Implications for the Effectiveness of Watershed Conservation, Agricultural Education, and Extension

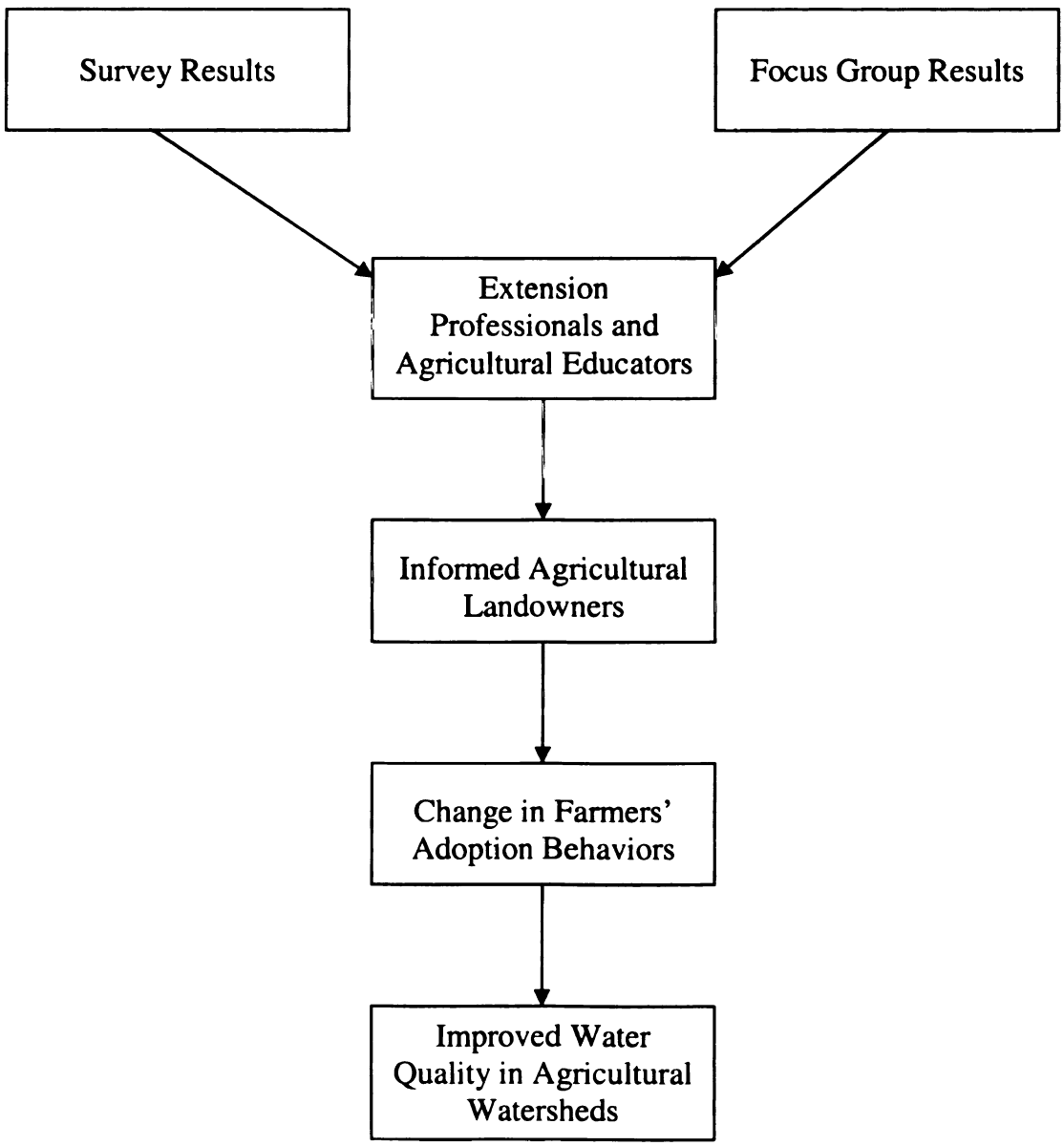
This study provides valuable information to Extension professionals and agricultural educators as it has established farmers' information preferences and how current extension practices (the use of the Internet to inform agricultural landowners about BMPs and watershed conservation issues) could be improved to meet the informational needs of agricultural producers. Once these informational needs have been met, agricultural landowners' adoption rate of conservation practices could improve resulting in improved water quality in agricultural watersheds.

These findings have the potential to benefit watershed conservation, agricultural educators, and extension professionals as they provide valuable information regarding factors that hinder Michigan agricultural landowners' adoption of BMPs and innovative farm technologies. Being aware of these factors, and addressing them accordingly, Extension and agricultural educators should be able to more effectively inform agricultural producers about watershed conservation practices and be better equipped to reach their goal of changing farmer behavior to improve water quality in agricultural watersheds (Figure 12).

Results from this study also have positive implications for future extension and education efforts as they will enable Extension professionals and agricultural educators to determine how they can more effectively educate rural landowners via the Internet and web sites. This is particularly valuable since there is an increasing desire among extension professionals and agricultural educators to inform farmers about BMPs and

watershed conservation issues via the Internet because this communication strategy is more time and cost effective than the more traditional methods of communication. Findings of this study also provide pertinent information that can aid in the development of an effective and well-designed web site to adequately meet the informational needs of Michigan's agricultural landowners.

Figure 12. How survey and focus group results ultimately result in improved water quality within agricultural watersheds.



**Implications for Water Quality in Agricultural Watersheds**

According to Lichtenberg and Zimmerman (1999), the effect of agricultural activities on water quality greatly depends upon the behavior of farm operators. Furthermore, Lewis (1996) claims that individual actions are essential when it comes to getting non-point source pollution under control. Therefore, because agricultural practices and farming operations can have significant adverse impacts on aquatic ecosystems, and because individual action is the means by which environmental improvements can be made, there is a need to educate agricultural landowners about watershed conservation issues and the importance of implementing conservation practices to lessen the adverse effects inherent to many farming practices.

Although behavior is influenced by a highly complex set of factors which are by no means well understood or consistent across different situations, farmers' adoption behavior (of BMPs and farm technologies) is partly shaped by attitudes towards the environment which are in turn influenced by knowledge and access to information. In addition, the Theory of Reasoned Action (Ajzen & Fishbein, 1980) would suggest that farmers' adoption behavior is primarily influenced by behavioral intentions which are consequently influenced by farmers' attitudes toward the behavior and subjective norms. According to these theories and ideas, water quality in agricultural watersheds may improve as agricultural landowners learn more about the existing water quality problems in their watershed, know appropriate solutions to these problems, and in response, increase their adoption of BMPs. According to Rhodes et al. (2002), it is clear that the likelihood of BMP and farm technology adoption is greater when farmers recognize there

is a problem, care about the problem, know appropriate strategies for addressing the problem, and can afford to implement these strategies.

Agriculture is currently the leading source of water pollution and a contributing factor to the impairment of 70% of streams considered impaired in the U.S., according to the 1996 National Water Quality Inventory (U.S. Environmental Protection Agency, 1996). As a result of this study, educational efforts to inform agricultural landowners about watershed conservation issues and conservation practices should improve and farmers' adoption of BMPs should increase resulting in improved water quality in agricultural watersheds. Because agricultural landowners are most likely to adopt integrated crop management, grassed waterways, and conservation tillage practices, and because more informed respondents are more likely to adopt streamside filter/buffer strips, grassed waterways, integrated crop management, and animal waste storage systems, water quality should improve. Specifically, there should be less impacts of sedimentation due to increased adoption of conservation tillage and grassed waterways. Water quality should also improve with decreased inputs of excess nutrients and pathogens resulting from farmers' adoption of animal waste storage systems and other conservation practices. Lastly, water quality should improve as fewer herbicides and pesticides enter waterways as a result of the adoption of integrated crop management and streamside filter or buffer strips.

As agricultural landowners' adoption rates of best management practices such as grassed waterways and buffer strips increase, sediment inputs into Michigan's streams and rivers should decrease. Reductions in sediment input from agriculture are important to stream biota because many macroinvertebrates and fishes require streambeds that are

relatively free from fine sediment (Waters & Hebel, 1982)). A reduction in sediment inputs in Michigan's streams will: decrease environmental problems associated with turbidity; increase the transmission of sunlight needed for photosynthesis; increase the success of organisms dependent on sight for foraging, mating, and escaping predators; reduce gill abrasion and digestion and respiration problems in fish species; increase dissolved oxygen concentrations; and encourage reproductive success for fish species spawning in gravel beds.

Increases in agricultural landowners' adoption rates of best management practices such as animal waste storage systems and streamside filter strips, nutrients and pathogens entering Michigan's waterways should be greatly reduced and ideally eliminated. An overabundance of nutrients such as nitrogen and phosphorus is another of the most serious problems facing the nation's lakes, rivers, estuaries, and streams (Lewis, 1999). One of the most devastating effects of excess nutrients on aquatic ecosystems is eutrophication. A reduction in the amount of nutrients and pathogens entering aquatic ecosystems will benefit water quality and improve aquatic habitat by: inhibiting the growth and overabundance of algae and other aquatic plants which deplete dissolved oxygen concentrations in the water when they die and decompose; encouraging the growth of underwater vegetation which provides food and nesting grounds for waterfowl, crustaceans, and fish; and reducing the abundance of microbes that can also drastically reduce dissolved oxygen concentrations which may eventually lead to the suffocation of fish, shellfish, and macroinvertebrate species.

In addition, as Michigan's agricultural landowners adopt conservation practices such as integrated crop management, the amount of herbicides and pesticides accidentally

entering Michigan's waterways should be diminished. Chemical compounds used on agricultural fields are easily washed into ground and surface waters by rainfall, melting snow, and irrigation flows (Lewis, 1996). By reducing the concentration of herbicides and pesticides entering Michigan's aquatic ecosystems, water quality and the health of aquatic organisms will be improved by: reducing the number of fish kills (and significant decreases in other species' populations) and improving the stability of the food chain; increasing reproduction rates of fish and bird species; decreasing organisms' vulnerability to other environmental stresses such as disease or predation; reducing the frequency of cancer rates, mutations, and fetal deformities in a variety of species; encouraging photosynthesis in aquatic plants; and decreasing the bioaccumulation of chemicals in organisms' tissues that would be biomagnified through the food chain.

Furthermore, as agricultural landowners adopt best management practices related to pasture management (such as livestock exclusion and stream crossings), the effects of temperature change on aquatic ecosystems should be reduced. Increased water temperatures caused by habitat modification (such as excessive cattle grazing and bank trampling) can be considered a pollutant to aquatic organisms as the cooling effects of natural shade are limited or removed (Lewis, 1996). By encouraging the growth of plants along streams and riverbanks, water quality and habitat will be improved by encouraging the spawning of temperature sensitive fish species and by providing shaded rested structures that are necessary for the reproduction of many aerial adult aquatic insect species.

**Future Research Needs**

Much research needs to be conducted in the social sciences/human dimensions before we can expect to adequately understand Michigan agricultural landowners' attitudes towards the water quality in their watershed, their knowledge about watershed conservation issues, and their adoption of BMPs. Of all the efforts that could be made to improve water quality in agricultural watersheds, I recommend: (1) obtaining a better understanding of agricultural landowners' attitudes towards water quality, knowledge about watershed conservation issues and BMPs, and adoption behaviors of conservation practices by performing higher order statistical analysis via multivariate statistics and multiple regression; (2) determining how agricultural landowners' perceptions and knowledge change over time as a result of conservation efforts by repeating this study in its entirety in two or three years; and (3) helping farmers' to overcome apprehensions they may have about technology and encouraging farmers' use of the Internet as a communication strategy to learn about BMPs and watershed conservation issues by offering internet training workshops to agricultural landowners.

First of all, there is a need for similar studies to be conducted in different regions throughout the state of Michigan (as well as other regions of the world) in order to obtain more information about farmers' information needs, attitudes, and behaviors. The results obtained from different regions in Michigan can then be compared with the results of this study to determine similarities and differences that may exist among different watershed conservation programs throughout the state. Doing so will enable researchers to gain a better understanding of how region of residence, culture, climate, etc. may impact farmers' information needs, attitudes, and behaviors and how Extension and other

agricultural educators can even more effectively meet the specific needs of their unique clientele. Statistical analysis using multiple regression would also be valuable as this analysis could determine: which demographic characteristics have a greater effect on respondents' concern for watershed conservation issues, which demographic characteristics have a greater effect on respondents' level of feeling informed about watershed conservation issues, whether satisfaction with water quality, level of concern for water quality issues, or level of feeling informed about watershed conservation issues has a greater effect on BMP adoption, or which demographic characteristics have the greatest effect on agricultural landowners' preference for the Internet.

In addition, interesting information would be gained from a longitudinal study where attitudes toward water quality and knowledge about watershed conservation issues were measured over time. By doing so, researchers could obtain a better understanding of the effectiveness of extension and education efforts in the targeted watersheds over a given period of time. For example, by measuring how informed farmers were about watershed conservation issues and how satisfied they were with the water quality in their watershed before conservation efforts were made within the watershed, one could re-measure the level of knowledge and satisfaction a number of years after a conservation program was implemented to determine how extension and education efforts had positively impacted farmers' level of knowledge about conservation issues or how much the water quality has seemed to improve as a result of the watershed conservation project.

Additional research is also necessary to further encourage farmers' use of web sites as a communication strategy to learn more about water quality and watershed conservation issues. While the Internet has the potential to provide more effective

information exchange, the specific effectiveness of the Internet and web sites without any formal training remains undetermined. Considerable amounts of research exist that support the use of computers and the Internet as extension communication tools; however, there is a need to determine the actual effectiveness of web sites if training sessions are not offered to help guide participants through the program. According to Carr (1999), in addition to the advocacy needed to ensure that technologies will be adopted, training in its technical aspects and application to real needs is crucial to its integration beyond the innovators and early adopters.

Furthermore, a need exists for Extension professionals and agricultural educators to help agricultural landowners overcome any reservations and misconceptions they may have about using the Internet as a communication strategy to learn about watershed conservation issues and BMPs. According to Carr (1999), if technology is perceived as difficult to learn, too time consuming to use, or is in some way perceived as threatening, it probably will not be used. Therefore, in addition to providing training sessions to introduce farmers to the benefits of using the Internet as a communication strategy, extension and other agricultural educators must specifically address reasons why farmers are hesitant to utilize the Internet as a communication strategy on an individual needs basis. This is particularly important as there is a strong desire among extension specialists to provide data via web sites as they prove to be more time and cost efficient than more conventional forms of communications (i.e., newsletters and brochures).

**Thesis Summary**

Of all the results presented in this study, there are a few important points that need to be emphasized. First of all, the impaired condition of many of Michigan's agricultural watersheds is a legitimate ecological concern. As an effort to improve water quality within agricultural watersheds, one must emphasize the importance of improving agricultural landowners' BMP adoption rates. One means of increasing BMP adoption rates, is to offer incentives to implement conservation practices. More importantly, however, is to effectively educate and communicate with agricultural landowners about water quality, watershed conservation issues, and the conservation practices that can be implemented to address these ecological issues.

To improve agricultural landowners' BMP adoption rates, one must first be willing to provide incentives such as financial assistance, information, training, assistance with the implementation of conservation practices, and one must be able to convince farmers that the implementation of conservation practices will result in improved water quality and a healthier and more sustainable environment. In addition, adoption rates of specific conservation practices can be improved by increasing agricultural landowners' knowledge and attitudes about water quality, watershed conservation issues, and best management practices. For instance, this study reveals that adoption rates of specific BMPs increased as respondents' satisfaction with the water quality in their watershed, and level of feeling informed about watershed conservation issues increased. Therefore, to encourage the adoption of BMPs, one should effectively inform landowners about watershed conservation issues which may also result in increased satisfaction with the water quality in their watershed. Another strategy may be focus efforts on informing

agricultural landowners about issues that they are less likely to be concerned about (i.e., reduced fish habitat and algae growth).

In addition to offering incentives and increasing agricultural landowners' knowledge about water quality and watershed conservation issues, one can improve BMP adoption by improving communication and educational efforts with farmers. The most effective way to do this is to determine farmers' preferred method of learning about watershed conservation issues and BMPs. Overall, respondents from this study had a strong preference for more traditional communication strategies such as newsletters and bulletins. Therefore, by using newsletters and bulletins to inform agricultural landowners about watershed conservation issues and BMPs, one should increase the likelihood that farmers will receive information in an appropriate and meaningful manner and that farmers' knowledge about watershed conservation issues and conservation practices will actually increase.

Although respondents from this study did not illustrate a considerable preference for the Internet as a communication strategy, rural educators are cautioned not to eliminate the Internet as an option to communicate with agricultural landowners. Results from previous studies (Bowen & Escolme, 1990; and Suvedi et al., 1999) indicate that the Internet will likely be a more preferred communication strategy in the future. And since the Internet can be a very time and cost effective method of communicating with agricultural landowners, its use is encouraged. Results from this study indicate that respondents' age, level of education, and gross annual income level have a significant effect on respondents' preference for the Internet as a communication strategy. Therefore, if one's targeted audience is composed primarily or exclusively of younger

agricultural landowners and/or landowners with higher levels or education, the use of the Internet to teach farmers about water quality issues and conservation practices is to be encouraged.

However, this recommendation is made with some reservation. An agricultural educator should rely on the Internet as a communication strategy only if their web site specifically caters to the personal preferences and information needs of the targeted audience. Furthermore, it may be necessary and at least beneficial to provide agricultural landowners with training sessions to convince farmers of the benefit of using the Internet (quick, convenient access to substantial amounts of relevant information) and to help landowners overcome any fears or apprehensions they may have about using such a technological communication strategy to obtain information about watershed conservation issues and BMPs. Lastly, since getting the information to the farmers is ultimately more important than providing information in a time and cost efficient manner, one must be willing to provide more traditional methods of communication (such as newsletters and bulletins) to accommodate the informational needs and preferences of agricultural landowners who either aren't capable or prepared to implement such technological innovations or those individuals who are simply left behind in the technological revolution.

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# Appendix A

Cover letter and survey instrument.

Greetings,

There is a need for watershed conservation programs to acknowledge the unique input, knowledge and diverse views of private agricultural landowners. The goal of this survey is to determine the informational needs of landowners. The benefit of such a survey is to provide information to develop extension and outreach programs that better meet the needs of private agricultural landowners. Funds for this project originate from the U.S. Department of Agriculture Cooperative States Research Education and Extension Service.

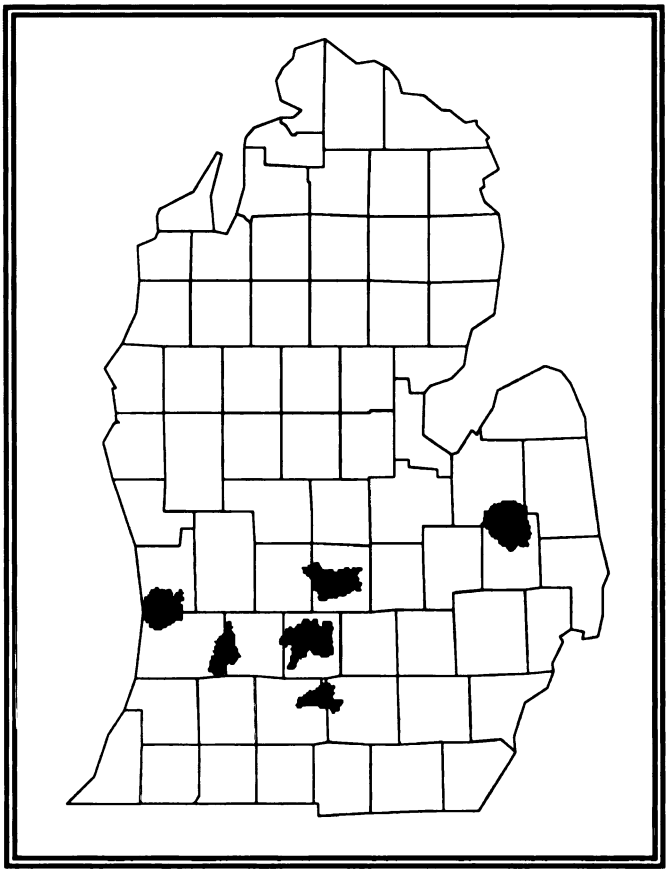
Your household had been selected at random for a survey of agricultural landowners in six watersheds (Gun River, Lake Macatawa, North Branch Flint River, Rice Creek, Stony Creek, and the Upper Thornapple). Survey results will be used to provide a review of landowner information needs regarding watershed conservation. Please take the time to fill out the survey and return it in the postage-paid envelope provided. Please respond to all of the questions to the best of your knowledge. The results will be most useful if all landowners express their thoughts. Remember that there are no right or wrong answers. The survey should take approximately 30 minutes to complete.

Please realize that all individual responses are voluntary and confidential and your privacy will be protected to the maximum extent allowable by law. You indicate your voluntary agreement to participate by completing and returning this questionnaire. Only I and our staff will see the completed surveys and your name will not appear on the completed survey form. The number printed on the survey is to help track the percentage of surveys that have been completed. I will only report the summaries as a group and not by individual. Summaries of the completed study will be available to all interested participants. In addition I will personally present the research findings to a local gathering at the conclusion of the study. I appreciate your time, effort and opinions. If you have any questions please contact me or your local representative of any of the organizations that have reviewed the survey. If you have questions regarding your role and rights as a subject of research, you may contact David E. Wright, Ph.D. Chair, University Committee on Research Involving Human Subjects
(517) 355-2180.

Sincerely,

Geoffrey Habron
Department of Fisheries and Wildlife and Sociology
Michigan State University
13 Natural Resources Building
East Lansing, MI 48824
517-432-8086

# *Landowner Watershed Information Needs*



**A Survey of Landowners in Vital Michigan Watersheds**

Conducted by the
Office for Survey Research,
Institute for Public Policy and Social Research,
Michigan State University,
321 Berkey Hall,
East Lansing, MI 48824

Should you have any questions about this survey, please contact:
Professor Geoffrey Habron, Department of Fisheries and Wildlife,
at 517- 432-8086 or at habrong@msu.edu

***All your answers will be kept strictly confidential. You indicate your voluntary consent to participate in this survey by answering and returning the questionnaire.***

## PART A. General Information

1. Please circle the number of the one phrase that best describes the kind of streams or drains that are on your property:

   The stream/drain flows all year ..... 1
   The stream/drain flows occasionally ..... 2
   I have no stream or drain on my property ..... 3

2. Does any stream on your property have a strip of grass, bushes, or trees along it?

   Yes ..... 1
   No ..... 2
   No stream or drain on property ..... 3

3. Please rate by importance to you the issues listed below that have been identified by some residents and landowners as current concerns with the water quality in the watershed.

| | **Extremely Important** | | | | **Not Important** |
|---|---|---|---|---|---|
| a) Soil erosion into streams and drains ..... | 1 | 2 | 3 | 4 | 5 |
| b) Flooding ..... | 1 | 2 | 3 | 4 | 5 |
| c) Reduced fish habitat ..... | 1 | 2 | 3 | 4 | 5 |
| d) Algae growth ..... | 1 | 2 | 3 | 4 | 5 |
| e) Bacterial contamination ..... | 1 | 2 | 3 | 4 | 5 |
| f) Excess phosphorous ..... | 1 | 2 | 3 | 4 | 5 |
| g) Excess nitrogen ..... | 1 | 2 | 3 | 4 | 5 |
| h) Other (_____) ..... | 1 | 2 | 3 | 4 | 5 |

4. Over the past ten years, has the water quality in the watershed. . .

   Become Worse ..... 1

   Stayed the Same ..... 2

   Become Better ..... 3

   Do Not Know ..... 7

5. Please, rank order the ten possible sources below in terms of how much pollution they each contribute to the overall pollution of waters in the watershed. Give a rank of 1 to the source of the greatest amount of pollution, a rank of 2 to the source of the next greatest, etc., and a rank of 10 to the source of the least amount of pollution.

*Write in the Rank*

_____ Municipal sewage from cities and towns

_____ Faulty septic systems

_____ Rural road runoff

_____ Storm drain runoff from paved surfaces

_____ Agricultural runoff from fields

_____ Soil erosion from farmlands

_____ Old dump sites

_____ Construction site runoff

_____ Industrial discharges

_____ Oil and gas well sites

_____ Other (*please specify*) _____

6. The following questions address the importance of watershed issues **to you** and how satisfied, informed, and knowledgeable you are about watershed issues. Please indicate how strongly you feel about each question by circling one of the following responses for each question:

E=Extremely V=Very M=Moderately S=Slightly N=Not at all

a. How satisfied are you with the water quality in your watershed? ..... E V M S N

b. How informed do you feel you are regarding watershed conservation issues in your watershed? ..... E V M S N

c. How important to you are watershed conservation issues?... E V M S N

d. How knowledgeable would you say you are about MSU Extension?..... E V M S N

7. The Michigan Department of Agriculture defines a farm as "any establishment from which $1,000 or more of agricultural products were sold or would normally be sold during the year, or property which includes 5 or more horses." **Based on this definition**, do **you** live on a farm?

Yes..... 1 ➡ ***(Proceed to Section B)***

No ..... 2 ➡ ***(Skip to Section E)***

## PART B. Watershed Conservation Practices

***The following questions focus on watershed conservation practices.***

8. For each of the practices listed below, select the one response that best describes your experience with the practice. If you have tried the practice indicate the year you first tried it. Regardless of your experience, please feel free to provide comments regarding the practice.

1 = NO I Have not heard of the practice.
2 = YES I Have heard of the practice.
3 = YES I Have heard of the practice and would like to try it.
4 = I Have tried the practice.

| PRACTICE | No, Haven't Heard | Yes, Have Heard | Heard/ Would Try | Yes, Have Tried | Year First Tried |
|---|---|---|---|---|---|
| a. Streamside filter or buffer strips . . . | 1 | 2 | 3 | 4 | _____ |
| b. Conservation tillage . . . . . | 1 | 2 | 3 | 4 | _____ |
| c. Manure management plan . . . . . | 1 | 2 | 3 | 4 | _____ |
| d. Grassed waterways . . . . . | 1 | 2 | 3 | 4 | _____ |
| e. Pasture management (livestock exclusion and stream crossings) . . | 1 | 2 | 3 | 4 | _____ |
| f. Integrated crop management (crop scouting, pest and fertilizer mgt.) . | 1 | 2 | 3 | 4 | _____ |
| g. Animal waste storage system . . . . | 1 | 2 | 3 | 4 | _____ |
| h. Wildlife habitat management or wetland restoration . . . . . | 1 | 2 | 3 | 4 | _____ |
| i. Structures for erosion or water control . . . . . | 1 | 2 | 3 | 4 | _____ |

Comments:

_____

_____

_____

9. Of the following management practices, about which ones would you like more information? *(check all that apply)*

- ❑ Conservation tillage, crop residue management
- ❑ Grassed waterway
- ❑ Filter strips (managed streamside vegetation)
- ❑ Pasture management (livestock exclusion and stream crossings)
- ❑ Integrated crop management (crop scouting, pest and fertilizer mgt.)
- ❑ Animal waste storage system
- ❑ Wildlife habitat management/wetland restoration
- ❑ Structures for erosion or water control
- ❑ Manure management plan

10. Please circle the appropriate number to indicate whether or not each of the following factors
does or does not prevent or hinder you from implementing watershed conservation practices?

| | Yes, Does | No, Does Not |
|---|---|---|
| Soils, topography, or flooding | 1 | 2 |
| Long or confusing applications and permits | 1 | 2 |
| Lack of funds | 1 | 2 |
| Lack of information | 1 | 2 |
| Lack of agency flexibility | 1 | 2 |
| Worried about getting fined | 1 | 2 |
| Other (please specify) _____ | 1 | 2 |

11. What is the best incentive that would help you implement conservation practices?

_____

12. In **the last year**, how many times, if any, have you sought advice from any organization or agency (extension, conservation district, livestock or woodland association, state agencies)?

| _____ Times |
|---|

(*Write in the Number of Times Last Year*)

## PART C. Farming Activities

***The following information about you and your agricultural operation is strictly confidential. The information will help determine the concerns of different types of landowners.***

13. Do you consider yourself a full time farmer?

Yes ..... 1
No ..... 2

14. Please circle the number corresponding to the category which best represents your farm operation.

Cultivated crops ..... 1
Pastured livestock ..... 2
Hayland ..... 3
Confined livestock/poultry ..... 4
Other _____ ..... 7

15. Do any of the following family members help manage your farm/forest property?

| | Yes | No |
|---|---|---|
| Children ..... | 1 | 2 |
| Grandchildren ..... | 1 | 2 |
| Spouse ..... | 1 | 2 |
| Parents ..... | 1 | 2 |
| Other _____ ..... | 1 | 2 |

16. What are the total acres of tillable ground that you operate (owned and rented)?

_____ Owned Acres

_____ Rented Acres

17. What percent of your total crops are planted no-till?

| _____% |
|---|

(*Write in the Percentage)*

18. How frequently do you have the soil on your property tested?

Every 3 years or more frequently ..... 1

Every 4-6 years ..... 2

More than 6 years ..... 3

Never ..... 4

19. How much starter fertilizer do you typically purchase for your entire cropping operation?

_____ Tons (*Please Specify What Analysis?* _____)

20. How often do you fertilize your crops?

Regularly, on some type of schedule ..... 1

Occasionally, or only when needed ..... 2

Never ..... 3

21. Is your field drained by a subsurface tile system?

Yes ..... 1

No ..... 2

Do Not Know ..... 3

22. Do you apply manure on your fields?

Yes.....1 ➡ ***(Proceed to Question 23)***

No.....2 ➡ ***(Skip to Question 25)***

| 23. Please indicate how frequently you do each of the following by putting a check in the appropriate space to the right. | Often | Sometimes | Rarely | Never | Not Applicable |
|---|---|---|---|---|---|
| a. I use cover crops | | | | | |
| b. I keep written records of manure applications (field/amount) | | | | | |
| c. I mostly spread manure on the same fields each year | | | | | |
| d. I try to spread manure on the same field no more than every 2-4 years | | | | | |
| e. I use book values of manure to plan land application rates | | | | | |
| f. I use manure tests to determine manure application rates | | | | | |
| g. I use nitrate soil tests, taken at sidedress, to determine nitrogen fertilizer rates | | | | | |
| h. I use soil tests to determine on which fields to spread manure | | | | | |
| i. I reduce my starter fertilizer, specifically phosphorus rates, on manured ground | | | | | |
| j. I have received complaint(s) from our neighbors regarding manure handling and/or odor | | | | | |
| k. I use buffer strips or observe a safe distance from surface water when spreading manure | | | | | |
| l. I have an agronomist or fertilizer dealer make our fertilizer recommendations and they take credit for our manure nutrients | | | | | |
| m. If you have alfalfa, do you spread manure on hay/haylage fields | | | | | |

24. Has your livestock manure been analyzed for nutrients (N-P-K) in the last 5 years?

Yes.....1

No.....2

## PART D. Information Sources and Needs

***The following questions focus on your information needs and preferences.***

25. Where do you get information about environmental and land use issues for this area? (*check all that apply*)

- ❑ Newspapers (*specify*) _____
- ❑ Agency or organization newsletters (*specify*) _____
- ❑ Friends or relatives
- ❑ Radio or TV
- ❑ Internet
- ❑ Other (*specify*)_____

26. If any, please indicate through which of the following you currently have access to an Internet-ready computer (*check all that apply*):

- ❑ Home
- ❑ Business
- ❑ Library
- ❑ School
- ❑ Friend
- ❑ Relative
- ❑ Other
- ❑ None

27. How often do you use the Internet for management decisions?

Frequently..... 1
Occasionally..... 2
Rarely..... 3
Never..... 4

28. We would like to learn how and where you receive information and which of these sources are important to you. Please check the space that shows how much you use information from each of the following sources?

| | None | A Little | Some | A Fair Bit | A Lot |
|---|---|---|---|---|---|
| a. Print Information (newspaper, magazines) | | | | | |
| b. Electronic Information (television, computer, radio) | | | | | |
| c. Organizational Events (field days, farm tours) | | | | | |
| d. Personal Sources (friends, family, extension) | | | | | |

29. Which of the following educational methods would you prefer to use for learning more about watershed conservation? *(Check all that apply)*

- ❑ Farm meeting/workshop
- ❑ Field Day/Demonstration tours
- ❑ Printed bulletin or fact sheet
- ❑ Newsletter or mailer
- ❑ Video tape
- ❑ Electronic mail
- ❑ Computer software package
- ❑ World Wide web page
- ❑ Mass media (newspaper, radio or television)
- ❑ Visit to resource office (extension, conservation district)
- ❑ Personal visit to your home from resource person
- ❑ Visit university

## PART E. Background Questions

***The following questions seek information that will help us interpret the answers you provided previously. As with the entire questionnaire, all responses will be kept confidential.***

30. What is your age? ..... _____ Years Old

31. Are you . . .

Male .....1
Female.....2

32. What is your highest level of education? (*Circle Only One*)

Grade school .....1
Some high school.....2
High school graduate .....3
Vocational or trade school .....4
Some college or junior college .....5
College graduate .....6
Post graduate work or degree.....7

33. Please check the range of your household income.

$15,000-25,000 .....1
$25,001-35,000 .....2
$35,001-50,000 .....3
$50,001-75,000 .....4
Greater Than $75,000 .....5

34. What advice, if any, would you give to agencies or organizations regarding watershed conservation programs?

_____

_____

_____

_____

35. Would you like a copy of the results of this survey?

Yes .....1
No.....2

***Thank you! You have now finished the survey.***

***Please place it in the stamped, return envelope and mail it as soon as possible.***
***We greatly appreciate your help.***

# Appendix B

Consent forms, background information sheet and script for focus group round-table discussion.

MICHIGAN STATE
UNIVERSITY

March 9, 2001

TO: Geoffry HABRON
13 Natural Resources

RE: **IRB# 00-576** CATEGORY: EXEMPT 1-C, 1-D, 1-E
**APPROVAL DATE: March 6, 2001**

TITLE: INFORMATION EXCHANGE, CITIZEN WATER MONITORING AND AGRICULTURAL BEST MANAGEMENT PRACTICES

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete and I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the **UCRIHS approved this project.**

**RENEWALS:** UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Projects continuing beyond one year must be renewed with the green renewal form. A maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for a complete review.
**REVISIONS:** UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB# and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.
**PROBLEMS/CHANGES:** Should either of the following arise during the course of the work, notify UCRIHS promptly: 1) problems (unexpected side effects, complaints, etc.) involving human subjects or 2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of further assistance, please contact us at (517) 355-2180 or via email: UCRIHS@msu.edu. Please note that all UCRIHS forms are located on the web: http://www.msu.edu/user/ucrihs

Sincerely,

Ashir Kumar, M.D.
Interim Chair, UCRIHS

AK: rj
cc:

OFFICE OF
**RESEARCH AND GRADUATE STUDIES**
**University Committee on Research Involving Human Subjects**
Michigan State University
246 Administration Building
East Lansing, Michigan
48824-1046
517/355-2180
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Web: www.msu.edu/user/ucrihs
E-Mail: ucrihs@msu.edu

**Michigan State University**

**Documented Informed Consent for a Focus Group**

There is a need for extension programs through Michigan State University Extension to acknowledge the unique input, knowledge and diverse views of residents living in agricultural watersheds. The goal of this study by Dr. Geoffrey Habron is to determine the informational impact of watershed websites. The benefit of such a study is to provide information to develop extension and outreach programs that better meet the needs of watershed residents. Funds for this project originate from the U.S. Department of Agriculture Cooperative States Research Education and Extension Service for programming in the Lake Macatawa (Allegan/Ottawa counties), Kalamazoo and Stony Creek (Clinton County) watersheds.

This study will include a hands-on computer session where you will explore a website that we have designed. We will collect data on which parts of the website were used the most and in which order. We will also ask you to complete a short form indicating how well the website helped you to answer questions about your watershed. After the computer session we will have a focus group interview that will last approximately 90 minutes. The interview will be audio taped to assist in correcting the interviewer's notes. The audiotape may be used for research, teaching and professional presentations. You may be assured that your response will remain completely confidential, as references to your identity will be deleted from any reports or transcriptions. Your privacy will be protected to the maximum extent allowable by law. Participation is voluntary and you may choose not to participate at all, refuse to answer certain questions or withdraw from the study at any time without repercussions.

If you have any concerns about your rights as a research subject you may contact Ashir Kumar at Michigan State University's office of Research and Graduate Studies at (517) 355-2180 (phone); 517-353-2976 (fax); ucrihs@msu.edu (e-mail). Additionally, if you have questions concerning the study please contact Geoffrey Habron at 517-432-8086 (phone); habrong@msu.edu (e-mail).

By signing this form, you are acknowledging your voluntary participation in today's focus group and granting your permission to be tape-recorded to ensure an accurate record of the discussion.

_____ _____

(Print Name) (Sign Name)

_____ _____

(Signature of principal investigator or authorized representative) (Date)

**Extension Consent Form (Demonstration tours, field workshops)**

Greetings,

There is a need for extension programs through Michigan State University Extension to acknowledge the unique input, knowledge and diverse views of residents living in agricultural watersheds. The goal of this study by Dr. Geoffrey Habron is to determine the informational impact of watershed websites. The benefit of such a study is to provide information to develop extension and outreach programs that better meet the needs of watershed residents. Funds for this project originate from the U.S. Department of Agriculture Cooperative States Research Education and Extension Service for programming in the Lake Macatawa (Allegan/Ottawa counties), Kalamazoo and Stony Creek (Clinton County) watersheds.

Please take the time to dill out the survey and return it today. Please respond to all of the questions to the ledge. The results will be most useful in all landowners express their thoughts. Remember that there are no right or wrong answers. The survey should take approximately 10 minutes to complete.

Please realize that all individual responses are voluntary and confidential and your privacy will be protected to the maximum extent allowable by law. You indicate your voluntary agreement to participate by completing and returning this questionnaire. Only I and our staff will see the completed surveys and your name will not appear on the completed survey form. I will only report the summaries as a group and not by individual. Summaries of the completed study will be available to all interested participants. In addition I will personally present the research findings to a local gathering at the conclusion of the study. I appreciate your rime, effort and opinions. If you have any questions please contact me or your local representative of any of the organizations that you have reviewed the study. If you have any concerns about your rights as a research subject you may contact Ashir Kumar at Michigan State University's office of Research and Graduate Studies at (517) 355-2180 (phone); 517-353-2976 (fax); ucrihs@msu.edu (e-mail).

Sincerely,

Geoffrey Habron
Department of Fisheries and Wildlife and Sociology
Michigan State University
13 Natural Resources Building
East Lansing, MI 48824
517-432-8086

**Background Information Sheet for Focus Group Participants**

1. If any, please indicate through which of the following you currently have access to an Internet-ready computer (*circle all that apply*).

| | |
|---|---|
| Home | Friend |
| Business | Relative |
| Library | Other |
| School | None |

2. What type of Internet access do you most often have?

| | |
|---|---|
| Ethernet | Do not know |
| Cable | None |
| 56K Modem | |

3. How often do you use the Internet for management decisions?

| | |
|---|---|
| Frequently | Rarely |
| Occasionally | Never |

4. What best describes how frequently you use the Internet?

| | |
|---|---|
| Once a day | Once every few months |
| Once a week | Not at all |
| Once a month | |

5. What is your age? _____ years old

6. Are you....?

| | |
|---|---|
| Male | Female |

*Over please*

7. What is your highest level of education?

| | |
|---|---|
| Grade school | Some college or junior college |
| Some high school | College graduate |
| High school graduate | Post graduate work or degree |
| Vocational or trade school | |

8. Please indicate your level of active farming:

Full-time Part-time None

9. Please list 3 questions you would like to answer from the project website

10. After our session has ended, please list the answers to any of the 3 questions that you were able to find on the website.

## Script/Questions for Focus Group Participants

Why did you decide to participate in this focus group session?

What is your prior experience with websites?

Overall, how satisfied were you with the website?

Was it difficult for you to find what you were looking for?

Were there terms used in the website that did not make sense to you?

Are there other topics, concepts, or general information that was not included in the web site that would have been useful to you?

Was the website layout confusing/frustrating?

Were graphics and charts helpful or distracting?

Did you use the graphics or the text version of the website first?

Were you able to easily retrieve target information?

What path did you take (by watershed, by county, or by issues)?

How was your overall experience using the website?

What do you specifically like/dislike about the website?

Do you anticipate that you will rely on the Internet to retrieve information about water quality in the future?

What suggestions would you make for improvements?