

Assessing Extension Program Impact: Case Study of a Water Quality Program

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Abstract

Over a five year period, Montana State University conducted a voluntary, Montana based, private well water test program to educate the public on water quality issues, as well as improve the decision-making skills of private well owners. The program provided an array of water quality resources including instructional videos, written instructions, sample collection and submission, and an impact assessment questionnaire. Data collected from the program were based on the following outcomes: comprehension of test results; changes in land use practices to improve water quality; purchase of point-of-use treatment systems; level of improved ability to make decisions about water quality; and overall assessment of the program. Assessments of various delivery mechanisms within the program concluded that extension faculty could improve the effectiveness of future distant delivery education by, 1) targeting specific educational resources, 2) specifying audiences by need, 3) structuring to the educational level of audiences, and 4) providing information that has immediate utility to the program.

The invaluable information MSU Extension WQ Program gained from the well test program has not only guided them in BEPs for the past ten years, but will be the basis for design and implementation of a sister program being conducted in 2004 and 2005. The revitalization of the well water test program will address the evolving water quality needs of Montana private well owners, help MSU WQ specialists continue to effectively serve the water quality educational needs of Montanans, and provide BEPs that can be shared as a regional resource in water quality education.

Background

Montana's historic economy was built around agriculture and natural resource extraction such as gold silver, copper, petroleum, coal, and timber. Alongside tourism, agriculture has remained Montana's primary industry. However, since the end of World War II many Montana farming and ranching operations have been depleted due to a declining workforce, adverse international markets, and climatic changes hindering growth and harvest vigor.

Due to the decline in factors that sustain productive agriculture operations, many producers are selling large amounts of acreages to developers who then subdivide the land in to smaller plots. Transitioning societies and the dominance of the "bedroom community" phenomenon in the western United States have put excess pressure on the water quality and quantity of this region due to the number of private wells installed on small acreages. Likewise, most development occurs either on or adjacent to agricultural lands, emphasizing the importance of monitoring water resources in these areas. The population increase and development process will likely be a fixture in many states for some time and education pertaining to private water resource protection and management will be a necessity to preserve the integrity of the resource.

In Montana records are available for over 65,000 domestic wells, representing approximately one well for almost every 12 Montana inhabitants. Water quality is a focus of research, public education, and curriculum development throughout the USA, especially as it relates to non point source pollution. Educational resources for private well owners on water quality issues and monitoring procedures is essential to protecting water resources at the wellhead.

An extension-sponsored private well water test program was initiated in January 1989 in cooperation with Montana State University (MSU), the Montana Department of Health and Environmental Sciences (DHES), and several agricultural organizations. The program was prompted by the 1988 "Well Aware" program conducted by the Future Farmers of America (FFA) with Successful farming magazine (Freese, 1988).

At the time of the initial MSU program, use of private well water quality test programs were reported, but not for general education. The scarcity of water quality educational resources in the public sector underscores the need for innovative approaches to collecting water quality data. The objectives of the 1989 MSU study were to assess the impacts of an extension-sponsored private well water test program on participant behavior and learning characteristics, and to gather information about preferred learning methods of a diverse, targeted extension audience. Additionally, the program wanted to offer an inexpensive, non threatening well testing service to provide educational resources to rural and urban private well water users in Montana, as well as educate private well water users about groundwater quality issues specific to agricultural area of Montana.

In the spring of 2004, MSU revitalized this program in efforts to establish an annual well water test program for private well owners in Montana so that they would be empowered to monitor, assess, and treat the quality of their drinking water. The current well water test program capitalizes on the outcomes and finding of the original pilot as well as on recent, similar focused educational methods for water quality education as it relates to small acreages and private well owners. The emphasis of this article is to summarize the results of the original 1989 educational program and program impact assessment, as well as the modifications and design of the more recent sister-program. Specific details of the educational impacts, well water sampling, geographic distribution of 3342 private wells sampled and tested, testing procedures, and summaries of well tests results have been reported previously, (Bauder, 1993; Bauder et al., 1991).

Methods and Materials

With the 1989 program samples were submitted on a voluntary basis from 53 of the 56 Montana counties and were tested for coliform bacteria, pH, total dissolved solids (TDS) concentration, Na^+ concentration, and NO_3^- - N concentration. The program was not designed or intended to obtain a random sample of wells throughout Montana (Bauder, 1990). The testing service was offered to private well water users through county extension offices, conservation districts, and Farm Bureau offices. The service was part of a multi-phase, multi-media distant delivery program consisting of the following steps.

1. An educational video on water quality issues and another on sample submission procedures were developed and provided to participants.
2. Sampling and testing periods were selected for the spring and fall of 1989 and 1990. A press release containing program details was provided to each county office to modify for publicity.
3. A 12 part fact sheet series dealing with specific issues of water quality was developed and distributed to each county extension office and printed in a state-wide agricultural magazine each month for the first year of the program.
4. The DHES conducted all coliform tests and reported all results directly to participants; all other analyses were completed by an analytical laboratory at MSU and reported directly to participants by the extension service. A statement of significance of test results, interpretation, and recommendations for action was mailed with test results to each participant.
5. Summaries of test participation and results were prepared for each county for each sampling period and for total participation in all four year testing periods.
6. A seminar series was developed and delivered to counties where high NO_3^- - N concentrations were detected. The seminar series, addressing health issues, water quality policy, NO_3^- - N contamination, well disinfection, and point-of-use treatment, was advertised locally and presents approximately 3 months after the final testing period.
7. Approximately one year after the test results and recommendations had been mailed; a questionnaire was mailed to each participant to assess program impact. The questionnaire consisted of 6 sections: (i) participant background, (ii) test results, (iii) participant opinions, (iv) recharge area land use characteristics, (v) program value impact, and (vi) participant demographics.

8. Questionnaire responses of each test period were summarized and mailed to each participant.

Results and Discussion

The following summarizes well owner interest in testing, perceived value if the well test program, views on sources of contamination, and water quality action taken. Return rate for the follow-up impact assessment questionnaire averaged 44%. Reports were analyzed for an entire sample and also separated by geographic location, farm vs. non farm, and level of education, where appropriate.

Geographically, the database was sorted into subsets consisting of well owners residing in three primary regions of Montana: 1) forested, intermountain areas of central and western Montana, 2) northern Great Plains region, and 3) southeastern and south central region. Designation of the regions was based on land use practices such as grain farming, livestock production, or non agricultural practices.

All well owners responding to the questionnaire were asked to specify if the well tested was located on a farm. Fifty-six percent of the respondents were testing a farm or ranch well; 42.3% were located in a non farm environment. Responses to the questions indicated that the non farm audience was slightly better informed about individual responsibilities, knowledgeable of water quality issues, and action needed than the farm audience. Also, farm well owners placed significantly greater value on the education than did the non farm well owners. Only 11% of the farm well owners said the program was of limited or no educational value, whereas nearly 17% of the non farm audience said the program was of little or no value. The difference in responses between the two groups can be explained in part by significant difference in level of education between non farm and farm well owners.

The entire data base was sorted by educational level of participants. One subset was for individuals with some college education and the other subset comprised responses from individuals with no college course work. The results indicated that individuals with less education were more inclined to seek alternative water sources if problems existed, whereas individuals with some college education were more inclined to implement some wellhead protection. Non farm well owners had a slightly higher average level of education than farm well owners. Nearly 20% of the non farm well owners indicated that they had earned a post college graduate degree, whereas only 5.8% of the farm well owners indicated an equal level of education.

Program Participation

Fewer than 20% of the respondents indicated that they occasionally test their water supply; once every 5 yr or less. Twenty-five percent of the participants indicated that they tested only when there was an apparent need, whereas nearly 60% of the respondents said they had no record of previous testing. Well owners who previously had tested their water most commonly cited three reasons: 1) advice of others, 2) extension publication and newspaper articles, and (3) water treatment salespersons. Participation in voluntary

programs of this type may be caused by a variety of factors, most specific to the participant; and the high level of participation in the program may have been associated with the limited effort required by well owners to participate. Table 1 summarizes participant reasons for participation in the program.

Table 1. Reasons for well owner participation in the Montana private well water test program. (N=1408).[†]

| Reason for participation | Percent of respondents who said the reason affected their participation | Rank based on the most important reason for participating, according to respondents |
|---|---|---|
| Curiosity about quality of water | 79.6 | 2 |
| Concern for personal or family health | 72.6 | 1 |
| Cost and availability of program | 55.6 | 3 |
| Encouragement from concerned party | 22.1 | 4 |
| Questions about agrichemicals in water | 20.7 | 6 |
| Questions about no agrichemicals in water | 18.6 | 5 |
| Advice or alarm of someone else | 3.8 | 7 |

[†]N = number of well owners responding to question

Program Value and Participant Learning

Several different approaches can be taken to assess the degree to which participants of outreach programs learn. One approach is to ask participants specific content questions about a subject. Another way is to ask participants questions regarding their perceptions of specific subjects. Participants were asked what conclusions they reached about the quality of their water, based on well test programs results. Table 2 summarizes participant responses.

Table 2. Conclusions about quality of well water samples and the need for action to ensure the quality of future well water supplies (N=1395).

| Conclusions from program participants | % of respondents |
|--|------------------|
| Water was okay to drink | 69.1 |
| Water quality was questionable | 20.9 |
| Water may be harmful to personal health | 11.1 |
| Need to resample and retest | 6.7 |
| Water was unfit to drink | 6.7 |
| Need to secure new source of water | 2.9 |
| Initiate regular/periodic sampling and testing | 24.5 |

Seventy-five percent of the respondents said the results were what they expected. Only 12.6% of the respondents said they were alarmed or surprised by the well test results. Approximately 30.5% of the respondents said they did not understand the results or significance of the results.

Well Owner Opinions

Participants were asked what might be potential sources of either $\text{NO}_3^- - \text{N}$ or bacterial contamination of well water. They selected from a list of 18 potential sources, ranging from naturally occurring contamination to fertilizer, mining, septic tanks, and soil erosion. Participant responses to this question were ranked, based on which was identified as the possible contaminant source (Table 3).

Table 3. Potential sources of $\text{NO}_3^- - \text{N}$ contamination and coliform bacteria identified by private well owners (N=406; 743)

| Sources of contamination | Percentage of participant who said this was the most likely source of contamination | Rank |
|--|---|------|
| <u>Most likely source of $\text{NO}_3^- - \text{N}$</u> | | |
| Naturally occurring | 18.2 | 1 |
| Septic tanks and sewer systems | 14.3 | 2 |
| Livestock feeding and confinement operations | 12.1 | 3 |
| Fertilizer application | 11.8 | 4 |
| Faulty well construction | | |
| <u>Most likely source of coliform bacteria</u> | | |
| Septic tanks and sewer systems | 13.9 | 1 |
| Naturally occurring | 13.3 | 2 |
| Faulty well construction and maintenance | 10.6 | 3 |
| Incorrect sampling procedure | 10.2 | 4 |
| Lack of well decontamination after drilling | 8.6 | 5 |

Actions Taken

As part of the educational program, each participant was sent a fact sheet describing water treatment options. Well owners were asked if they knew how to treat water for various contaminants and other undesirable conditions. Well owners claimed they best understood treatment for coliform bacteria and hard water. The least understood treatment was for $\text{NO}_3^- - \text{N}$.

Well owners can take a variety of actions to deal with undesirable water quality. These include purchasing bottled water, modifying an existing well, or drilling a new well, hauling water, or joining a water district. We asked each well owner *how much money* they spent on any of these actions, other than purchasing water treatment equipment, as a result of the information they obtained. On average, \$992.00 was spent per well where action was taken, and the annual cost was about \$238.00 per well. Average cost of point-of-use water treatment equipment was \$425.00 per household.

Participation in the well test program and perceived benefit gained from the program appeared to be a function of the immediate usefulness of information to the participant, amount of effort needed to get the information and participate, and cost of participation. For example, we asked each participant how much they would be willing to pay for the water testing service they received if they were required to get the information from a private testing laboratory. Nearly 85% of the respondents indicated willingness to spend between \$10 and \$40 for the water testing service.

Program Value and Information Transfer

Nearly 55% of the respondents indicated they told an average of four people about the program. Well owners were also asked what benefit they gained from the program. According to those surveyed, the most valuable parts of the program were water test results (89.4%), costs of the program (76.2%), information on water quality protection (64.2), and specific information about treatment (50.2).

The participants were asked what extent their participation in the program affected their ability to understand water quality issues and make knowledgeable decisions about water quality. Eighty-three percent of the respondents indicated that the program increased public awareness of private well water quality issues and well water protection, a moderate amount or a great deal.

Participants indicated that printed text and communication with county agents were the preferred type of educational information offered through distant delivery. Phone communication with specialists, videos, workshops, television programs, lecture, and audio tapes were not as attractive options to respondents.

Reinstitution of the Program

The private well test program was intended to improve the decision making skills of private well owners in Montana. The impact assessment verified that by using a variety of information delivery sources and methods the program was able to improve decision making skills of and also promote participants to take follow-up action. In addition, the program provided a cost-effective approach to distance delivery education of more than 3,300 Montana residents. Based on the outcomes of the initial well water test program, extension faculty looked to improve the effectiveness of future distant delivery education for private well owners both statewide and throughout the region.

In the spring of 2004, MSU water quality extension revitalized the initial well test program. The goal of the program directors is to build a stand alone, self directed, inexpensive and low maintenance annual well water test program available to Montana private well owners. More broadly, the template of private well water test program developed by Montana extension will be a regional resource for partner states to implement and make suitable for specific state private well water quality issues.

Participants in the 2004 program included returnees from the original program illustrating the impact the original program had on the attitude of some private well owners in

Montana. The implementation of a water quality extension website, designed and hosted by MSU, provided additional advertisement and recruitment for the program. Additionally, extension offices in the ten fastest growing counties in Montana were contacted to help promote the program. Newspaper articles were provided for participant counties to advertise the program, similar to the approach taken in the initial program. Other advertising options that will be implemented in the current program include public radio and local television stations as well as statewide agricultural magazines.

Like the initial program, the 2004 program utilized a questionnaire to get the basic demographic and education information from participants. The participants were sent the survey and then instructed to pick up sampling materials from their local extension office. Participants were provided the name and address of a contracted lab that provided testing services for half the standard drinking water analysis price. Partnership with the laboratory provides consistence in data throughout the life of the program, as well as an inexpensive testing option for participants in the program. A secondary survey was sent post-analysis asking participants what educational resources are needed to help them understand their individual well water results. Extension faculty hope to provide a more needs based approach to resources that offer information of immediate utility to program participants.

Educational methodologies that MSU extension will use to promote future test periods of the program will include public radio, television, and newspaper advertisements. More communication and partnerships with county agents will also help facilitate program unity. Based on outcomes of participant responses in the 1989 program, private well water users prefer working with county extension agents, thus they can serve as the liaisons between extension programs and the public. Finally, internet education resources such as online training programs or instructor facilitated courses will also provide convenient access for private well water users to obtain water quality educational tools.

The goals of the reintroduction of the program include: 1) provide an annual resource to enable private well owners to monitor the water quality of their wells, 2) provide educational resources specific to the water quality concerns of private well owners, and 3) provide a nitrate and bacteria database for Montana. Extension faculty will integrate a variety of educational delivery mechanisms into programs that provide opportunity for direct participant involvement and that offer immediate utility to program participants. With this approach, an established well water test program can be instituted in Montana and shared as a pilot template for other states with increasing private well users.

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