Poster Abstracts and Papers on Target Audience Education Practices and Measures of Success

Water Quality Education for Irrigated Agriculture on California's Central Coast

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Abstract

The Monterey Bay National Marine Sanctuary is the largest marine protected area in the United States, covering more than 5,000 square miles along the Central Coast of California. Runoff from agricultural lands in coastal watersheds and transported to Sanctuary waters often carries pollutants such as sediments, nutrients, and pesticides. In 1999, the agricultural industry organized to voluntarily reduce water quality threats and avoid increased regulation. The University of California Cooperative Extension (UCCE), in partnership with the USDA Natural Resources Conservation Service (NRCS) developed a Farm Water Quality Planning Short Course to assist farmers to develop individual water quality management plans. The course is based on the success of the Rangeland Water Quality Short Course which has been taught 50 times in 27 counties and has resulted in 400 ranch water quality plans representing 1.2 million acres. The new UCCE peer-reviewed Farm Water Quality Planning Short Course is offered to Watershed Working Groups organized and staffed by the Coalition of Central Coast County Farm Bureaus. During the course, producers receive:

- Information on water quality regulations
- Techniques for self-assessment of nonpoint source pollution problems
- Management goals for sediments, nutrients, and pesticides
- Methods for recognizing practices that are already in place that protect water quality
- Management practices that may be selected for local conditions and crop types, and practice evaluation methods.

To date, 278 growers in 14 Watershed Working Groups have received training on the development and implementation of farm water quality management plans.

Target Audience(s): Agricultural commodity groups, farmers

Educational Purpose: Education

Activity-Based Learning and Daily Field Experiences Help Bring Watershed Restoration To Life

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Abstract

Watershed Restoration is a nationwide shortcourse for agency partners engaged in restoration of disturbed landscapes. Presented in Wenatchee, Washington during 2001 and 2003 and Logan, Utah in 2001, the course is part of the U.S. Forest Service's National Continuing Education Program. It combines activity-based and field experiential learning (30% presentation and 70% practice) to provide an understanding of watershed linkages, particularly upstream-downstream and upslope-downslope relationships, essential to the success and longevity of all restoration approaches. Each instructor provides a landscape level view to restoration approaches, issues and relevance by exposing participants to experiences in a broad array of climates and geographic regions. Morning sessions take place in a room transformed to a watershed restoration context by wall peripherals, displays, models, and new and innovative materials. Each session establishes clear, meaningful goals and objectives, and promotes the embracing of learning benefits through emphasis on real world examples. Verification of learning is accomplished through hands-on practice, collaborative pre- and post-tests, problem solving exercises, and data gathering and synthesis. Pertinent exercises, group discussion and "food-for-thought" challenges are followed by a reinforcing field experience every afternoon. Immediate field application and observation of session exercises provide the ability to expose, in a non-confrontational manner, the environmental, operational, or organizational barriers that prevent restoration success. A relaxed, activity-charged atmosphere supplies a vehicle for evaluating each barrier to success—what can be done to eliminate it, reduce it, or program around it? "Show-you-know" exercises, clear synthesis, and detailed participant evaluations help verify learning success.

Target Audience(s): Agency partners, soil and water conservation districts

Educational Purpose: Education

Timing and Design of Education Programs to Enhance Participation: Manure Management Education in Minnesota

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Abstract

An education program can attain its goals only if it reaches the target audience. Participation can be enhanced by timing the program with and designing it around a landmark event that enhances awareness of and perceived need for the education. In this case study the University of Minnesota Extension Service, anticipating release of new state feedlot rules, prepared a two-year education program to inform livestock producers about contents of the rules and to provide manure management education. The goal was to enable producers to implement manure management practices required or encouraged under the rules. Participation in these programs far exceeded that for manure management education in the state prior to rule adoption. Attendance exceeded 4,000 in the first year and 1,100 in the second. This is being followed with an in-depth and personal two-year education program in which small groups of producers develop two field manure/nutrient management plans for their own farms. To date, through the small-group project, 520 producers have developed nutrient management plans. Participation at programs timed to coincide with rule release benefited from both the heightened awareness brought by major rule adoption, and by the recognized need by many producers to learn about and implement improved manure management practices specified in the rules. Coupling of education programs with a change in regulations, new incentive payment programs, or some other high-profile event, effectively exploits a "teachable moment."

Introduction

The University of Minnesota Extension Service has provided publications and workshops over many years on appropriate management of manure and fertilizer in crop production. However, in-depth on-farm interview surveys indicated that significant over-application of nutrients in manure and/or fertilizer continued to be frequent. Practices requiring wider adoption include:

- Soil testing and manure analysis
- Crediting legume and manure nitrogen contributions when applying fertilizer
- Manure spreader calibration

Education programs, to be successful, must reach the target audience. If the target audience is farmers that have not implemented water quality protection practices, then education programs describing voluntary practices alone are insufficient to reach them.
This poster describes two programs delivered by the University of Minnesota and its partners that reached the target audience by expressly timing program delivery to coincide with events that were expected to heighten audience awareness and concern.

Feedlot Rules Education Project

Declining lake and stream water quality due to eutrophication led to increasing concern that voluntary practices and education were insufficient to change production practices. In a four-year multi-stakeholder process, new state feedlot rules were developed and readied for release in year 2000. Communication within livestock producer groups, reports in the press, and rule-making hearings raised considerable awareness in the agricultural community about the impending rules. UM Extension anticipated that education programs timed to the release of the rules would reach a wider farm audience than previously available. A Section 319 grant was applied for in 1999, and the two-year project was approved in time for the rules' effective date in October 2000.

Publications and slide presentation were prepared by an interagency team led by Extension. In each of the first two years, five regional "train the trainer" sessions were held for county and regional staff of Extension and agencies. These were followed by county sessions for farmers and agricultural professionals. In the first year, education focused on requirements for feedlot registration, permitting, and land application. The second year focused on manure and nutrient management planning and record keeping.

Results:

The high level of awareness in the agricultural community afforded by rules' release brought over 4,000 producers to the first-year county sessions, far exceeding any previous education effort in this subject area. By the second year, interest had dissipated somewhat; 1,150 farmers attended the sessions on nutrient management planning. A third year was added to the project to address improvement of small open feedlots as required in the rules by January 2005. Attendance was 718 farmers and agricultural professionals.

Small-Group Nutrient Management Planning

The new feedlot rules require livestock operations with greater than 300 animal units to maintain, on the farm, a nutrient management plan for all fields where manure is applied. The deadline to complete these plans is January, 2005. Anticipating this requirement, UM Extension applied for a Section 319 grant to lead producers through plan development, in a workshop setting, for two fields of each of their own farms. Beginning in fall of 2002, groups of 8-15 producers are being recruited by Extension, county feedlot, and Soil and Water Conservation District staff as well as by livestock producer organizations. Farmers bring their own data (soil tests, manure tests, field maps) to half-day workshops where Extension staff guide participants through development of their nutrient management plans. Application rates are based on UM recommendations; participants each calculate fertilizer cost savings based on their new plan compared to their previous application rates.

Results:

As of April 2004, 55 workshops have been held for over 560 producers, all of whom developed two-field plans. Most participants are in the operation size category required to have a plan by the rule; others, however, also attend. In end-of-workshop surveys, 73% responded that they intend to finish the plans for their entire farm, either by themselves, or with a professional, and only 3% said they would not. (The rest did not respond to the question.) Over 84% calculated that significant fertilizer cost savings (more than $5/acre) would be obtained for their operations by following their plans. Demand for the workshops continues. More workshops will be offered in the next winter season near the rules' deadline.

Discussion and Conclusions

"Build it and they will come" is not a productive approach in water quality education for farmers. In the absence of significant economic incentives, like production cost reductions or cost-share/incentive programs, additional strategies are required to reach the target audience and motivate changes in practices. The strategy successfully employed by these two projects was to couple education with heightened awareness surrounding new regulations and their application. Education was designed to address practices that would assist in meeting requirements of the rules and provide good resource management. This was possible because Extension staff served as technical advisors in development of the rules, and was therefore aware of opportunities for education and its appropriate timing.

Additional opportunities to couple education with increased awareness include the TMDL process now underway in Minnesota and elsewhere. Many of the state's water bodies are listed for impairments that include fecal coliform bacteria, sediment, and/or excess nutrients. Coupling water quality education with TMDLs is more challenging, however, because the TMDL process occurs over a long period of time and is watershed-specific. This will require examining stages of the process for high-profile periods, when potential audiences are likely to be involved or have a higher level of awareness. These might include a period around release of load allocation studies or public hearings on preliminary implementation plans. Education opportunities must be anticipated well in advance for program delivery to be ready when awareness is high.

Montana Beef Environmental Management Systems Pilot Project

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Abstract

A pilot project was conducted to determine the effectiveness of using an environmental self-assessment in an effort to address potential sources of surface water pollution from beef cattle ranches in Montana. Montana is largely a rural state with a land area of 93 million acres and 11,400 beef cattle enterprises ranging in size from a few to 10,000 head. Only 55 of these operations are licensed concentrated animal feeding operations (CAFO), which leaves the remaining as cow/calf rangeland operations or small to mid-size lots. Many of these livestock operations were established near surface water sources, and in present day society there are increasing concerns about the compatibility of livestock agriculture with environmental quality, especially that of water. The Montana Beef Environmental Management Systems (EMS) Project focused on facilities related to beef cattle ranching such as corrals, winter feeding grounds, back-grounding lots, and calving areas to develop a self-assessment guidebook and workbook to lead producers through the process of identifying priority environmental issues, assessing potential environmental risk, and developing a plan to mitigate risk. The tool was pilot tested on 23 ranches across Montana, as well as on 3 research farms. Pre- and post-surveys were completed to assess rancher attitudes before and after identifying environmental risks on their own operations, and to evaluate their experiences with the self-assessment. Overall accomplishments and outputs of the project will be discussed as well as lessons learned regarding the selected approach for dealing with environmental issues on ranching operations, and survey results will be presented.

Target Audience(s): Agricultural commodity groups, farmers

Educational Purpose: Capacity building

Financial Safety Net for Corn Farmers: An Emerging Educational Tool to Increase Adoption of Nutrient BMPs

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Abstract

Surveys and case studies over the past 30 years have demonstrated that economic risk is a major barrier to farmer adoption of Best Management Practices (BMPs). For example, farmers are often reluctant to lower nitrogen, phosphorus and potassium applications to university recommendations. If the farmer or advisor miscalculates the rate, or unusual weather causes the BMP to fail, yields and profits may decline. Since fertilizer costs are inexpensive relative to the potential loss, farmers "self-insure" by applying higher than recommended rates. The project partners have tested a BMP “net returns” fertilizer rate recommendation guaranty that provides a cash payment to participating corn farmers if the recommendation results in lower yields. The participant (or a sponsor) purchases a specially designed service agreement, applies university-recommended BMP rates, and applies additional fertilizer to a check strip. If a yield loss occurs on the BMP-fertilized acres vs. the check strip, and the value of the yield lost outstrips the fertilizer cost savings, the guaranty provides a payment to compensate for the loss. Between 2001 and 2003, more than 30 corn farmers in five states have participated in research and development, with average fertilizer rate reductions of 24%. Up to 400 additional farmers are being recruited for the 2004 growing season. Watershed managers are quickly recognizing these systems are highly cost effective in terms of setting up field-scale demonstrations and are now purchasing or cost-sharing the agreements for farmers.

Target Audience(s): Agency partners, environmental conservation nongovernmental organizations, soil and water conservation districts; ag commodity groups/farmers

Educational Purpose: Education

Duluth Streams (duluthstreams.org) – Making Water Quality, Land Use, and Stormwater Data Come Alive for Decision Makers

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Abstract

The Web site, DuluthStreams.org provides Web-based delivery of automated data using advanced data visualization tools for understanding urban stormwater and water quality issues. Duluth, Minnesota lies adjacent to the pristine waters of Lake Superior. The City has 42 named streams, 14 trout streams, and borders the Duluth-Superior Harbor Area of Concern. Duluth's stormwater infrastructure includes 93 miles of streams and wetlands. Urbanization and rural development are increasing temperature, turbidity/sediment, salinity, organic matter, and nutrients in area streams. DuluthStreams established a partnership between the University of Minnesota, Duluth and local water resource management agencies to enhance public understanding of aquatic ecosystems and their connections to watershed land use by illustrating the nature and consequences of degraded stormwater. Water quality data are fed to the Web site, www.duluthstreams.org, and linked to GIS landuse, current and historical water quality and biological data, and engaging text and photos. Data animations and interpretive text visually engage the public and students via the Internet and local kiosks. Collaboration with the St. Louis River RiverWatch Program developed curricula and stream monitoring materials for schools and established uniform protocols for volunteers throughout the region. The Partnership has also adapted NEMO (Nonpoint Education for Municipal Officials) to the Duluth area and initiated a Regional Stormwater Protection Team, a coalition of new Municipal Separate Stormwater Sewer System permittees (MS4s), local universities, and regional agencies, to develop a unified watershed approach for educating the public on nonpoint source pollution issues and protecting the waters of the region.

Target Audience(s): Local decision, policy makers

Educational Purpose: Capacity building

Catfish in the Mainstream: Social Marketing and Change

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Abstract

Water education is "real life" education. If Tennessee's population continues to grow as it has in the last ten years, we will soon be approaching a crisis situation regarding clean, potable water. Our economy, the health of our citizens, and wildlife habitat are dependent on plentiful and safe sources of clean water.

WaterWorks! was launched this year. It is a new initiative in outreach education for the Center for Environmental Education at Middle Tennessee State University and is funded by the Tennessee (TN) Department of Agriculture Nonpoint Source Program. The program's focus is on improving water quality in Tennessee. *WaterWorks!* models social change through focused marketing to an audience of Tennessee households and homeowners. Specific components are designed to promote and reinforce the message of individual responsibility. Highlights include:

- Video and audio public service announcement series promoting clean water quality through responsible action
- Web site showcasing public service announcements, youth projects, links to water-related groups and sites in Tennessee
- *Stream Savers*, a recognition program for youth groups completing projects that improve water quality
- Statewide survey providing baseline information about citizen water quality attitudes and actions
- Brochures focusing on homeowner, builder, developer, contractor, and agriculture practices
- Interactive watershed map with watershed links, watershed groups, stormwater information, and county/city contacts
- Stakeholder meetings with NPDES Phase II representatives and others involved in water quality efforts in Tennessee

Introduction

Social marketing = advertising? The average person may equate the two terms, but according to Les Robinson (1998, ¶5), an expert in this field, advertising is "… NOT about changing behavior. It's about changing *brands*." In thinking about solutions to environmental issues and problems, the focus is usually on a change in *behavior* brought about either through a revision of attitudes or a forced compliance to a rule or law. Robinson's focus is not on building awareness but on removing barriers to behavior change. An excellent source about the theory and application of social marketing techniques is *Fostering Sustainable Behavior* by Douglas McKenzie-Mohr and William Smith (1999), who advises those interested in social marketing techniques to study benefits of, and barriers to, the desired behavior.

WaterWorks!, a new education initiative funded by the TN Department of Agriculture Nonpoint Source Program and implemented through the Center for Environmental Education at Middle

Tennessee State University, was launched to improve water quality in Tennessee. The initiative has a multi-faceted approach with components added and strengthened over the project period. The *WaterWorks!* education campaign is designed to change behavior by first promoting awareness, then adding knowledge and skill-building with subsequent messages, so that citizens are brought to an awareness that individual decisions affect water quality, their actions make a difference, and that together, responsible attitudes and actions can change water quality for the better.

The Project

The first phase of the project was to develop a series of video and audio messages promoting clean water through responsible action, a statewide survey to create a baseline about what Tennessee citizens know and *do* about water quality, a recognition program for youth, and stakeholder meetings with others involved in water quality statewide. A Web site to showcase the messages and provide an information base for the program was begun, with links to other helpful watershed organizations and state agency sites. In addition, the Web site has a watershed map in its basic form, with plans to add information about local contacts for information on particular municipalities and on volunteer watershed groups within a county or a watershed.

Project Components

Video and Audio Messages

Three video messages and four radio messages were created and were aired for the first time September 16, 2003; they are aired as non-commercial sustaining messages through the Tennessee Association of Broadcasters (TAB) and were sent to 321 radio stations and 33 commercial television stations across the state. During the first two months of the program (October and November, 2003) the television spots aired more than 460 times and radio announcements had 4,519 airings.

The television spots featured Chuck the Catfish, a gruffly lovable character who in one message, a la Dr. Seuss, exhorts citizens to “abstain from putting bad stuff in the drain” in order “to maintain my wet domain”; in another message, Chuck admonishes adult citizens who exhibit irresponsible behavior that hurts water quality; in the third message, he is teaching clean water tips to a classroom of children who are already very aware of the correct behavior.

Two of the radio messages are the voice of Chuck the Catfish; the other two are based on an original song, “I Am the River” by Nashville singer/songwriter Dan Tyler (“Bobbie Sue,” “Hearts on Fire,” “Twenty Years Ago,” “The Light in Your Eyes”) who graciously donated the use of his song for this campaign.

Statewide Survey

In 2003, the Social Science Research Institute at the University of Tennessee, Knoxville, conducted a telephone survey of adult residents of Tennessee regarding perceptions of water quality across the state and household habits pertaining to the disposal methods of potential pollutants. Additionally, respondents were asked about their knowledge of nonpoint source pollution and preferences for the financing of water quality improvement. The survey was conducted using the Random Digit Dialing method. A total of 871 randomly-selected adult

residents of Tennessee were interviewed with a resulting +/- 3.3% margin of error. The cooperation rate for the survey was 35.9% (Social Science Research Institute, 2003).

Results of the survey indicated that while over 85% of respondents were satisfied with the quality of their drinking water (almost 45% ranked it "good"), 36.8% of those surveyed ranked the water quality of their rivers and streams as "fair" and 30% "good." Over 76% of Tennesseans surveyed believe that everyday activities in our homes, workplaces, and cars cause most water pollution. Just over 80% believe that small changes in people's daily habits will improve water quality, with the likelihood of disagreeing with this statement increasing as age increases. Over 93% of Tennesseans surveyed were not familiar with the term "nonpoint source pollution" but once the term was explained, respondents expressed agreement as to important sources of nonpoint source pollution: agricultural chemical runoff, automobile fluid runoff, construction runoff, and lawn chemicals. A finding on how Tennesseans prefer to pay for the costs of improving water quality is of significant importance to stormwater managers across the state: over two to one Tennesseans prefer an assessed fee rather than a general tax increase.

Trained personnel, using a Computer-Assisted Telephone Interviewing (CATI) System, conducted all interviews. The survey was designed and analyzed for the *WaterWorks* Program by Social Science Research Institute staff members, Dr. Michael M. Gant, Director and Linda M. Daugherty, Program Director.

Youth Recognition Program

In fall 2003, *WaterWorks!* began its *Stream Savers* program. Youth groups, both formal (classrooms) and informal (clubs, Scouts, 4-H, Boys and Girls Clubs, etc.) in Tennessee could win $300 for their water quality project; monthly winners are eligible for further recognition in 2004 by competing for an annual award of an additional $500.

Eligible projects include, but are not limited to:

- River or stream cleanup
- Water testing
- Stream bank repair/restoration
- Education or awareness project

From fall 2003 through spring 2004, six school or club groups were awarded *Stream Saver* status. Winners, including clubs and classes from elementary, secondary and home-school groups, participated in projects such as:

- Bundling trees for distribution with an accompanying informational brochure for streambank restoration
- Stream cleanups
- Macroinvertebrate sampling
- Water sampling and testing
- Maintaining annual records of aquatic wildlife and macroinvertebrates
- River trail maintenance
- Water education programs

Many of the awarded projects were 'combination' projects that accomplished more than one of the above activities.

Stakeholder Meetings

WaterWorks! is connected with a variety of water-related organizations and groups, and has had representation at state, regional, national and international levels. Sample groups include: TN Environmental Education Association, Environmental Education Association of Alabama, TN Council of Social Studies, TN Educators of Aquatic and Marine Sciences, TN Section of the American Water Resources Association, National Conference Nonpoint Source Pollution Information & Education Programs, and North American Association of Environmental Education.

Web Site

WaterWorks! Web site (www.tennesseewaterworks.com or www.mtsu.edu/waterworks) is unique in that its homepage showcases beautiful water features of Tennessee, with the permission of the photographer, Mack Prichard. Opportunities for others to share their Tennessee water pictures are available; credit is always given to the photographer.

Web site features include:

- About *WaterWorks!*
- Public Service Announcements
- Youth Recognition
- Brochures (under "construction")
- Survey
- 10 Water Tips
- Watershed Map
- Watershed Groups
- Links

Watershed Groups
Watershed groups, friends' groups, and other water-related organizations are listed on our Web site; updates are made as groups asked to be listed or linked. Additional links are/will be made to state (and other agencies) and organizations on the "Links" page. As the "Watershed Map" page becomes more interactive (county names in green are hot buttons to GIS-generated maps of the counties and main waterways, watershed groups and MS4 contacts), watershed group contact information is checked and rechecked, making sure that the information is consistent and current.

Watershed Map
One of the most interesting features of the Web site is a state map with watersheds overlaid on the counties. Plans for developing this page include adding contact information about watershed groups in each watershed, city/county officials in charge of stormwater permits, whom to contact for suspected pollution, etc.

Waterworks! in the 'Mainstream'

Opportunities for the Tennessee Phase I and Phase II Municipal Separate Stormwater Sewer Systems (MS4's) to fulfill their public education and outreach commitments are available through the use of *WaterWorks!* video and audio messages.

To ensure that radio and television stations would air the announcements, *WaterWorks!* entered into a contract with the Tennessee Association of Broadcasters (TAB) to utilize that organization's Non-Commercial Sustaining Announcement (NCSA) program. Once *WaterWorks!* provides TAB copies of the television and radio announcements, TAB handles distribution of the spots to over 331 member stations. Under terms of the contract, *WaterWorks!* is guaranteed a four-to-one ratio of advertising value generated to cost. In other words, a $10,000 investment would yield at least $40,000 in advertising value.

During the first two months of the program (October and November, 2003), the actual results show that the advertising value of the *WaterWorks!* campaign was $88,800 (the cost to *WaterWorks!* for these two months was $1,667). The television spots aired more than 460 times and radio announcements were aired 4,519 times, which amounts to over 53 times the value paid.

Because not all stations report the airing of these announcements, we are confident that the true value of this program is actually much higher.

We plan to use the survey form again in the spring of 2005, including questions which indicate whether respondents remembered seeing or hearing the television and radio spots. Additional ads will be created and released in the year 2004-2005, so respondents to the spring 2005 survey will have two years to have heard or seen the ads.

Conclusion

WaterWorks! is a unique partnership between private and public entities, providing a usable, affordable way for municipalities to implement a uniform public outreach plan statewide that helps meet their stormwater education plan requirements. Through a recognized and respected agency, attention-getting and informational messages are created and aired with the help of the Tennessee Association of Broadcasters. Through the Stream Savers' program, *WaterWorks!* recognizes, in a meaningful way, projects of formal and informal youth groups that improve water quality; the watershed map, groups page, and links on the Web site provide additional information in an easily-understood format for citizens and municipal officials alike.

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Tailoring Pollution Prevention for Urban Landscapers in Madison, Wisconsin

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Abstract

Nestled between two glacial lakes, Madison, Wisconsin is blessed with water resources. As in many urban watersheds, however, Madison has growing water pollution issues. One important pollution source is urban landscaping, in particular runoff from over-fertilization and pesticide misuse in lawns and gardens. The goal of this project is to develop social action strategies, for implementation by urban watershed and neighborhood organizations, that will reduce the human health and ecological hazards of pesticide misuse for urban landscape development and maintenance.

The project aims to identify the barriers and benefits to the use of Integrated Pest Management perceived by paid landscape managers in the Lake Monona watershed in the City of Madison and Dane County, Wisconsin. This poster will discuss the results of our telephone survey research analyzing landscape managers' and groundskeepers' perceptions of IPM practices. We have also evaluated existing IPM materials and messages available to professional landscapers and urban residents. This poster will share the results of research into the development of educational materials, which we will pilot test in collaboration with grassroots organizations, watershed educators and public agency partners in the Lake Monona watershed. We will discuss the development of a social marketing strategy with principles and recommendations useful to urban watershed protectors nation-wide. This includes communications plans to use existing, revised or new landscaping IPM educational materials (such as a one-stop guide for landscape managers and a "green Landscaper" certification program in Wisconsin) and a social strategy for instituting new behavioral norms of urban landscape management.

Target Audience(s): Urban landscapers, urban watershed organizations

Educational Purpose: Communication; education

Water Resource Education for Real Estate Professionals in the South Puget Sound Region, Washington

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Abstract

Increased development of natural lands, caused by a rapidly growing South Puget Sound population, greatly influences the long-term health of the region's water resources. Individual land-use practices, in particular, can critically affect these resources.

Real estate professionals influence these land-use practices, yet tend to have poor knowledge of environmental issues. In 1998, a needs assessment of local environmental educators identified this audience as underserved yet a high priority for water resource education. As a result, Washington State University Thurston County Extension developed and implemented a Water Resource Education Program for Real Estate Professionals.

The program's objective is to educate real estate professionals so they can make environmentally suitable decisions regarding development and land-use practices, as well as educate their clientele about land stewardship, water quality, and aquatic habitat. Courses cover the science, policy and regulations of water resource related issues such as onsite sewage systems, wetlands, shorelines, salmon and streams, and low-impact development. Experts give up-to-date objective presentations in a classroom setting and most courses have a field trip component for hands-on learning. Real estate professional attendees receive continuing education credit toward their biennial professional license recertification.

Attendance in 41 courses over six years totals more than 1112. Course evaluations demonstrate that information provided is relevant and useful for participants' work. Follow-up evaluations show that over 90% of program participants regularly share information they learn with clientele and colleagues. Further research is needed to quantify the impact that this program has on local and regional water resources.

Target Audience(s): Real estate salespersons, brokers, developers, appraisers

Educational Purpose: Information

SMARTYARDS and Other Watershed Outreach Programs of the Christina Basin Clean Water Partnership in Delaware, Maryland and Pennsylvania

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Abstract

The Christina Basin Clean Water Strategy (CBCWP) is a cooperative interstate effort to protect and improve the water quality of streams in the Brandywine, Red Clay, and White Clay Creeks, and Christina River watersheds of Delaware, Maryland, and Pennsylvania. The streams in the 565-square mile, Christina Basin drain areas of three states (Delaware, Maryland, and Pennsylvania) and are the sources of drinking water for over 0.5 million people in these states. The Christina Basin Partnership was one of 20 watersheds from throughout the USA (from a pool of 170 applications) that was the recipient of a $1 million Watershed Initiative Grant from the U.S. Enivornmental Protection Agency.

This paper describes the watershed outreach and education programs of the CBCWP. These include continuing and enhancing the community participation and public education efforts to inform the watershed community and landowners about the need to implement BMP's and how to implement better watershed stewardship in their day-to-day activities and businesses. This program includes cooperative public outreach efforts regarding the ongoing development of the low flow and high flow TMDL load allocations. The watershed outreach programs include:

- Distribution of free native plants to homeowners through the SMARTYARD program.
- Annual bus tour of the watershed on the first Friday after Labor Day.
- Storm drain stenciling in coordination with Boy Scout and Girl Scout troops.
- Distribution of outreach publications and brochures at public events such as University of Delaware football (22,000 seats) and basketball games (5,000 seats).
- SMARTYARD program whereby homeowners are given up to $250 of free native plants and a landscape design plan as incentive to replace water-and chemical dependent lawns.
- Rain barrel program where homeowners in eligible sub-watersheds are provided free rain barrels.

Target Audience(s): Homeowners

Educational Purpose: Capacity building

Fostering Locally-Led Holistic Watershed Management

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Abstract

The Water Quality Outreach Program was created within the University of Missouri Outreach and Extension Program to work with agencies, organizations, local governments, and individuals to develop information, technical expertise, and strategies for protecting water resources throughout Missouri. Early in the development of the water quality program, the importance of developing collaborative networks was realized for success in protecting Missouri's water resources. To achieve this, MU Extension programs took a community development approach in working with communities. The approach was to create capacity (leadership) within the community by the transference of knowledge and technical expertise to people in the community. As this program has now worked with twenty different watershed-planning groups, it has been found that citizens will choose to become involved if they understand the situation and how it might affect them, and if they have the knowledge and resources to work through the situation.

To date, twenty watershed-planning groups have been involved with this program because of being forced through regulatory action or because of concern for their water resources. Each of the twenty watershed planning committees is at a different interval in the planning process. Lessons learned so far are as follows:

- People do care about their community.
- People will become involved if they understand the problem/situation.
- People need to do the work with assistance from agencies, organizations and government (local ownership/buy-in).
- National/state, community/economic, and environmental/natural resources problems are local problems "first."

Target Audience(s): Local decision/policy makers, agency partners, soil and water conservation district personnel

Educational Purpose: Communication, capacity building

Water Leaders Class – Preparing for the Future

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Abstract

The Water Leaders Class is a one-year program of the Water Education Foundation that identifies young community leaders from diverse backgrounds. These young professionals include members of minority and ethnic communities, and representatives of many professions such as engineering, law, environmental planning, and public interest advocacy.

The program is designed to educate the Water Leaders Class about water issues, as well as enhance individual leadership skills and prepare participants to take an active, cooperative approach to decision-making and problem solving.

Serving as mentors to class members each year are leading urban, agricultural and environmental stakeholders, and state policy-makers. Mentors in past years have included state senators, state water board members, water district executive directors, leading attorneys, and NGO executive directors. Class members are matched with mentors from perspectives differing from their own points of view.

Class members participate in state-wide water policy briefings, technical water issues tours, “shadow” their mentors, and develop a group paper or PowerPoint presentation on a water issue of current importance like water transfers, groundwater, water and growth, or water marketing.

The benefits of the program include better understanding of water issues, ongoing relationships with class members which are helpful to participants’ professional lives, and a continuing commitment to remaining in water-related professions. The Foundation is in the eighth year of the Water Leaders Program and many graduates have attained high professional status, including congressional staff members and a California State legislator.

Target Audience(s): Local decision and policy makers, agency partners

Educational Purpose: Capacity building

Web-Based Watershed Tools for the Classroom: A Pilot 319 Project for Grades 4-8 in Southwest and Northeast Missouri Watersheds

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Abstract

Water is costly to purify and transport, is impossible to substitute, and is essential to food production, economic development, plant and animal life. In the United States over 250 million people depend on rivers, lakes, streams and groundwater supplies for their drinking water. Approximately 179 water bodies are listed on Missouri's 1998 Final 303 (d) List for Impaired Waters and require immediate restoration to designated uses. Many streams suffer from low water volume, organic enrichment, siltation and polluted runoff. There is need to address surface runoff, groundwater, sediment, in-stream nutrients, and wildlife and fish populations from the perspectives of variety of stakeholders: researchers, state and federal conservationists, local citizen-based watershed groups, natural resource interest groups, landowners, farmers, young children, plus local officials.

The Internet plays an increasingly vital role in providing access to watershed information. The Missouri Watershed Information Network (MoWIN) proposed to develop and disseminate interactive watershed information Web sites for use in schools (grades 4-8) in five Missouri watersheds. Web site topics include history, agricultural activities and statistics, human impact on the environment, recreational resources, nonpoint source pollution and prevention, plant and animal life, plus water quality information. This project provides an additional tool for educators to improve science education library collections and integrate watershed education with science, social studies and other subjects and to help increase children's awareness of local community natural resources. Objectives include: providing information to encourage participation in watershed stewardship; increasing knowledge and understanding about watersheds; and facilitating development of skills to identify and prevent nonpoint source pollution. For additional information please visit the MoWin Web site: http://outreach.missouri.edu/mowin

Background

We all live in watersheds; they are natural habitats for people, animals and plants. We each have a responsibility to safeguard the future of our watersheds to ensure long-term sustainability for ourselves and future generations. Water plays a crucial role in most of our activities, including agriculture, industry and human settlement, and it is one of the most important resources available for human survival. People can survive without food for several weeks, but not without water.

According to Population Action International (1993, Introduction, ¶8 & ¶9),

> As population grows, the average amount of renewable fresh water available to each person declines. Hydrologists and other water experts agree that when certain ratios of human numbers to renewable fresh water supplies are exceeded, water stress and outright scarcity are all but inevitable.

> In recent decades these ratios have been approached or exceeded in more than two dozen countries. And the projected population growth of the next few decades could push yet another two dozen countries and hundreds of millions more people over the brink of water shortage. Moreover, predicted changes in global climate could redistribute or reduce water supplies and intensify storms, adding to the challenge of managing water supply.

Worldwide, millions of gallons of water are needed every day for personal, industrial and agricultural uses. Freshwater supplies are scarce because more than 97 percent of the Earth's water is saltwater in oceans and lakes. Water has an intrinsic value. It is costly to purify and transport, is impossible to substitute, and is essential to food production, economic development, and plant and animal life.

Over 250 million people in the United States depend on rivers, lakes, streams and groundwater supplies for their drinking water. In Missouri approximately 179 waters bodies are listed on Missouri's 1998 Final 303 (d) List for Impaired Waters and require immediate restoration to designated uses. Many have impaired aquatic habitat due to a combination of factors that include natural geology, climate, industrial activity, construction and agricultural land use. Others suffer from low water volume, organic enrichment, excessive siltation and polluted runoff.

There is need to address water resource issues of surface runoff, groundwater, sediment, in-stream nutrients, wildlife and fish populations from the perspectives of biological researchers, state and federal conservationists, local citizen-based watershed and natural resource interest groups, landowners, farmers, youth and young children. The environmental challenge lies in designing relevant programs that involve communities. Additional challenges facing natural resources experts include the ability to meet human needs without threatening the integrity of the ecosystems that form the basis of our survival. Addressing these issues should aim at increasing awareness, knowledge, understanding, and the capacity of local watershed groups and community members to identify and address relevant topics.

Rationale for the Project

Access to information, and knowledge about water conservation, usage, supply, recycling and reuse plus good water management can improve water resources. Through relevant information and education, all of us can become aware of, understand the importance of, and take responsibility for local watershed stewardship. The process of building awareness requires that outreach experts plan programs/activities that inform and educate citizens of all ages about the impacts of their actions/non-actions in their watersheds. It is also important to inform children at early stages so that they can grow up knowing the value of the environment. Various instructional methods that integrate school and communities are available to meet the need for disseminating environmental and watershed information.

Environmental education can provide a vehicle for young people to learn about various ecosystems, the interrelations among them, and their roles in preventing nonpoint source pollution. As society becomes more technologically oriented, elementary and secondary school science educators will be charged not only with preparing tomorrow's scientists and technologists, but will also be expected to foster an educated citizenry that is capable of weighing the potential benefits and limitations of new technologies and discoveries, and is able to make informed decisions about their lives and environment (President's Committee of Advisors on

Science and Technology [PCAST], 1997). With the advanced use of technology, the Internet is increasingly playing a vital role by providing access to widely scattered environmental information. In addition, a number of research studies suggest that geographic information systems (GIS) have considerable potential to promote elementary and secondary school students' inquiry-driven, interdisciplinary, project-based learning (Winn, Maggio, & Wunneberger, 1996) that spans local to global issues, particularly those focused on understanding and conserving the environment (Ramirez & Althouse, 1995).

Recent reform documents, including the National Science Education Standards (National Academy of Sciences, 1996) and the National Educational Technology Standards for Teachers (International Society for Technology in Education, 2000), emphasize the importance of environmental science in K-12 classrooms and incorporation of technology into curricular contexts. Like any other aspects of learning, watershed education is a process that increases knowledge and awareness about the environment and its associated resources. Curricula designs should include content that: a) develop skills and expertise fostering attitudes, motivations, and commitments to make informed decisions and take responsible action, b) enhance critical thinking and problem-solving, and c) increase appreciation for natural resources.

Furthermore, research has shown that education can play an important role in facilitating change. Education increases our capacity to make informed decisions and to act effectively in addressing environmental and developmental issues. Environmental education curricula need to be well designed, targeted, and coordinated. They need to have measurable goals, and to reflect priorities in environmental protection; with strong linkages between programs, collaborating state and federal agencies, citizens of all ages and local communities. Strong links also need to exist between watershed education in the community and that taking place in local schools, colleges and universities.

Relevant outreach programs should be designed to provide learning opportunities:

- Awareness of local watersheds resources,
- How to make a contribution towards ensuring adequate food, clean water, and long-term sustainable agriculture, and
- Ensuring that waters maintain designated uses.

One approach that could be used in local communities is to bolster environmental education for the several hundred thousand youngsters at primary schools throughout the state of Missouri using locally available Internet resources in addition to traditional methods of instruction. Currently, Missouri state and federal agencies, educational institutions, individuals, citizen-based watershed groups, business and industry groups are collaborating to develop and implement watershed and environmental education programs geared towards point, nonpoint source pollution, watershed restoration and water quality through water festivals, 4-H and other kids programs.

Objectives that focus on Web resources for students, grades 4-8, include:

- Provide Internet resources to facilitate increase of awareness, knowledge and encourage participation in watershed stewardship activities.
- Design and provide interactive Web sites to initiate activities for use by science educators, grades 4-8. Information includes natural resources, animal and plant life, history, agricultural land use, plus demographics.

- Design and develop mini-Internet research quizzes based on local watershed activities.
- Plan and develop instructional workshops/demonstrations for science educators to demonstrate use of materials.

Project Description

Mitchell and Graham (1996) recognize that "school-based watershed education programs must coexist within two worlds: the world of education and the institutional structure of schools, and the community in which most of the activity occurs" (p. 938). In addition, programs must also negotiate the worlds of the Missouri Department of Natural Resources Environmental Education and The Show-Me Standards curriculum. Recognizing this complexity, project staff has developed interactive Web-based instructional materials to provide grades 4-8 teachers and students with a variety of technology-based materials to learn about shared natural resources. Web sites include information about:

- History
- Agricultural activities and statistics where applicable
- Human impact on the environment
- Recreational resources
- Nonpoint source pollution and prevention
- Plant and animal life
- Water quality information

Interactive Web sites provide students with animated information on the water movement process, hydrologic cycle, uses of water in and outside the home, fun ways of conserving water, water treatment process, stormwater movement and others. Interactive sites are posted on the MOWIN Web site: http://outreach.missouri.edu/mowin/Project31903/ interacmowin.html

Information will also be available on CDs to provide equal opportunity for areas that have no or slow Internet access. This project is intended to be an additional tool for educators' science education library collections. The project focuses on protecting the environment with an ultimate goal of preventing and managing source water pollution, preserving water quality and quantity, and restoring water bodies to their designated uses. The program has been designed for implementation in elementary schools in Elk River, James River, North Fork Salt River, Sac River, and Spring River watersheds (see Figure 1). Watersheds were determined using the United States Geological Survey (USGS) 8-Digit Hydrologic Unit Codes.

Interactive Web site information will be offered to teachers for introducing students, grades 4-8, to watershed management, nonpoint source pollution, and relevant demographic and natural resource facts. Local professional and community specialists will facilitate hands-on demonstrations, will assist in planning, implementing and evaluating the impact of this project, and will determine if results can be replicated statewide (in Missouri). We expect young people to begin to take interest in natural resources and to act to protect and preserve them. We also expect youth to ask questions that may help enhance watershed restorative and management of local communities.

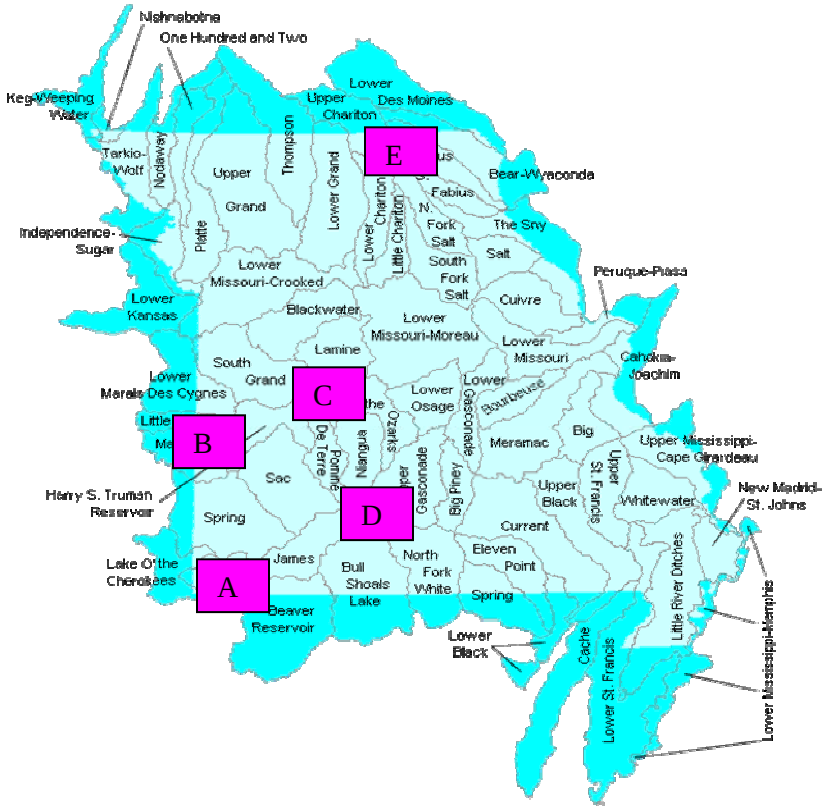
Conclusion

Outreach efforts must go beyond education and information. They must go beyond the

"traditional knowledgeable" adult population and include citizens of all ages capable of understanding various levels of information. Every citizen should be provided with the opportunity to get involved, take action, and contribute to positive environmental changes. Paying attention to all age groups may help us learn what motivates people to act and perhaps be useful in attaining our project success. Working with schools and students allows collaboration with parents – thereby involving the whole community. Our goals include building strong communities while achieving local objectives. Focusing on local, social and economic environmental needs makes it possible to find ways of creating opportunities that improve standards of living. Outreach and awareness efforts include workshops for youth and teachers, after school programs, computer games at water festivals across the state, and instructional CDs with lists of interactive Web sites for schools. To date, over 200 CDs have been used to disseminate this information. Teachers and youth leaders can access these sites at: http://outreach.missouri.edu/mowin/ Project31903/interacmowin.html

Our guiding principle for this project is that if students can see, feel, experience and recognize their local and natural environmental conditions, they will be better equipped to a) understand the basic ecological relationships and concepts they are taught through formal education, b) relate concepts to their environments, c) learn to appreciate and value local community resources and d) view watershed preservation as an important aspect of life at early ages.

Figure 1. Project locations



Elk River Basin	A	James River Basin	D
Spring River Basin	B	North Fork Salt River Basin	E
Sac River Basin	C		

Acknowledgments

MoWIN's success is a result of hard work by many individuals and groups. All our partners are involved in reviewing plans, designs and the compilation of information. MoWIN Advisory Council members and University Outreach and Extension (UOE) specialists continuously contribute ideas to enhance MoWIN Web site information and the e-curriculum, answer citizen queries, and offer invaluable day-to-day support.

Collaboration with state and federal agencies, non-governmental organizations, and business and industry, was and continues to be MoWIN's emphasis in adult and youth Internet programmatic efforts. The involvement of the Clarence Cannon Wholesale Water Commission, East-West Gateway Coordinating Council, St. Louis Metropolitan Sewer District, Soil and Water Conservation Districts, the James River Basin Partnership, the Watershed Committee of the Ozarks and Mid-America Regional Council offered additional platforms for MoWIN to reach broader communities directly involved with watershed and water quality activities. Entities directly involved in this youth project include:

- University of Missouri Outreach & Extension
- Bryant Watershed Atlas Project volunteers
- James River Basin Partnership
- Watershed Committee of the Ozarks
- Clarence Cannon Wholesale Water Commission
- Missouri Department of Natural Resources

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Team WET Schools: Building School-Community Partnerships to Promote Water Education and Stewardship Among Underserved Urban Youth

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Abstract

By using James S. Hogg Middle School as a model case study, staff from the Council for Environmental Education (CEE) will illustrate how Team WET Schools, a water-focused urban environmental education program, operates. The Team WET School model illustrates major strengths of the program, the ability to reach diverse students and teachers with water education and service learning opportunities, and the ability to involve a variety of non-traditional partners in environmental education. The session will focus on how local organizations and businesses have worked and can work with the CEE national office in individual school buildings to empower urban students and teachers to become responsible water stewards.

Since the spring of 2002, CEE has worked closely with the City of Houston and the Harris County Storm Water Management Joint Task Force (JTF) to support the water education and stewardship efforts at Hogg Middle School, a primarily Hispanic school located near downtown Houston. CEE and the JTF teamed up to offer workshops to help educators integrate activities from the *WET in the City, K-12 Curriculum and Activity Guide* into school curricula. Twenty-three Hogg teachers, representing 39% of the faculty from across the disciplines, participated in the workshops and are actively using *WET in the City* activities in their classrooms.

Target Audience(s): Local decision and policy makers, agency partners, households, neighborhood organizations, service clubs, environmental/conservation NGOs, soil and water conservation districts, specific ethnic groups

Educational Purpose: Education

"Water For West Texas" – A New Extension Program

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Abstract

WEST TEXAS! What a wild, scenic and yes, often desolate area it is. And what a rugged, self-sustaining and pioneering-type of person settled West Texas! From the earliest paleo-Indians, Apaches, Comanche, Jumanos or Pueblos – to the Spanish and Mexican settlers, later, the first Anglo ranchers – all learned to know, respect and preserve the rare and precious waters or perish. West Texans never had to be taught that their water resources, whether flowing in the Pecos or Rio Grande Rivers or from a spring, or lying below ground in an aquifer, were precious. This is instinctive to people living and working in dry, arid climates and in deserts. Truly here, “Water IS Life!” or, “Agua ES Vida!”

Historically, considerable irrigation water was produced by both the Pecos and Rio Grande Rivers. Increased upstream demands for irrigation and domestic uses, plus saltcedar invasion and a ten year drought, have resulted in less water and poorer quality water for river irrigators. The balance of the irrigation is from ground water or from still healthy flowing springs. Other historically large springs in the region once produced pure, cool irrigation waters and provided recreation for many, but now are dried up due to overuse of the aquifers. This new program has been developed to assist the residents of the region through a variety of methods including: educational exhibits and presentations, demonstrations, workshops and seminars, applied research programs, publications, media articles and through collaborative efforts with a diverse group of agencies, governmental units and non-profits.

Target Audience(s): Diverse, iinclude all listed in CFP plus irrigation districts and groundwater conservation districts in West zone

Educational Purpose: Information, education

The University of Vermont Watershed Alliance: Using Youth Education and Service to Engage Communities in Local Water Quality

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Abstract

Audience size and limited human and financial resources limit Extension's ability to educate individual homeowners, landowners, local officials and others. Leverage and multiplication of effort is needed.

The Watershed Alliance (WSA), a youth water quality/watershed education, monitoring, and service program, prepares youth to inform and engage communities in water quality issues. Water education often focuses on classroom education and student monitoring. WSA adds student community service and information components to enhance community understanding of water quality issues, improve access to information, and spur community action for watershed protection.

Students increase awareness and stimulate action by presenting local water quality data to select boards and town government. Student, through water monitoring, have detected water quality problems in several towns. Reporting these problems have led to a "boil water" advisory, the emergency repair of a local WWTP, revision of WWTP operations, and increased community awareness of water quality. Students work with local community groups in public awareness, education and data collection. Students developed media efforts to increase local awareness and engage the public to address pressing local water quality problems.

The service component and database effort promotes local ownership and community responsibility. The database provides easily accessible and useful information in an understandable form. Because water quality data is locally collected, stored and used by students, there is ownership and trust of the data. Schools become community information resources on water quality. Communities are more responsive and engaged in water quality protection and improvement when local youth monitor, report, and educate about local waters.

Target Audience(s): Households, homeowners, local decision and policy makers

Educational Purpose: Education, capacity building

Watershed Development in Una District of Himachal Pradesh in India

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Abstract

In the rain-fed, irregular, hilly terrain of District Una in Himachal Pradeshthe, the Integrated Watershed Development Project (IWDP) is in operation, funded by the World Bank. In the present paper an attempt was made to investigate the effectiveness of various methods used for water harvesting and its conservation in the study area.

Data was collected from members of the village development committees (VDCs) through interviews and participatory observations. Analysed data indicated that under the IWDP Project (through VDCs developmental works particularly related to minor irrigation) water management, watershed development and soil conservation have been carried out.

A large number of check dams and specially designed ponds have been constructed for harvesting rain water. In the study area, where water was scarce, the stakeholders have now adopted fish farming which has improved their economy and are conserving water in the ponds. A large number of trees have been planted to slow down water runoff in the project area, to check soil erosion, and to regenerate the depleted forest cover.

The paper highlights formation of the village development committees through Participatory Rural Appraisal methodology, as well as their functioning and water harvesting at the micro-watershed level. To continue watershed development in areas where topography is irregular and water is scarce, various development agencies in the hilly regions should start planning to link up existing VDCs with other institutions. The significant achievements and drawbacks of the approaches used under the IWDP will be discussed in the presentation.

Target Audience (s): Agricultural commodity groups, farmers, environmental/ conservation, non-government organizations

Educational Purpose(s): Education, capacity building

Best Practices for Environmental Field Days

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Abstract

Over 75 % of Minnesota counties report holding environmental field-day programs, involving thousands of 4-6 grade youth. The investment of time and money by state and federal governments, and non-profit organizations to support these programs for K-12 schools is significant. To be more effective, these programs require expensive planning and partnerships as outlined in the best practices for environmental field days researched by the environmental science education working group at the University of Minnesota. We have identified a list of best practices, from both literature and practical experiences, for the organizers and presenters at these events, resulting in guidelines for improving the impact these programs can have on young people.

The intent of the Best Practices for Environmental Field Days Program is to provide organizers, presenters, participants, and volunteers of environmental field day events with practical research-based information to increase the success of their events, improve student learning and retention, and make meaningful strides in the development of an environmentally literate citizenry.

This presentation will highlight the best practices program for planning and delivering effective environmental field day programs.

This is a spotlight program for the University of Minnesota Extension Service.

Target Audience(s): Agency partners, environmental/conservation nongovernment organization, other natural resource professionals

Educational Purpose: Information

Teacher Perceptions of Iowa Workshop Model Aspects for Fostering Use of Project WET

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Abstract

State partners of national environmental education (EE) programs contribute to professional development in EE through their program delivery. This study describes teacher perceptions of individual elements of EE workshops provided by one such program, Iowa Project WET. The study found that educators associate three types of workshop activities with successful classroom integration of Project WET activities:

(a) Experiencing activities first-hand
(b) Interacting with other educators
(c) Learning about the Project WET Activity and Curriculum Guide.

Almost 90% of survey respondents integrate some of the activities they experience during the workshop into their classrooms. Some of these teachers also integrate additional activities not presented in the workshop. Multiple measures of activity use indicate the respondents select and use activities to meet curriculum goals. Survey data and phone interviews show that respondents utilize each activity they implement to meet multiple goals related to the curriculum, student interactions, and assessment of student knowledge. Respondents reported that insufficient planning and class time limited use of activities. Suggestions are made for improving the workshop model.

Target Audience(s): Environmental/conservation nongovernment organizations

Educational Purpose: Education

How Does Risk Information Shape Protective Behavior and Support for Policy to Mitigate Risk in the Environment?

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Abstract

The purpose of this study is to understand how experiential and external sources of risk information influence behavior to reduce arsenic exposure and opinions about policy to reduce arsenic in the environment. External information sources were the self-reported arsenic level and total information use. Experiential information was perceived overall water quality and arsenic-related health effects. We applied the common sense model (CSM) that illustrates how people process information to construct representations that guide responses to health threats. Of 649 surveys mailed to private well owners with arsenic levels that exceeded the current arsenic drinking water standard, 545 (84%) were suitable for analysis. Structural equation modeling quantified relationships based on the CSM and fit the data with behavioral outcomes (RMSEA=.045) or policy outcomes (RMSEA=.045) and explained 57% and 55% of the variance in behavior and policy opinions respectively. External information sources had their greatest effect on behavior through certainty about knowledge and control methods and on policy opinion through understanding causes of arsenic. Experiential information (predominantly water quality) had its greatest effect on behavior through the emotional representation, health and property value consequence dimensions and the exposure identity/cause dimension. Experiential and external sources of information influenced behavior while external information was the dominant influence on policy. Information should 1) promote understanding lab results and provide guidance for 2) interpreting and responding to perceived overall water quality and 3) selecting effective arsenic control methods in order to promote protective behavior. Public information should educate the public about arsenic causes to promote groundwater policy support. People need to understand how to identify, causes and consequences of, and how to control both risk exposure and risk in the environment to foster comprehensive environmental health prevention.

Target Audience(s): Agency partners, NGOs

Educational Purpose: Information, communications, education

Evidence Supporting Yearly Community Well Testing

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Abstract

An evaluation of an arsenic well test program (WTP) offered in 19 of 37 towns in Wisconsin's arsenic advisory area showed that participants in the one town that offered the WTP each year over 3 years 1) tested for arsenic more often 2) used more arsenic-related information, 3) rated information sources as more useful, 4) had a greater recognition of being at risk for having arsenic-contaminated well water, 5) selected a lower arsenic level for identifying their water as unsafe, 6) were less likely to agree that the newly revised drinking water standard was too strict, and 7) had more confidence in how their town officials were handling the arsenic problem than participants in towns offering the program only one time. An ongoing program offered at the local level with cooperation from local officials may foster trust at the local level that in turn enhances the acceptance of prevention information. This evaluation research, a mailed survey with a response rate of 85.4% (N = 1233), also shows that collaborations between university students and agencies can produce results useful to both agency staff and researchers.

Target Audience(s): Agency partners, NGOs

Educational Purpose: Information, communications, education

A Utilization-Focused and Theory-based Evaluation of an Arsenic Well Testing Program

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Abstract

A utilization-focused and theory-based evaluation study was conducted to understand how private well users responded to an educational arsenic well test program (AWTP). The common sense model (CSM), a health behavior theory, has shown that people process health threat information to formulate personal understandings (representations) that guide responses to threats. In this case the threat was arsenic. The CSM was applied to measure arsenic information use and perceived usefulness, arsenic representations, and outcomes of water safety judgments, policy opinions, and protective behavior. In communities that offered the AWTP, 1496 surveys were delivered to households, with 1237 surveys going to households that tested through the AWTP and the balance to households that did not test through the program. Of the surveys delivered, 1233 (82.4%) were suitable for analysis. Program staff estimated that about 30% of community households tested through the AWTP and study results indicated about 40% tested privately. It is important to provide arsenic information available to the general public. Information mailed with the well test is used the most by all participants and is also considered a very useful source for informing well water decisions. Participants who did not test for arsenic were less aware of arsenic risk. Over 60% of participants with arsenic levels over the current drinking water standard perceived their water as at least somewhat safe. It is important for people to understand how arsenic drinking water standards are selected and what they mean. Participants living in a community that offered the AWTP each year adopted lower arsenic safety thresholds compared to those living in a community where arsenic was highly publicized but the AWTP was offered once over 3 years. Ongoing education may promote more accurate understandings than high publicity.

Purpose

The purpose of this evaluation research is to understand *how* a Wisconsin arsenic well-testing program was working. The research sought to highlight how 1) private well users responded to an educational arsenic well test program, 2) four different types of information were related to outcomes through personal understandings of arsenic in well water, and 3) community awareness

was related to adopting a lower arsenic drinking water standard. The purpose of this paper is to discuss selected study findings and implications for outreach programs.

Background

The purpose of most well test outreach programs is to educate private well users about groundwater and well contaminants to promote: 1) stewardship of groundwater resources and 2) informed decisions about managing their well to optimize well water quality for various uses including safe drinking water. An educational **arsenic well test program** (AWTP) is offered in a geographic area of Wisconsin designated as an arsenic advisory area (AAA) where 23.2% of tested wells have arsenic levels at or over the current drinking water standard of 10 micrograms per liter (µg/L). It is estimated that about 4,700 wells used by about 11,700 people have levels $\geq$ 10 µg/L.

Arsenic in the AAA

The main arsenic source is from a naturally occurring sulfide deposit in the aquifer used for most private wells in the area. In the AAA, this deposit is close to the surface such that wells are likely to transect the arsenic rich deposit. Two processes are believed to release arsenic to the groundwater: 1) an oxidation process initiated when the water table drops and exposes arsenic deposits to air, and 2) reduction processes from anaerobic conditions within wells. The growth of aerobic and anaerobic bacteria within the borehole also contribute to the release of arsenic (Gotkowitz, Schreiber, & Simo, 2004). Increasing arsenic levels in the AAA have been attributed to decreasing groundwater water levels at a rate of 2–4 feet per year due to residential and industrial development (Riewe, Weissbach, Heinen, & Stoll, 2001).

The Arsenic Well Test Program (AWTP)

Towns make the decision of whether to offer the program because town officials do the work of notifying the community, collecting a batch of water samples and transporting the samples to the lab. Mass sampling allows test labs to charge a reduced rate in the range of $20 rather than $35 for the arsenic test. Residents pick up their samples at an educational town meeting conducted by state and local Department of Natural Resources (DNR), UW-Extension, and county and state public health department staff. As of February 2003, 20 of 37 towns in the AAA offered the AWTP with only one town offering it more than once. Overall, about a third of residents tested through the program and about 30–50% (depending on the town) attended the town meeting to pick up their test results. Test results were mailed to those not attending the meeting.

Agency sources of arsenic information are available at the town meeting, by phone contact with staff, and from brochures and Web sites. Non-agency sources of arsenic information include: newspaper articles, television programs, salesmen of arsenic filters, well drillers, health care providers, non-agency arsenic Web sites, and friends or neighbors. Information provided at the town meeting and in brochures included: how to identify an arsenic problem, causes of arsenic in well water, how and why arsenic levels are changing with time, health consequences of arsenic exposure, and how to control arsenic to prevent consequences. The risk message delivered with the program changed each year. The U. S. Environmental Protection Agency (EPA) proposed an arsenic standard of 5 µg/L in 2000, 10 µg/L in 2001, and, the federal arsenic standard was changed from 50 to 10 µg/L in October 2001. The Wisconsin arsenic brochure developed in 2000 recommended that people with arsenic levels between 5 and 50 µg/L *may* want to use another water source (Wisconsin Department of Natural Resources, 2000). The Wisconsin arsenic

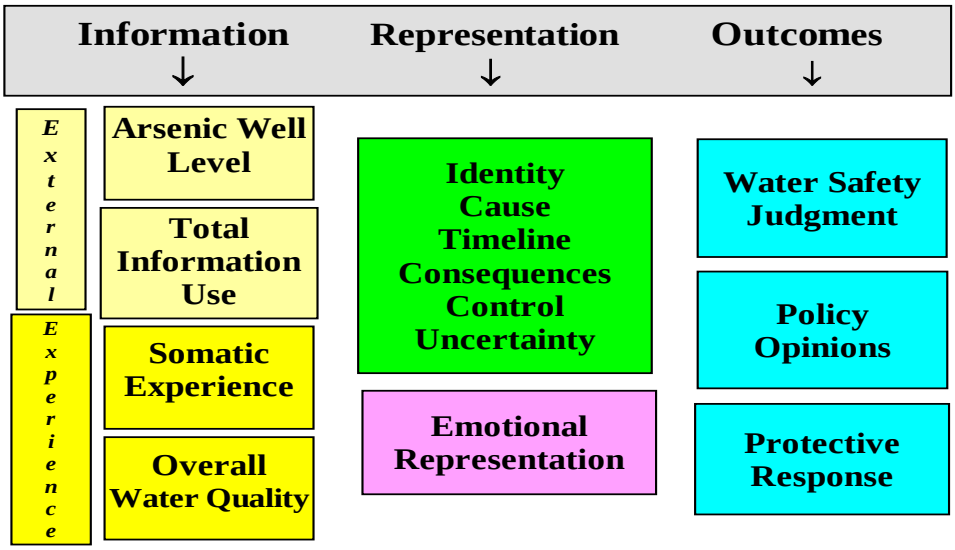
brochure developed in 2001 stated that people with arsenic levels at or greater than 10 µg/L should stop drinking their well water (Wisconsin Department of Health and Family Services, 2001). People may feel uncertain about how they should identify arsenic risk when different guidelines have been proposed and when the drinking water standard has been recently revised.

A utilization-focused and theory-based evaluation of the program was designed to understand how people residing in AWTP communities responded to the program. *Utilization-focused evaluation* is designed to generate findings that can be directly used by program staff (Rossi, Freeman, & Lipsey, 1999). Utilization-focused elements included measuring patterns of 1) information use, perceived usefulness, and preferences, and 2) actions used to reduce arsenic exposure among people in communities offering the AWTP. *Theory-based evaluations* identify plausible causal mechanisms to explain how program activities are related to outcomes (Rossi et al., 1999). Theory-based evaluations 1) strengthen claims of causal relationships, 2) identify successful causal mechanisms that can be applied to other programs, and 3) target measuring modifiable intermediating variables that can specify program changes (Reynolds, 1998). We selected the common sense model (CSM), a health behavior theory illustrating personal understandings of arsenic as the causal mechanism that explains how information leads to outcomes.

The CSM was selected as a good fit because it embodied program processes and the program philosophy of informed decision-making. Twenty-five years of CSM research shows that people process health risk information to formulate structured personal understandings or representations that guide behavioral and emotional responses to health threats. People actively process information to “make sense” of a situation and respond in a way that fits their common sense understanding (Leventhal, Brissette, & Leventhal, 2003; Leventhal, Nerenz, & Steele, 1984).

Information sources used to form CSM representations are characterized as information 1) stored in the memory, 2) from external sources, and 3) from personal experience. Personal understandings, referred to as **cognitive representations**, are comprised of five or six dimensions: identity, cause, timeline, consequences, control, and sometimes coherence (Hagger & Orbell, 2003; Leventhal et al., 2003). *Identity* pertains to how a threat is recognized and labeled. *Cause* is perceived causal mechanisms for a health threat. *Timeline* is beliefs about how a threat will change over time and its duration. *Consequence* is beliefs about how the threat impacts their lives. *Control* reflects beliefs about controlling a threat. *Coherence* is the degree to which people have an overall understanding or comprehension of the threat (Moss-Morris, et al., 2002). We replaced the concept of *coherence* with *uncertainty*, a central concept in risk assessment and communication (Griffin, Dunwoody, & Neuwirth, 1999). **Emotional representation**s are the emotional feelings elicited by information and the cognitive representation. **Protective responses** are a function of information use and their cognitive and emotional representations. The CSM provided a framework (see Figure 1) for selecting variables used to quantify 1) information sources, 2) representations (risk understandings), and 3) outcomes of safety judgments, opinions about policies to address root causes of arsenic, and responses to reduce exposure.

Figure 1. Study framework based on the Common Sense Model



Methods

Survey instrument

A survey was constructed to measure concepts depicted in the study framework and to also measure the utilization of arsenic information. The survey was pre-tested using methods outlined by Dillman (2000). ***External and experiential sources of information*** were measured. *External information* sources were: 1) self-reported arsenic level and 2) total information use (calculated by summing all sources used and how frequently they were used). Total information use reflects the amount (or dose) of information used as well as their motivation to seek information. Measures of information use, perceived usefulness, and preferences provide measures of program utilization, satisfaction and information preferences. They also indicate information sources used to supplement program information. E*xperiential information sources were*: 1) perceived arsenic-related health effects, and 2) perceived overall water quality.

Variables selected to measure personal risk understandings or **representations** were derived from interviews with AWTP staff, community residents, and research literature exploring correlates of protective behavior. Thirty-five variables were selected to measure how arsenic risk is identified, its cause, timeline, consequences, control, feelings of uncertainty, and negative emotions. Variables selected to measure **outcomes** included 1) water safety judgments, 2) policy opinions (including whether the DNR should mandate well drilling methods, if towns should discourage new industry that uses a lot of water, and whether communities should reduce groundwater withdrawal by drilling fewer private wells and encouraging water conservation among residents), and 3) protective responses used to reduce arsenic risk. Measures of actions to reduce arsenic exposure illustrated who is doing what and were categorized as: no action, ineffective action, somewhat effective action, or as a state recommended action for reducing arsenic exposure. Quantifying total information use, representations, and the protective response allowed an analysis of relationships among these variables.

Design

Surveys were mailed at a single point in time 0.5–3 years after the AWTP was offered to community residents. The sample consisted of: a) all households that tested their wells through the program and had an arsenic level ≥ 5 µg/L (N=1154), and random samples of b) AWTP households with wells from 1–4 µg/L (N=100) and c) households who didn't test their well through the AWTP (N=259). Instructions asked that one household adult was to complete the survey. A modified Dillman (2000) method was used that entailed up to five contacts by mail: 1) pre-notice letter, 2) survey, stamped return envelope and $2 incentive, 3) postcard reminder, 4) replacement survey and return envelope, and 5) final postcard reminder.

Analysis

A data management and analysis product called SPSS (Statistical Package for the Social Sciences) was used for the descriptive analysis and analysis of variance. The software LISREL was used for structural equation modeling. The modeling analysis was conducted on a sub-sample of AWTP participants with arsenic levels ≥ 10 µg/L.

Selected Results and Implications for Practice

Well testing

Two thirds of participants not testing through the AWTP privately tested their well. Across communities, agency staff indicated that about 30% of households were testing through the AWTP; thus about 40% were testing privately. The AWTP may prompt increased private testing due to the awareness raised by advertising the AWTP. This proposition cannot be answered with this study as it lacked a no-treatment comparison group. It is important to develop sources of arsenic information that are available to those who test privately. No-test-participants have less awareness of the arsenic problem and less awareness that their well water may be a source of arsenic exposure. Considering information use, perceived usefulness, and preferences among the no-test group, it may be possible to reach no-test-participants using a mailing from the town or DNR and through newspaper coverage.

Arsenic level

The arsenic level had the largest effect of all information sources on protective responses. It is an essential source of information for private well users. Arsenic well level knowledge shapes information use, personal understandings and outcomes. Other researchers have found that nitrate levels (Poe, van Es, VandenBerg, & Bishop, 1998) or radon levels (Weinstein & Sandman, 1992) were strongly related to perceived safety and/or actions to reduce risk. People have a tendency to recall lower levels of arsenic or to not remember if they have tested for arsenic. People who couldn't recall their arsenic level used less information than those who reported even low arsenic levels. Those not testing used far less information than other participants. Strategies to help people keep track of well test information such as a refrigerator magnet or a sticker that could be placed in a handy location (such as a calendar) might improve the accuracy of self-reported well levels. People will likely have a better recall of the meaning of a test result than they do of the actual result. In a study of cholesterol level recall, all study participants accurately recalled their cholesterol risk status while only about half could recall their actual cholesterol value (Glanz, et al., 1990). Accurate recall of the meaning of their test result may be facilitated by providing them with their risk status (e.g., unsafe – safe) along with their arsenic well level. A disadvantage of this approach is the tendency for people to think that levels above a threshold are safe and levels

below are unsafe rather than more accurately understanding that the relationship of exposure level to risk is usually linear with subtle differences just above and below a safety threshold (Weinstein, Sandman, & Roberts, 1989). It would be essential to communicate how their risk status was determined and to provide further information about how arsenic drinking water standards are selected.

Information use

AWTP participants used information mailed with the well test most often, rated it as the 3rd most useful information sources (after conversations with agency staff and staff presentations at the town meeting), and rated it as the most preferred source. Private well testers rated information mailed with the test as most useful and the most preferred sources of information, but it was used slightly less than information from other mailed sources; likely because some test laboratories send no information with the well test report. When information use, perceived usefulness, and preferences are considered together, information mailed with the well test is the most important information for AWTP and private well testers combined. Further research is needed to understand information that is currently provided by private testing labs and the feasibility of using this channel to better meet information needs. Information received with a well test is available at a "teachable moment" when well users are motivated to understand their test results. This information could include links to other sources of arsenic information so people could seek further information from reliable sources more easily. It is important that this information is easily understood by the general population.

On average, participants used nine "hits" of information from 5 different sources. Arsenic risk information should be publicly available from a variety of mediated and personal contact sources. A meta-analysis of studies evaluating patient education found that offering information from a variety of mediated and personal information sources was related to adopting preventive behavior (Kok, van den Borne, & Mullen, 1997; Mullen, et al., 1997). Attempts should be made to improve the accuracy of arsenic risk information that is provided by non-agency sources. For example, the Wisconsin DNR provides training for well drillers. In the AAA, this training currently includes information about arsenic and about well drilling methods that can mitigate the amount of arsenic in well water. It may be possible to provide information through local sources such as town newsletters or local newspapers, although information from newspapers was rated as minimally useful for making well water decisions among participants who tested their wells. It is important to develop information sources for people who test privately.

Information use and outcomes

Total arsenic information use (from external sources) had its greatest influence on protective behavior through certainty about control methods. Information should promote informed decision-making about selecting appropriate control methods by providing information that allows consumers to compare different arsenic control methods based on cost and removal efficacy.

Total arsenic information use was related to policy opinions through beliefs about causes of arsenic in well water. In a synthesis of evidence related to environmental literacy, Coyle (2004) states that people need to understand causal sequences that link human actions to environmental problems in order to take action or support policies that address the root causes of environmental problems. Understanding causes of arsenic in well water was strongly related to support for policies to decrease the withdrawal of groundwater such as community-wide water conservation

and reducing the number of private wells being drilled into the arsenic-containing aquifer. These results support Coyle's claim that environmental stewardship is promoted by educating people about these causal relationships. The arsenic town meetings provided detailed information about the causal relationships between water use, groundwater levels, and aquifers that may have been a factor in developing these beliefs and opinions.

Perceived water quality

Sensory qualities of water were most strongly related to identifying risk, health consequences/negative emotions, and water safety judgments. People need specific guidance for how to interpret and respond to sensory qualities of water. While people generally know that arsenic cannot be sensed, it is important to remind the public that arsenic cannot be tasted, smelled or seen and that well testing is the only way to know whether they have arsenic-contaminated water. It is likely that sensory qualities of water will remain a strong influence on perceptions of water quality/safety and to a lesser degree on protective behavior because experience is a psychologically powerful source of information (Leventhal, Safer, & Panagis, 1983).

Somatic experience

There was a clear linear relationship between arsenic level and perceived arsenic related health effects, but relatively few perceived these health effects (about 11%) which attenuated its effect as a source of information in the modeling analysis. Somatic experience was most strongly related to beliefs about health consequences and negative emotions.

Safety threshold

People selected a wide range of personal safety thresholds (the highest arsenic level they considered safe) ranging from 0 µg/L to > 100 µg/L. Safety thresholds were related to the protective response through safety judgments. When a safety standard has been revised, people need more information about why and how it is selected. Media sources tend to cover controversy more than synthesize facts and tend to cover opposing points of view about an issue to provide balanced reporting (Dunwoody, 1999). These reporting tendencies may lead the public to perceive more controversy about the revised drinking water standard than was the case. Agency professionals should assess beliefs about safety thresholds so specific public questions about safety thresholds can be addressed.

Protective response

About half of participants with arsenic levels over the current drinking water standard are not effectively reducing arsenic exposure. Researchers exploring responses to radon risk found that roughly half of participants with high radon levels were not taking action to reduce exposure (Weinstein & Sandman, 1992; Doyle, McClelland, Schulze, Elliott, & Russell, 1991). Selecting a higher safety threshold than the current drinking water standard, optimistic beliefs about water safety, perceived barriers (cost and effort) to controlling arsenic, and uncertainty about arsenic control methods may partially explain why participants do not take action to reduce their exposure. These are all elements that can be addressed in educational materials provided to private well owners. For example, people need information about arsenic control methods that allow them to compare the costs and benefits of each method to promote informed decisions.

Community awareness and adopting a lower arsenic drinking water standard

Participants living in a community that offered the AWTP each year adopted a lower arsenic safety threshold compared to those living in a community where arsenic was highly publicized but the AWTP was offered once. Education may promote more accurate understandings than publicity.

Application of the CSM to Outreach Programs

A meta-analyses of health education and health promotion programs found that the application of social science theory to program planning was a strong determinant of effectiveness (Kok et al., 1997). Environmental communication researchers recommend applying psychosocial behavioral theories to the design of outreach programs to enhance program effectiveness (O'Keefe & Shepard, 2002). The CSM, together with findings from this study, could be used to modify information provided to well owners to meet information needs identified by this study and to employ CSM derived knowledge about how people use and apply information about health risks.

Summary

Efforts should be made to make well test results and the water safety implications of their results easier for people to recall. User-centered information should be included with the arsenic well test and should also be available from a variety of sources. Information should clearly explain the revised arsenic drinking water standard, provide information about various arsenic control measures that allow people to compare measures based on cost and effectiveness, and provide guidance for how people should interpret and respond to perceived sensory qualities of well water. Programs should provide education about the causal sequences that link human activities to increasing arsenic levels to promote support for policies to address the problem on a larger level. The CSM may be a useful framework for designing risk information provided to private well users. Information designed to educate the public based on cognitive understandings of threats would include: 1) how they can identify an arsenic problem (an arsenic level compared to a safety threshold); 2) how safety thresholds are determined; 3) factors that identify their level of exposure to arsenic (arsenic level, amount of well water consumed, and length of time used); 4) potential health consequences of exposure; 4) how arsenic levels are expected to change over time; 5) methods of reducing exposure including the costs and benefits of each; and 6) causes of arsenic in groundwater. Outreach programs that foster a comprehensive understanding of well water quality and well water safety promote informed beliefs and decisions about water treatment and groundwater protection.[1]

Acknowledgments

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APPENDIX (Severtson)

Implications for Evaluation and Outreach Programs

Implications for Evaluation

The process evaluation of information use suggests communication strategies based on information use, perceived usefulness and preferences. People who participate in a program may use different ‘doses’ of information that can be related to outcomes. This evaluation measures all arsenic information sources used including non-program information.

Members of a target audience who do not directly participate in a program may use available program information sources. It may be useful to include non-program participants in your evaluation to understand their utilization patterns, preferences, outcomes and barriers to participating in the program.

This was not an evaluation of program effect because all participants were in the treatment group. They all lived in a community that offered the arsenic well test program (AWTP). A representative comparison group of people living in Arsenic Advisory Area towns that did not offer the AWTP would have provided this comparison group. The time and cost of selecting a representative sample of this group precluded including them in this study but it would have been a useful addition.

The goal of this evaluation research was not to measure the effect of the AWTP, but rather to understand how arsenic information influenced judgments and behavior. The ability to draw causal inferences from a cross-sectional study was enhanced by modeling potential causal relationships using a theory selected to explain how information influences judgments and behavior. The coherence of study results are supported by study relationships that fit the theory and that are supported by other research. Knowledge of how interventions work can be used to improve programs and can be generalized across various programs utilizing the same intervention.

An 87% response rate was obtained using a modified Dillman method (Dillman, 2000) outlined in the abstract. The additional time and cost of using this method improved the validity of study results.

This evaluation research, a mailed survey with a response rate of 85.4% (N = 1233), also shows that collaborations between university students and agencies can produce results useful to students, researchers, and agency staff.

Implications for Well-testing Programs

The common sense model (Leventhal, Brissette, & Leventhal, 2003) was a useful framework for understanding responses to arsenic information and could be applied to other environmental health risks. This model provided data that could be used to specify risk message content and

Appendix (continued)

delivery strategies, and may illustrate successful causal mechanisms for outreach programs. Representation measures suggest information needs and partially explained differences in outcomes.

Results indicated that over 40% of town residents tested privately while about 30% tested through the agency sponsored AWTP. An agency-sponsored AWTP may prompt private testing behavior that is not evident in program participation. Further research is needed to substantiate this claim.

People have different information preferences and use multiple sources of information. It is important to offer information from multiple sources that are preferred by the public and considered as useful sources. Participants that tested through the well test program preferred mailed information, a town meeting educational session, and personal contacts with agency staff. Participants who tested privately used mailed information most often and considered information mailed with the test as most useful.

Overall the 'no arsenic test' and 'don't know my arsenic level' groups have a weaker sense of arsenic risk and generally rate their water as safe. Beliefs of not feeling their household is at risk, their water is a source of arsenic exposure, that family members are exposed to arsenic from their water, and that their water is safe may explain why people don't test their wells and suggest specific information needs.

Accurate knowledge of the arsenic level is essential for promoting appropriate understandings and protective responses. Arsenic well level knowledge shapes information use, representations and outcomes. People are more likely to remember whether their level was considered safe or not than their actual well level. It is essential that they can easily compare their well test result to a recommended standard to allow them to judge whether their test indicates a water safety problem.

People selected various personal arsenic safety thresholds. Their safety threshold was the most influential part of their personal understanding for making safety judgments and engaging in protective responses. People need more information about how safety thresholds are selected - especially when a safety standard is revised. Media sources tend to cover controversy more than synthesize facts and tend to cover opposing points of view about an issue to provide balanced reporting (Dunwoody, 1999). These reporting tendencies may have prompted some people to perceive more controversy about the revised standard than was the case.

Other than identifying a well water problem and using more information, beliefs of fewer barriers to controlling arsenic and being more certain about whether and how to control arsenic exposure were most strongly related to reducing exposure. People need information about arsenic control methods that allow them to compare the costs and benefits of each method to promote informed decisions.

Beliefs about causes of arsenic in well water were most strongly related to policy opinions to reduce groundwater withdrawal – a stance supported by the Wisconsin Department of Natural Resources. The arsenic town meetings provided detailed information about the causal relationships between water use, groundwater levels, and aquifers that may have been a factor in developing these beliefs and opinions.

Appendix (continued)

People use and apply experiential information, especially their perceptions of water quality. People need guidance for how they should interpret and respond to sensory qualities of water.

External information sources and experience equally influenced representations, safety judgments, and policy opinions. However, external sources of information had a larger total effect on protective behavior. Perhaps 'in the head' concepts (representations, judgments and opinions) more equally reflect information from experience and external sources, but decisions to engage in costly behavior may place more weight on information from external sources.

Ongoing educational programs are more effective than one-time programs. While high publicity was related to information use and to recognizing risk, education seemed to be a factor in the adoption of a lower drinking water standard. This tentative 'case study' finding should be explored with further research.

Information needs to:

- Be mailed with the well test and should provide links to other information sources.
- Be available from a variety of media and personal contact sources.
- Be offered on an ongoing basis and be available from local sources.
- Provide guidance on how the public should interpret and respond to sensory qualities of well water quality. People need to be reminded that arsenic cannot be sensed and that well testing is needed to identify an arsenic problem.
- Interpret the meaning of the arsenic test. It is likely that the meaning of the test will be better remembered that an actual arsenic level. When a safety standard has been revised people need information about why and how a standard was determined to establish the credibility of the revised standard.
- Provide information about arsenic control methods that promote informed decisions (for example information that helps them to compare advantages and disadvantages of each control method).
- Provide information about causes of arsenic in the environment and policies that might address root causes of the problem.
- Be understandable for a wide audience.

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Enlisting Landowners in Water Conservation

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Abstract

In an attempt to reach landowners using a more practical means of media, The University of Tennessee Agricultural Extension Service (UTAES) has developed two highly successful water quality publications. The first publication is a handbook entitled "Conservation Practices for the Farms and Forests of Tennessee." It describes 51 best management practices (BMPs). The entry for each practice includes full-color pictures of the practice; description of the practice; water quality benefits; landowner benefits; considerations; complementing practices; maintenance; and costs.

The handbook is not a technical manual. Rather, it is an attractive, easy-to-understand book designed to introduce readers to BMPs; to explain why they should be considered; and to provide direction when they choose to implement practices. This is an excellent example of how to reach those who are uncertain about BMPs or why they should consider implementing them.

The second publication is a BMP calendar developed for the Pond Creek watershed in East Tennessee. It was developed as part of a pilot project, and was designed to introduce landowners in the watershed to BMPs and to inspire them to make any necessary changes. Each month features a BMP that addresses major sources of ag-related contaminants in the watershed with a picture and description of the practice, an explanation of what it can do for them, and an outline of water quality impacts. By combining a calendar with BMPs, landowners are exposed to the concepts each time they glance at the calendar, and they are informed in a positive, non-threatening way.

Handbook

Initial contacts with landowners about ways to protect and improve water quality can be undermined by their lack of familiarity with best management practices (BMPs). To help overcome this barrier, The UTAES contracted with the Tennessee Department of Agriculture (TDA) to produce a handbook entitled "Conservation Practices for the Farms and Forests of Tennessee."[2]

A team of UTAES faculty, in consultation with TDA and the Natural Resources Conservation Service (NRCS), identified 51 key BMPs for Tennessee (see Appendix A). Each BMP is described with full-color pictures of the practice; a written description of the practice; a discussion of how the practice protects and improves water quality; an outline of key landowner

[2] The handbook is not an original idea. Georgia and South Carolina developed water conservation handbooks prior to this project. Other states and agencies have also created comparable products.

benefits; a list of complementing practices; and a description of maintenance considerations; costs; and other considerations, such as cost-share eligibility.

The handbook is not designed to be a technical manual. The goal was to create an attractive, easy-to-understand publication to introduce readers to BMPs; explain why they should be considered; and describe how to incorporate them into a farm or forest operation. It provides a conversation starter to use with landowners who are not familiar with BMPs or who are unsure why they should consider implementing them.

A “further information” section lists each county Extension and soil conservation district office, including address and phone number. Contact information for state and federal natural resource agencies and organizations is also included in this section, providing users with a ready reference to sources of additional information and assistance.

Appropriate Extension faculty specialists developed the information in this handbook to ensure transfer of current, optimal instruction per practice. Photos to illustrate the practices were taken across the state specifically for the handbook. TDA and NRCS reviewed the draft materials for technical accuracy and completeness. Finally, materials were edited by a communications specialist for consistency in presentation and ease of understanding.

Twenty thousand handbooks were printed at an approximate cost of $5.60 each. An initial distribution of 100 was made to each of the 95 county Extension offices and Soil Conservation District offices in the state.

The handbooks, distributed in 2001, have proven to be popular and useful according to reports from across the state. Few copies remain in inventory; funds for a second printing are being sought. Anecdotal reports from the counties indicate the handbook is an effective way to illustrate practices and launch discussions of incorporating BMPs with landowners and their families.

Pond Creek Watershed Calendar

In an extension of the handbook, a BMP calendar was developed as part of a pilot watershed project in Pond Creek (HUC: TN06010202013).

The major sources of ag-related contaminants in the watershed were identified by infrared aerial photography. Twelve BMPs that address these problems were then identified. Each month includes a picture of a practice, and a description including landowner benefits and the effects on water quality (see Appendix B).

Two thousand full-color calendars were printed at a cost of approximately $4.20 each. Calendars were hand-delivered to farm families in the watershed, providing an opportunity to introduce them to the project and discuss watershed issues one-on-one. Calendars were also distributed to agribusinesses, local agencies and organizations, and the general public in the watershed.

Community involvement also included several public meetings within the watershed to discuss the pilot project, impacts of agriculture on water quality, and BMPs. In addition, a manure management field day held on a dairy just across the watershed divide, involved many members of the Pond Creek community.

The full-color calendars are eye-catching and tend to be retained and used. Many were hung in dairy barns allowing employees, as well as the farm families, to see how practices like stream crossings and heavy use areas can improve working conditions.

According to reports of Extension and NRCS personnel working in Pond Creek, six of the twelve BMPs have been implemented on one or more farms in the watershed since distribution of the calendars. They credit the calendar with creating awareness and interest, which led to the implementation of these practices.

Currently, we are planning a 2005 Pond Creek Calendar. It will feature photos of BMPs implemented in the watershed, with the farm family's permission. A common question has been about where the pictures were taken; landowners are interested in seeing the practices "on-the-ground."

Concluding Comments

The handbook and calendar have proven to be popular, in part because they are attractive, full-color products. They create awareness of BMPs and provide positive reinforcement of the concepts each time an individual thumbs through the handbook or glances at the calendar. They are worthy of consideration when one is looking for ways to create awareness and interest in water quality education.

APPENDIX A (Smith)

Handbook BMPs

The 51 practices outlined in *Conservation Practices for the Farms and Forests of Tennessee* are:

- Access Roads
- Alternative Watering Systems
- Buffer Strips
- Conservation Tillage
- Contour Farming
- Contour Stripcropping
- Cover Crops
- Critical Area Planting
- Crop Rotation
- Dead Animal Composting
- Diversions
- Farm Ponds
- Field Scouting
- Grade Control Structures
- Grassed Waterways
- Insect Traps
- Integrated Pest Management
- Irrigation Management
- Keeping Excellent Records
- Liquid Manure Storage
- Locating & Constructing Forest Roads
- Log Landings
- Manure and Litter Application
- Manure Composting
- Manure & Litter Testing
- Micro-Irrigation
- No-Till
- Nutrient Management Plans
- Pasture Management
- Pesticide Application
- Pesticide Handling
- Pesticide Loading Facility
- Plant Tissue Testing
- Poultry Litter Storage
- Precision Farming
- Protected Heavy-Use Areas
- Protecting Streams and Wetlands
- Runoff Management
- Sediment Basins
- Setting Realistic Yield Goals
- Sinkhole Protection
- Skid Trails
- Soil Testing
- Sprayer Calibration
- Stream Crossings
- Stream Protection
- Terraces
- Weed Management
- Well Protection
- Wetlands
- Wildlife Habitat

APPENDIX B (Smith)

Example of Calendar BMP entries

Beef and dairy operations are the major sources of contaminants in the Pond Creek Watershed. The BMPs included in the Pond Creek calendar are:

- Stream Protection
- Stream Crossings
- Nutrient Management Planning
- Buffer Strips
- Manure Testing
- Manure Application
- Liquid Manure Storage
- Runoff Management
- Manure Composting
- Soil Testing
- Alternative Watering Systems
- Protected Heavy-Use Areas

Minnesota Water–Let's Keep It Clean: A Twin Cities Stormwater Education Collaboration

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Abstract

Over 150 Minnesota cities are required to implement Stormwater Pollution Prevention Plans. Each plan requires a strong educational component, with target audiences and educational goals identified for each six Minimum Control Measures.

Metro WaterShed Partners, a collaboration of water resource educators in the Twin Cities, saw an opportunity to assist cities in delivering quality stormwater education and established "Minnesota Water – Let's Keep it Clean", a program that does three things:

1. Collaborate with putting clean water messages in mass media, something out of financial reach for individual cities.
2. Make ready-to-adapt stormwater educational materials available to cities and neighborhood organizations.
3. Achieve a consistency of message across the Twin Cites Metro.

A regional communication/marketing firm, Periscope, has been contracted for placing messages in the media and Web site design.

By June 2004, the program will have completed a spring and fall mass media campaign, and will have established a resource laden educational Web site at www.cleanwatermn.org. Current $110,000 funding is from state and regional governmental grants. Continuation funding is sought from subscriptions from cities, corporate sponsorship and grants.

During a case study presentation, the following will addressed:

- Formation of collaboration, development of messages, delivery strategy
- Fall and Spring mass media campaigns, messages and impacts (Web site data)
- Creation and content of Web site based educational resource for cities, et. al.
- Program continuation funding, success of subscription funding

Target Audience(s): Agency partners (city staff), households, neighborhood organizations

Educational Purpose: Information, capacity building

Lake-Friendly Gardening: Case Study in Homeowner Education in Whatcom County, Washington

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Abstract

Stormwater pollution is a growing concern for Lake Whatcom, a multi-use lake that is the drinking water source for over 85,000 Whatcom County, Washington residents. A 1999 state report documented multiple urban pollutants, including pesticides used by homeowners, in stormwater drains and tributaries within the watershed (Serdar and Davis, 1999). In addition, the Lake is in the Clean Water Act 303(d) list for low dissolved oxygen due to excessive phosphorus, a component of most fertilizers.

Changing residents' yard and garden practices was key to minimizing urbanization's effects on the Lake. In response, Washington State University Extension and Whatcom County Water Resources produced a booklet series, the *Lake-Friendly Gardening Kit* (http://lakewhatcom.wsu.edu/gardenkit). The team rewrote research-based Extension materials in a more engaging style and design. The kit is geared towards local issues, with booklets titled "The Ten Most Un-Wanted Pests," "Top Secret Agents," and "Passive-Aggressive Plants," among others.

Three months after receiving the kit, recipients were mailed a written survey. About 50% responded, with these results:

- 38% of respondents read the entire kit; 48% read half to most of it.
- 100% agreed the kit was useful.
- 98% thought the materials were easy to understand.
- 86% felt they learned how to make their practices more lake-friendly.
- 52% managed pests differently.
- 48% purchased pest-resistant plants.
- 52% changed their lawn care practices.
- 48% shared what they learned with someone else.
- 89% recognized the connection between their land use actions and water quality.

Target Audience(s): Homeowners, landowners

Educational Purpose: Information, capacity building

Leaving a Legacy

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Abstract

The Legacy program is a cooperative educational venture between the St. Johns River Water Management District (SJRWMD) and area schools. The program enlists educators and their students to help District staff make public lands more accessible while serving as living laboratories and classrooms. The Legacy program provides students unique opportunities to (1) assist with managing District lands, (2) participate in service learning, (3) increase environmental awareness, and (4) based on teacher observations, increase their school performance.

In turn, the District benefits because students remove exotic invasive plants, design and build trails and other amenities, post signs, pick up trash, provide tours, develop interpretive and educational materials, inventory natural resources, and test water.

The Legacy program began in 1993. Currently, 13 schools in 10 counties participate in Legacy programs. Although there are many similarities between Legacy programs, each program has unique, individualized teaching strategies and the programs are structured to fit the needs of students, schools, and the natural resource site.

Two evaluations, conducted in 2000 and 2003, have shown that participation in the Legacy program has assisted in improving students' grades, raised their awareness of water resource issues, and helped them develop leadership skills that benefit them, their schools, and their communities.

Introduction

The Legacy program began in 1993. Currently, 13 schools in 10 counties participate in Legacy programs. Although there are many similarities among Legacy programs, each program has unique, individualized teaching strategies and the programs are structured to fit the needs of students, schools, and the natural resource site.

2002 – 03 Annual Legacy Statistics
Schools participating – 13
School districts involved – 10
Number of students involved – 3,094
Number of adults involved – 205
Student service hours – 12,073
Adult service hours – 1,725

2003 – 04 First Quarter Legacy Statistics
Student service hours – 5,231
Adult service hours – 531

The Legacy program is a cooperative educational venture between the St. Johns River Water Management District and area schools. The program enlists educators and their students to help District staff make public lands more accessible while serving as living laboratories and classrooms.

Legacy is implemented differently by each program and is structured to meet the individual needs of the students and the school. Elementary, middle, and high schools have participated in the Legacy program, which may involve students for multiple years or for only a single year.

Students with some programs receive all of their classroom instruction through the Legacy program. And some programs have students take part in periodic site visits and only part of their classroom instruction takes place through Legacy. There is a wide variety of implementation strategies and practices used.

Through its Legacy program, the District gives students an opportunity to assist in managing public lands and to participate in service-learning projects within the District's jurisdiction. The Legacy program provides students a unique opportunity to (1) assist with managing district lands, (2) participate in service learning, (3) increase environmental awareness, and (4) based on teacher observations, increase their school performance.

Two evaluations, conducted in 2000 and 2003, by different independent consultants have shown that participation in the Legacy program has assisted in improving students' grades, raised their awareness of water resource issues, and helped them develop leadership skills that benefit them, their schools, and their communities. Participation in the Legacy program for one year yielded significant changes in skills and attitudes by students, even with schools that only held monthly on-site activities.

2000 Evaluation

In 2000, the District contracted with Elise Cassie to conduct an evaluation of all Legacy programs in existence for more than one year. Thirteen program contacts were provided. Thirteen teachers were contacted by phone, and interviews were conducted. Interviews lasted from 10 to 30 minutes, with teachers responding to five questions. Four of the five questions were observational, and the last question required specific data from the teachers.

Question 1: In general, rank the student's environmental awareness as a result of participating in the Legacy Program.

No Increase	Moderate Increase	Significant Increase
0	2	11

All teachers felt, without hesitation, that participating students had increased their environmental awareness as a direct result of the Legacy program.

Question 2: Based on your observation, rank the student's overall environmental behavior (e.g. picking up trash, recycling) as a result of participating in the Legacy program.

Poor (exhibits no positive behavior)	**Satisfactory**	**Good**	**Excellent** (always exhibits positive environmental behavior)
0	0	5	8

Although this scale appears vague and obviously subjective, all teachers provided at least one example of a student or students exhibiting positive environmental behavior on their own time (not associated with a grade). Examples of student action (behavior) include the following, which resulted from students' increased environmental awareness from participating in Legacy programs:

- A group of students initiated a recycling program at their school where they collect recyclables from teachers.
- Students have actively pursued and participated in environmentally related internships.
- A student told a teacher about spending a day on the beach with her family and picking up trash on the beach.
- Students now recycle at home with the assistance of their families.
- Students have asked to organize field trips where they perform water testing. (Students have become empowered by Legacy and have assumed leadership roles.)
- Students told a teacher they have gotten together on weekends to pick up trash and remove exotic plants from the District site they are involved with through the Legacy Program.
- During spring break, students volunteered to spray-paint "no dumping" signs on storm water drains, explaining to parents why their actions were important.
- Students willingly visit the District site they are involved with on their own time, bringing trash bags for litter cleanups.
- Students who have not been successful with mainstream education take pride in providing guided tours of the District lands they are involved with to classmates and visitors.
- During the fires in 1998, students volunteered to assist the firefighters after understanding the value of their participation in the Legacy program.
- Students "pack out what they pack in" while camping.
- Students who, before participating in the Legacy program would discard fishing line in the water, have been observed at the end of the year refraining from throwing the line in the water. These same students now use oil recycling facilities for discarding used motor oil.

The environmental implications of specific student action examples provide justification for the value of Legacy-type programs.

The educational premise that hands-on learning stimulates interest and often increases motivation has been in place for a century. Studies are beginning to emerge which validate the concept of environmental, specifically outdoor, education as a means to improve student performance (Leiberman, 1998).

Question 3: On average, what can you say about the student's grades as a result of participating in the Legacy Program?

Not Enough Data	Decreased	Remained the Same	Increased
1	0	0	12

One teacher noted that the students who benefited the most from Legacy program education are those students not "classroom oriented." Another teacher noticed an increase in grades among the dropout prevention students in particular. One teacher said that the Learn and Serve grant she received has documented grade-increase data.

Another teacher went beyond observational data and documents GPAs and student standardized test scores over time. Students were tracked for consecutive years and as a group within the school. Table 1 illustrates an increase in GPA scores over a three-year period.

Table 1. *Legacy Students' GPAs Over a Three-Year Period*

Legacy Students' GPAs	**1996–1997**	**1997–1998**	**1998–1999**
Overall	2.95	2.86	3.15
At risk	1.26	1.84	2.09

The GPA for Legacy participants is, on average, 0.34 higher than that of all students in the school. In addition to GPA information, the Florida Comprehensive Assessment Test (FCAT) writing scores for at-risk students participating in the Legacy program increased from 3.0 in 1997 to 3.5 in 1998. The teacher attributes the increase in both GPA and test scores to participation in the Legacy program.

Question 4: On average, what can you say about the student's attendance as a result of participating in the Legacy Program?

Not Applicable	Decreased	Remained the Same	Increased
3	0	2	8

Teachers who responded "not applicable" stated the following reasons:

- Legacy program involves AP classes, which is a group of advanced students not likely to have attendance issues.
- They could not participate in Legacy field trips if they missed school classes.

The final question (5) asked if the teachers had comparative data examining participating and non-participating students in terms of dropout rate.

None of the teachers maintained data investigating this question.

Findings and Recommendations

Based on telephone interviews with Legacy participants, the Legacy program is a valuable tool, acting as a catalyst for environmental attitude and behavior change in young people. The majority of the teachers feel that the District has played a significant role benefiting both the students and the environment. Preliminary findings revealed through teacher observations are that the Legacy program has a positive impact on participating students, communities, and the environment in general. One teacher noted a major improvement in the educational attitude of students.

The benefits to District-acquired lands are obvious, with trash and exotic plants removed, trails built, signs posted, tours provided, and water tested, in addition to other multi-use benefits for schools and the general public. Students have increased their environmental awareness and sensitivity, environmental behavior, grades, and attendance.

Recommendations for Legacy programs include the following:

- Continue monetary and personnel support for teachers and schools participating in Legacy programs. [The District can provide limited monetary support but assists all programs in developing funding partners, grant applications, and donations.]

- Provide support for teachers to track student performance by creating a simple tracking form for GPAs and test scores from year to year to examine trends. [Note: This has been attempted by the District with varying levels of success. Florida has experienced drastic education accountability changes in recent years; the District is outside the traditional education system and is not allowed access to some data.]
- Determine specific information the District needs on a yearly basis and provide a simple reporting form for numbers of participants, etc. (Since financial support is not always from the same funding agency, the District needs to track information consistently.) [Annual Legacy reports have been developed by the District and are provided to all partners, school district superintendents and boards, the Department of Education, and the Governor's office. Current and past reports can be found on the District's Web site at http://www.sjrwmd.com/]
- All participating teachers/schools need to model reporting of GPAs and test scores after Winter Springs High School (WSHS). The WSHS Legacy teacher has carefully tracked this information since the beginning of the program. [Note: This has been attempted by the District with varying levels of success. Florida has experienced drastic education accountability changes in recent years; the District is outside the traditional education system and is not allowed access to some data.]
- Encourage teachers to provide tours by students of the lands they are involved with, modeled after Princess Place. [This has been accomplished by all programs and expanded to include Legacy participating in most District water festivals, special events, and other programs. Legacy students serve as educators and interpreters.]

2003 Assessment

In August 2003, the District contracted with Mary Marsters of Marsters & Associates to conduct an assessment of the District's public education programming (Marsters, 2003), of which Legacy is a major component. The expertise of this contractor is to provide program assessment that looks at program outcomes and determines the impact of a program on its targeted customers: Were the customers satisfied with "the product" (in this case, the core education programs including Legacy offered by District education staff) and did the product have a sustainable impact on customer behavior? This information is then used to improve overall program management and performance.

The Legacy component of this assessment provided the District feedback and guidance on the Legacy program as presently implemented by District education staff.

Regularly used District Legacy delivery mechanisms and information were the source of information for this assessment and included the following:

- Workshops (both educator and student)
- Education presentations
- Water festivals, special events, and Legacy celebrations
- Publications
- Existing evaluation reports
- Program-related documents and reports

Also considered in this assessment is "education partner" satisfaction with District programs. This assessment is a strong and inclusive sample review at audit standards that allows for probability assertions on program accomplishment and the impact to be drawn.

The intended use of these assessment findings is to assist District staff to better understand present levels of program performance and from them, to be able to discern measures they can take to strengthen and improve program results. These findings can assist education staff in addressing a question related to program performance and management: Are we achieving the results we want, and what can we do to gain a greater return on our program-related investment?

Information-gathering was done to balance, to the greatest extent possible, its look at the breadth and depth of program impact. That is, for each core program area, the attempt was made to include numerous District counties or groups with active programs (breadth) and at the same time, to explore program impact through as many customer levels as served by a Legacy program (depth).

Findings were presented on the effectiveness of the overall Legacy program and its implementation along with recommendations for improvement and for gaining a greater return on their program time and resource investments.

Methods

Methods used to assess the Legacy program included an observation of two Legacy student events; an on-site visit to a Legacy-participating school; on-site interviews with participating teachers/professional volunteers; on-site interviews with participating students; informal interviews with parents of participating students; telephone interviews with teacher-coordinators from seven additional Legacy programs; a review of existing Legacy program documents; and a review of earlier Legacy evaluation findings.

Findings and Recommendations

1. ***Legacy provides a first-time opportunity for many students to directly interact with the environment.*** As one teacher stated, "[before Legacy] the students' idea of the environment was going to the beach." One key change in students that most interviewees noted was their significantly increased concern about protecting and conserving their environment, including and focusing on water resources, as a result of their involvement in the Legacy program. This makes it a strong program that is clearly helping SJRWMD achieve its educational goals.

2. ***Across the board, teachers stated that they noticed a significant decrease in behavioral problems among students participating in the Legacy program.*** In many cases, teachers stated that these behavioral changes were because students had to maintain a clear behavioral record in order to continue to participate in the program. For example, one teacher noted, "The kids are totally different when out in the field, doing something real." Students want so much to be in the program that they monitor their own behaviors closely to avoid missing a Legacy session.

3. ***Teachers identify a dramatic impact on student academic performance and FCAT scores that,, again, they attribute to participation in Legacy.*** In some cases, teachers require students to maintain a certain grade point average in order to continue their participation. But overall, teachers find that students, when working in a real setting outside the school, engage in real learning. They apply academic concepts to their work in the field (such as science, math, language arts, literature, foreign languages, history, and social studies) and translate that learning into higher test scores and grade point averages.

4. ***Each Legacy program directly impacts a large number of students on an annual basis.*** At one observed site visit, 80 high school students were preparing for the arrival of 400 elementary students, to educate the younger students about various aspects of the preserve habitat in which they were working. Across Legacy programs, literally thousands of students and adults visit Legacy program sites on an annual basis and receive guided tours of the natural environment, learning from Legacy students the theory and practice of water and natural resource preservation.

5. ***Notable is teachers' praise of the program for its impact on at-risk students.*** Many teachers stated that students, who would otherwise become drop-out statistics, have not only remained in school but have flourished academically, solely because of the Legacy program. Other impacts are significant. To a person, teachers indicated that the program has encouraged some students to enter environmentally related fields for college study and career. Further, at-risk students have become so engaged in learning that they are able to identify and pursue career paths. As one teacher stated, "They will be gainfully employed and functioning citizens rather than out standing on a street corner causing problems."

6. ***Legacy students interviewed during this project reflected on their own changes as a result of participating in the program.*** Many happily discussed their career goals, and have become more dedicated to their own education. One of the most common comments heard from students and teachers was that they (the students) became more responsible because the program required that they take more responsibility for their actions and for the environment. As one teacher noted, "[Legacy allows students] to show people they can do something." Students take the program, and their roles within the program, very seriously and responsible behavior carries over to other aspects of their lives.

7. ***For some teachers, this program has rejuvenated their own careers and rekindled their enthusiasm for teaching.*** A few teachers were explicit that Legacy was responsible for keeping them from becoming "drop-outs" from their profession. Interviews with teachers found that they are deeply committed to the Legacy program and have put in hundreds of hours over and above their regular teaching hours in order to make their programs successful. Yet it has energized them unlike any other education program they had encountered and has given them a new realization of what education can do to change young lives.

8. ***SJRWMD is praised for its support and oversight of the program.*** Legacy program teachers find the technical support they receive to be positive and encouraging, and value-adding in terms of the skills and knowledge staff brings to the development of their individual programs. Teachers particularly note that the SJRWMD staff is adept in critical areas that they, the teachers, are not: negotiations with county representatives, finding available grant money, suggesting program directions that mesh with school and school district guidelines, and gaining administrative support and encouragement for the program. Project WET lessons and training are seen as invaluable in moving student knowledge forward in the field.

9. ***Program cost has not been a stumbling block to those teachers interviewed in this project.*** In some cases, teachers have become creative in their methods to fund their programs, including student fundraisers or charging students a small participation fee (which they indicated parents were more than happy to contribute). Transportation to the environmental worksites was stated to be the
most costly item for most programs. Many funded their programs by securing grants from state monies, for example, the Learn and Serve program. But they do state that the search for dollars is never-ending.

10. ***One major program stumbling block, particularly for low-performing schools, is the correlation of Legacy program activity to Sunshine State Standards and FCAT preparation.*** Administrators in some schools have given lower priority to the program because their schools received low grades from the Department of Education and, as a result, they look only for the "skill-and-drill" of readying students for tests. Legacy's acceptance and ability to substantively grow is incumbent upon its ability to be keyed to these requirements that every teacher faces, and particularly teachers in schools that are struggling to improve.

11. ***Legacy needs a full time equivalent coordinator to build the program.*** The demand for the program, either with new start-ups or support for present Legacy programs, is beyond what a part-time staff person can handle. The program cannot achieve maximum return on SJRWMD's investment by limiting it to a part-time service. It costs SJRWMD very little other than the coordinator's time, and for Legacy to grow, it needs to have a dedicated full-time staff position.

Observations and Suggestions

1. ***The Legacy program leads to some of the most profound impacts of any environmental education program I've observed or assessed over the last decade.*** Participating in this program has been truly and dramatically life-changing for many students, particularly those considered "at-risk" and who would otherwise drop out of school. These same students now not only have perfect attendance records because of Legacy, but have dramatically improved their grades and perceive their lives filled with hope rather than without it. Similarly, it has literally brought teachers who had become jaded and exhausted by teaching back to life and injected energy and enthusiasm into their work.

2. ***Staff needs to organize a summer session of some key Legacy teachers to develop a curriculum for the program to make it compatible with Sunshine State Standards- and FCAT.*** Some teachers have already begun to do this on their own, and because enthusiasm for the program is so high, it would be relatively easy to get a group of 4–5 teachers willing to take on this task during the summer of 2004.

3. ***The land approved for the students to use as their worksite needs to be as free of owner resumption issues as possible.*** Three programs in particular mentioned that their students had constructed environmental projects, only to have them disrupted by the landowners. While there are no guarantees in life, gaining owner buy-in toward preserving student work on the property may be a necessary prerequisite step before launching a Legacy program.

4. ***The Board of the SJRWMD needs to be informed of Legacy program outcomes and impacts.*** While many of those interviewed talked about their need for receiving communication from the Board in terms of mission, goals, and educational priorities, Legacy teachers felt the SJRWMD Board was quite unaware of the impact their own program is having on these schools and students, and therefore, the Board needed to receive information from its own customers about the power of the Legacy program. Legacy student presentations at Board meetings are a key way to inform Board members about how well-spent their dollars are in funding this program.

Conclusion

The educational premise that hands-on learning stimulates interest and often increases motivation has been in place for a century. Studies are beginning to emerge which validate the concept of environmental, specifically outdoor, education as a means to improve student performance (Leiberman, 1998).

Legacy is a program that has been shown over time to significantly contribute to student learning and, in some cases, to teacher rejuvenation or retention. Education standards and objectives have changed in Florida to address the Sunshine State Standards and the Florida Comprehensive Assessment Test (FCAT). Legacy has improved critical thinking skills and hands-on application of knowledge, which are key components of the FCAT, and has led to behavior change. Students have implemented waterway cleanups, reduced their personal littering and water use, and changed buying habits. They have taken the initiative to start programs to protect the environment and volunteered with different groups to protect and improve the environment (Athman, 2003).

Legacy is a program that can be duplicated in many different schools, counties, and venues. Key to its success is: involvement of a passionate teacher, participation of a knowledgeable and interested agency or partner staff, empowerment by school district and administration, and support of the program, both monetary and in-kind. Although each program has similar elements, all Legacy programs are unique and designed to address the individual needs of each school and to evolve over time to meet changing needs and opportunities.

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Stream Side Science–Developing Outreach Materials with the Audience in Mind

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Abstract

In 1999, Utah State Universtiy (USU), Water Quality Extension developed an in-depth manual to help teachers and other educators teach watershed concepts by designing and implementing their own water quality monitoring programs. The manual was well received by teachers who were already interested in water quality and had the resources to do the activities, but did not spark the interest of other teachers or the Utah State Office of Education.

The two main reasons cited for this were 1) a lack of knowledge about water quality and watersheds, and 2) a need by Utah teachers to restrict their time and resources to materials that are directly linked to the Utah State Core Curriculum for each grade level.

Over the last year, USU Water Quality Extension worked with teachers and Utah Office of Education staff to develop a curriculum which utilizes the hands-on activities in the *Utah Stream Team Manual*, but is also aligned to the Utah State Core Curriculum for 9th Grade Earth Systems Science. These activities now have the full support of the state education office and the Utah Governor's Watershed Initiative, including evaluation of the materials, printing and distributing the materials statewide, and assistance in teacher training.

This poster will discuss the process of partnering with state agencies and educators to develop educational materials and trainings that not only meet the needs of educators through alignment to core standards of the state, but also provide hands-on, high quality water education for high school and middle school students.

Target Audience(s): Teachers

Educational Purpose: Education

A Blended Learning Program for Golf Course Water Conservation

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Abstract

In collaboration with the Golf Course Superintendents Association of America (GCSAA), a new concept in training golf course superintendents was developed. This program is unique for GCSAA, in that it was designed as a "blended learning" experience that assists practitioners in the development of water conservation plans that are site-specific to their golf courses. The University of Georgia turfgrass faculty was responsible for development of sound scientific-based educational resources. The responsibility of GCSAA was to market the program to its clientele. The first phase of the blended learning program was the development and launch of an on-line course entitled **W.A.T.E.R.** The course was designed to provide introductory level information on **W**ater; on how water is impacted by **A**tmospheric factors; on uptake and use of water by the **T**urfgrass plant; on the impact of **E**daphic or soil factors; and the **R**elationship of the soil/plant/atmosphere continuum. The second phase of this program was a workshop conducted by Drs. Carrow, Duncan, and Waltz, with hands-on development of water conservation plans. The superintendents will have instruction and access to templates they can modify and implement to accommodate the nuances of their locales. The program will conclude with a 60-day access to instructors through a GCSAA maintained list-serve for final refinement of individual plans. The deliverables of this program were written plans that were developed to be followed for water conservation on individual golf courses. Within the first two weeks of launching the on-line phase, registrants included superintendents from 20 states and 7 counties.

Introduction

A mission of many university systems is to disseminate useful, practical, and scientific-based information to their clientele. As society struggles with issues related to water management and conservation, it is these stakeholders who will look to Cooperative Extension Service and Experiment Station personnel for guidance, recommendations, and solutions. Informational packages must be developed for an increasingly educated, Web adept audience with demands for

high levels of educational programs. To meet these expectations, novel modes of information delivery and packaging must be employed.

Tenets for the implementation of water conservation practices are to present in-depth informational packages of scientific principles with specific, practical applications to all individuals involved with water management (i.e., elected officials, municipal authorities, regulatory agents, on-site water managers, and the general public). While educating all involved is critical, improving the practitioners' awareness of water conservation practices, coupled with implementation on their sites, are where the most immediate and long-lasting effects can be realized. Site specific practices are developed using a template of best management practices (BMPs) that is holistic, comprehensive, and science based.

Without accounting for the many environmental, ecological, and economic benefits of turfgrass systems, some special interest groups and municipalities have targeted turfgrass and golf courses as initial areas for water restrictions or bans. In an effort to improve water use efficiency and the industry's image, a partnership between The University of Georgia (UGA) Extension and Research faculty, and the Golf Course Superintendents Association of America (GCSAA) was initiated in 2003. The objectives of this collaboration were to generate and disseminate educational packages focused on turfgrass water conservation practices. These packages were marketed to golf course superintendents, who are often well-educated managers who have been placed in charge of a golf facility's water resources.

The Program

Upon completion of this program, it is expected that the participating golf course superintendent and the golf facility's officials go through the process of developing and implementing a set of BMPs for water conservation that is site-specific. These BMPs would be the guiding document for daily water management practices, future renovation plans or new constructions, and general turfgrass management. Furthermore, the development, implementation, and adherence to these BMPs will provide documentation of a course's previous and ongoing stewardship efforts that may be used as proof of existing water conservation measures when resources become limited. This water management approach may allow golf courses to continue to operate without any additional irrigation restrictions when other industries are adjusting to meet water conservation demands.

The "Blended Learning Program for Golf Course Water Conservation" is divided into three modules. The specific goal of each module follows:

Module 1: To develop an online course of introductory level information on **W**ater and how it is impacted by **A**tmospheric factors; uptake and use by the **T**urfgrass plant; impact of **E**daphic or soil factors; and the **R**elationship of the soil/plant/atmosphere continuum. The title of the course was **W.A.T.E.R**.

Module 2: To develop an 8-hour interactive workshop titled "BMPs for Turfgrass Water Conservation." The seminar was conducted by The UGA turfgrass scientist during the GCSAA's annual conference and show.

Module 3: To provide access to a "list serve" hosted by GCSAA where course participants could post questions, and could interact with colleagues and scientist during the development process of their site-specific water conservation plans.

This program "blended" three learning styles: a self-study style though the on-line course, a classroom lecture style as part of the seminar, and an active participation style through the development of a deliverable product, the site-specific water conservation plan, and access to a "list serve" for discussion of ideas and feedback.

Module 1: W.A.T.E.R. for Efficient Water Management (online course)

This is a stand-alone, for fee, on-line course that provides a sound, scientific understanding of turfgrass water relationships. Module 1 learning objectives are listed in the Appendix. The targeted audience was golf course superintendents, assistants, and technicians, agronomy and horticulture students, grounds managers, or other turf industry professionals who desire a better understanding of turfgrass water management. While this was written as a stand-alone course available to anyone (GCSAA member or non-member), Module 1 integrates into the "blended learning" concept by being a prerequisite to continue into Modules 2 and 3.

The development of this course was a joint project between The UGA faculty and GCSAA and is hosted on the GCSAA server, www.gcsaa.org/learn/online/water.asp. It was the responsibility of the turfgrass scientists to write and ensure scientific accuracy of the content while keeping the course focused on turfgrass water use and conservation. Furthermore, submission of content updates and revisions will be the responsibility of The UGA authors. The GCSAA was responsible for preparation of the course format, advertisement to its membership, collection and distribution of fees, and the administration of membership continuing education credits. In addition, graphic artists on staff assisted the authors with design and development of graphical content, and with interactive activities within the course.

W.A.T.E.R contains five chapters, each featuring a chapter outline, learning objectives, in-depth reading material, interactive reviews, and photos and illustrations. Each chapter is broken down into a number of sections so a student does not have to complete the entire course, or even one chapter, in a sitting. The flexibility of online learning allows participants the ability to repeat chapters or advance to the next section when they feel they have mastered the chapter's concepts.

The course was launched in December 2004 and has been well received. With 43 participants, W.A.T.E.R. had the best first month registration and use of any GCSAA's online courses (see Table 1). Through February 2004 the course had 71 students, representing 26 U.S. states and 10 counties. California had the greatest number of individuals to complete the course (8), followed by New York (6) and Florida (5). The remaining 23 states with participants, ranging from Main to Hawaii, had four or fewer students. Internationally, Canada had four participants, while Australia, Barbados, France, Germany, Portugal, and Spain had one each. The diversity of participants in this course certainly demonstrates a universal interest among golf course superintendents in water conservation.

Not surprisingly, initial registration was greatest in December and January. This is likely due to several factors: 1) GCSAA's aggressive promotion, 2) appropriate timing for golf course superintendents, many have time for self study during winter months when there is little activity on the golf course, and 3) need to complete the course as a prerequisite for Modules 2 and 3. This is an online course so it is offered year-round. There are times of the year, however, where increased activity is expected.

Table 1. *Distribution of Participants of W.A.T.E.R. Online Course.*

	Number of Participants		
Month and Year	**United States**	**International**	**Total**
December '03	33	10	43
January '04	20	-	20
February '04	8	-	8
Total	61	10	71

Module 2: BMPs for Turfgrass Water Conservation (workshop)

The second phase of this program was a full-day (six-hour) workshop during the national GCSAA meeting in February 2004. The focus of this workshop was to assist golf course superintendents in the development of site-specific BMPs for water conservation in a manner that would be acceptable for submission to their facilities' decision makers, elected officials, municipal authorities, regulatory agents, on-site water managers, and the general public.

During the initial four hours of the workshop, a science-based and holistic, systems approach for developing BMPs for water conservation was presented through a lecture format. Also, the major categories of water conservation strategies were presented along with options within each strategy so that superintendents could select appropriate options for their site-specific situations.

During the next two hours, instructors facilitated discussion among the participants and initiated the development of individual plans. In the development of their water conservation plans, participants were instructed to include various options and the practical implications of specific practices on water use and turfgrass management. Furthermore, the participants were encouraged to include the scientific reasons and justifications for these options.

To aid in the writing of site-specific plans, the superintendents were provided with copies of a 97 page workbook, "Best Management Practices for Turfgrass Water Conservation" in a hard- and electronic-copy format. Chapter titles included the following:

- Chapter 1 Components of a Golf Course Water Conservation Program
- Chapter 2 Initial Planning and Site Assessment for a Water Conservation Plan
- Chapter 3 Alternative Irrigation Water Sources
- Chapter 4 Irrigation System: Design, Installation, and Maintenance
- Chapter 5 Irrigation Scheduling for Water Conservation
- Chapter 6 Selection of Turfgrasses
- Chapter 7 Golf Course Design for Water Conservation
- Chapter 8 Management Practices for Water Conservation
- Chapter 9 Additional Water Conservation Strategies
- Chapter 10 Benefits and Costs

The workbook detailed specific water conservation practices with scientific documentation of the practices. Using electronic copies allowed participants to integrate contents into their plans.

Module 3: List-serve and Conference Call (follow-up)

For 60-days following the workshop, the instructors were available via a voluntary list-serve to assist the participants in development of their water conservation BMPs documents. The instructors offered technical and scientific assistance through the list-serve, while GCSAA maintained and hosted the service.

At the conclusion of the 90-day period there was a voluntary conference call between participants, instructors, and GCSAA Education Department personnel. The purpose of the conference call was to obtain industry input for improvement of future offerings; participants provided specific feedback for improvement of all the learning modules.

Conclusion

The purpose of this “blended learning” program was to use various learning styles to increase the level of understanding of water conservation, to educate participants on methods of improving and implementing water conservation practices, and ultimately to develop site-specific plans to be employed on individual golf courses. This program was initiated in 2004 and thus far, participant reviews have been positive. The instructors will integrate suggestions for improvement and offer the entire course again at the 2005 GCSAA conference and show.

APPENDIX (Waltz)

Learning Objectives for Online W.A.T.E.R. Course: Module 1

Chapter I. An Overview of Water

1. Understand the importance of water to biological systems.
2. Identify the structure of the water molecule and explain how structure affects other physical characteristics of water.
3. Relate the chemical properties of the water molecule to plants, soil, and other compounds.

Chapter II. Atmospheric Factors Influencing Water Management

1. Understand the hydrological cycle and its relevance in water conservation.
2. Relate the influence of climatic factors to evapotranspirational losses from the turfgrass plant.
3. Explain the influence of individual microclimates on turfgrass growth and water conservation.
4. Devise a basic irrigation guidance program using the “Checkbook Method” of irrigation.

Chapter III. Turfgrass Characteristics and Water Management

1. Describe how water is taken-up by the plant and the factors that influence water movement.
2. Understand the root and shoot morphological characteristics of turfgrass that influence water uptake, translocation, and transpiration.
3. Relate established crop coefficients to irrigation guidance programs.

Chapter IV. Edaphic Factors Influencing Water Management

1. Correlate soil physical characteristics to soil/water interactions.
2. Explain the movement of water through soils and the importance of basic soil characteristics which are incorporated into established guidelines.
3. Learn methods and instruments for measuring soil water and the application of knowing soil water contents for irrigation guidance.

Chapter V. The System: Soil – Plant – Atmosphere – Continuum

1. Integrate the concepts of the previous chapters into an overall water management program with primary focus of water conservation through improved irrigation application.
2. Communicate the basic principles of soil/plant/atmospheric interactions and relevance of water to a comprehensive water management program.