Water Quality:

A Challenge For The Cooperative Extension System

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Quality water is an integral part of the agricultural and industrial growth of our country. There has been a fundamental assumption that water of good quality is available to support the population growth and agricultural and industrial development in the United States. Now, people are beginning to find that this fundamental assumption is no longer valid, and we must now find ways to improve water quality to continue our growth and development and to protect the health of our citizens.

The water quality issue is now being emphasized in different—often negative—ways; medical debris on beaches, oil pollution on the Ohio River, selenium in the Kesterson Reservoir, assorted chemicals in the groundwater, and the (largely undocumented) effects of nitrates in drinking water.

The Cooperative Extension System (CES) has, for some time, been aware of, and gearing up to meet, the challenge of water quality. In 1984, Extension Service-USDA and the Extension Committee on Organization and Policy (ECOP) appointed a national task force to assess the groundwater quality situation. That task force report—published in February 1986—identified opportunities for the Cooperative Extension System, and recommended increased programming.

This work led to the identification of "Water Quality" as a national priority initiative for the Cooperative Extension System, and the identification of four critical issues (see page 4 of this magazine).

The Water Quality Initiative report, published in January 1988, was released at a national workshop for Extension Directors and Administrators. By the end of the 3-day workshop, Water Quality was identified as one of the pre-eminent national initiatives.

Shortly thereafter, ES and ECOP endorsed a statement on water quality programming that committed the Cooperative Extension System to increased effort and to the reporting of quantifiable impacts. This was followed by a national workshop for Extension personnel, which attracted 165 participants from 44 States (see article, page 5).

Programming Advanced

Since that time, ES and the state CES have been advancing the timing and intensity of water quality programming. This effort has included the signing of a memorandum of understanding between ES and the Soil Conservation Service, and the development of a unique roles document, which articulates the roles of these two agencies. These have been followed by a series of CES-SCS regional workshops, where active cooperation could be dramatically increased.

The Department of Agriculture (USDA) has greatly increased its involvement in water quality. In 1987, policy statements on nonpoint source pollution and on groundwater quality were adopted. USDA has also developed a coordinated water quality effort, which includes discussions with both the Environmental Protection Agency and the Department of the Interior.

Congress has recognized the need, as well. The ES budget for Fiscal Year 1989 contained the first specific appropriation for water quality programming. This "first small step" will be closely scrutinized as the CES gears up to "help people help themselves."

We estimate that the CES now invests about $20 million per year in water quality programming. These efforts include the programs and activities described in the ensuing articles. We fully expect to see that amount, the number of programs, and the impacts on "how people do things" (the *results)* increase dramatically.

While all of the identified "critical issues" (page 4) are critical, there are three components of particular interest. These fall under critical issue No. 2, and may be paraphrased as: "What are the impacts of *agricultural pesticides* and *nitrogen fertilizers* on water resources, water uses, and water users?" and "What can people do about it?"

The CES is rapidly moving to address these issues in a positive way. Programs to address the impact of agricultural pesticides and nitrogen fertilizers are blooming; these will be accompanied by greatly increased staff training and by programs to encourage rural residents to test their water-supply wells.

Essential Focus

In all of these programs, there are two overriding concerns. First, we must continue to focus on people, and on what people do, especially as a result of our programs. Second, we must be able to show *results*; how many rural residents actually had their wells tested? How many farmers changed their nitrogen (or pesticide) management practices? How did they change them? How did this affect inputs of these materials into the environment? Finally, we may even ask what effect these programs had on water quality. Our focus must be on *people*, and what *people* do to enhance or protect water quality.

We have every confidence in the CES, and in the ability and dedication of the people who constitute the CES. As Extension responds to local water quality needs, we will—in concert with many other public agencies—impact how *people* practice good stewardship of our Nation's water resources. We have a mission, and we are acquiring increased resources; we must produce results. ▲

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National Initiative: Water Quality

Situation
Over 95 percent of the Nation's rural residents depend upon groundwater for drinking water; more than one-half of the total population drink groundwater. Every American is dependent upon water for health and well-being. Our water supplies are sometimes contaminated and frequently perceived to be jeopardized by chemicals (including agricultural chemicals) from septic systems and other sources.

There is a need for public education programs on the importance of high-quality water to life, well-being, and agricultural production; on the need to use water resources wisely; on the impacts of agricultural and other chemicals on water quality; on methods of conserving water supplies; and on the development of appropriate policies to assure adequate supplies of quality water.

Critical Issues
To meet these national challenges and opportunities, Cooperative Extension System programs must address four critical issues:

Issue 1: Public understanding of water resources, especially the nature of the resource—where it occurs, why it is vulnerable, how it is used; the interactions of human activities and water quality, and the options for protecting water quality or making it safe.

Extension Goal: To develop private and public understanding of the nature of the interactions between human activities and water quality.

Extension Role: Deliver appropriate educational programs to the audiences most affected, notably rural residents and local government officials.

Issue 2. The impacts of agricultural, industrial, and household chemicals on water quality and subsequent uses and users of water.

Extension Goal: Provide appropriate programs to those who use such chemicals or who develop policies governing their use and disposal.

Extension Role: Make audiences aware of actual or potential impacts; help them adopt appropriate technologies, strategies, and policies to minimize chemical contamination of water resources.

Issue 3. The importance of water conservation programs and strategies for domestic, agricultural, and municipal water consumers to meet local problems such as drought-induced shortages, declining water tables, increased pumping costs, and increased production and treatment costs.

Extension Goal: Promote public awareness, understanding, and strategies or policies to respond to state and local needs.

Extension Role: Develop and deliver appropriate educational programs in areas where such matters are of private and public concern.

Issue 4. The key role of local government officials in developing strategies for addressing the public concern about the interactions of land use, chemical use, and water quality.

Extension Goal: Work with an aware, informed, knowledgeable cadre of elected or appointed officials in developing appropriate policies to protect the quality of community water resources and thereby enhance well-being.

Extension Role: Deliver programs to assist government officials in developing appropriate strategies. ▲

The Water Quality Initiative Workshop

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The Water Quality Initiative Workshop, held February 16-18, 1988, at the National 4-H Center near Washington, DC, had the objective of exchange of program information. The National Coordinating Committee (co-chaired by Denzil Clegg, Associate Administrator, ES-USDA, and Chet Black, Director of the North Carolina Agricultural Extension Service) and the Water Quality Initiative Task Force (co-chaired by Fred Swader, National Program Leader, ES-USDA and Art Hornsby, Extension Soil Specialist, University of Florida) set this goal for the workshop. The Water Quality Initiative Task Force (WQITF), in planning the workshop, chose to focus on successful programs and program components through working sessions and a resource fair. The WQITF identified resource persons who were potential for participants in the program.

Material presented at the workshop needed to be useful also to people who did not attend. The WQITF designed and sent to participants, in advance of the workshop, specific forms for handout materials that would discuss the objectives and key elements of the model programs being presented. Resource fair participants were encouraged to prepare these materials to describe specific program materials or lists of resource materials available from their states.

WQITF organized the resource fair. Equipment demands made it clear that the people involved in water quality educational programs are leaders in the use of the latest technologies. Many requested computers or VCR's. Exhibits were excellent. The participants, through their interest and energy at the resource fair, made our efforts worthwhile.

The workshop was opened by Charles Benbrook, Executive Secretary of the Board on Agriculture, National Research Council, who challenged the participants, observing that water quality seemed to be an unusual program area for Cooperative Extension. The workshop format was a "triple threat," with plenary sessions in the mornings, workshop sessions in the afternoons, and the resource fair in the evenings. Attendance was excellent—165 people from 44 states.

Plenary speakers covered a wide range of topics, ranging from "The Politics of Regulation" (David Allee, Cornell University) to "Risk Assessment" (Frank Post, Oregon State University). The workshops provided examples of successful programs, ranging from "Chemigation" through "Nutrient Testing" to "Radon". The Resource Fair had displays from Puget Sound to Florida, and from Arizona to Connecticut

Exhibitors provided data sheets and resource material lists. During the workshop, members of the WQITF collected copies of the material from each exhibitor and supplemented that information by visiting each exhibit and copying information not available on the data sheets. That material has been compiled, reproduced, and distributed to all workshop participants and water quality state contacts in a "Water Quality Resource Materials Catalog." The 40-page catalog contains summaries of the state and regional water quality programs presented at the resource fair. Each program summary includes a list of resource publications and materials. Programs from all Extension disciplines: Agriculture, CRD, 4-H, and Home Economics, are represented. To obtain a copy, contact Debra Henderson, ES-USDA; 3344-S, South Bldg., Washington, DC 20250-0900. Phone: (202) 447-5369. ▲

Safe Water

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Bacteria and viruses contaminating the water pose a thousand times greater danger to health than do any other contaminants, including chemicals.

University of Arizona (UA) Environmental Microbiologist Charles Gerba can prove that rather startling statement. He has tested water—wastewater, drinking water, well water, water in rivers and streams—in Arizona, all over the United States, and in many other parts of the world.

Although about 40 outbreaks of waterborne diseases are reported in this country every year, Gerba believes many other cases are never reported. Viral contamination causes 65 percent of the outbreaks. An extremely low level of viral contamination can be an infectious dose.

Extent Unknown
Twenty percent of the groundwater samples Gerba tested were contaminated with viruses. Gerba believes no one really has a good idea how many people are being exposed to viral contamination in their drinking water.

He says viral contamination may be more common than expected, particularly in rural areas. Poorly placed septic tanks are the primary villain; septic tanks should not be used when the groundwater table is too high or if there is not enough soil for water to percolate effectively.

New Testing Technique
Until very recently, testing for viruses in water has been a tedious, expensive process. The standard cell culture tests require a minimum of 2 weeks; only one kind of virus can be tested for each time; and the price ranges from $300 to $2,000.

Gerba has developed a gene probe test that is so sensitive it can detect one virus particle in 1,000 liters of water—phenomenal accuracy. Test results are available within 48 hours, and it is possible to test for more than 70 different viruses at one time. The cost probably will eventually be less than $100 per test.

Temperature Is Greater Factor
Gerba has studied how water acidity, nitrate and sulphate chemical content, mineral content, and water temperature affect virus survival. He found that water temperature has the strongest effect.

Knowing the temperature of the groundwater and the rate at which it flows through the ground, Gerba can predict the distance the water can travel before disease-causing viruses are killed. Using this method, he has developed a computer model for microcomputers that will predict the safe distance between a well and a septic tank.

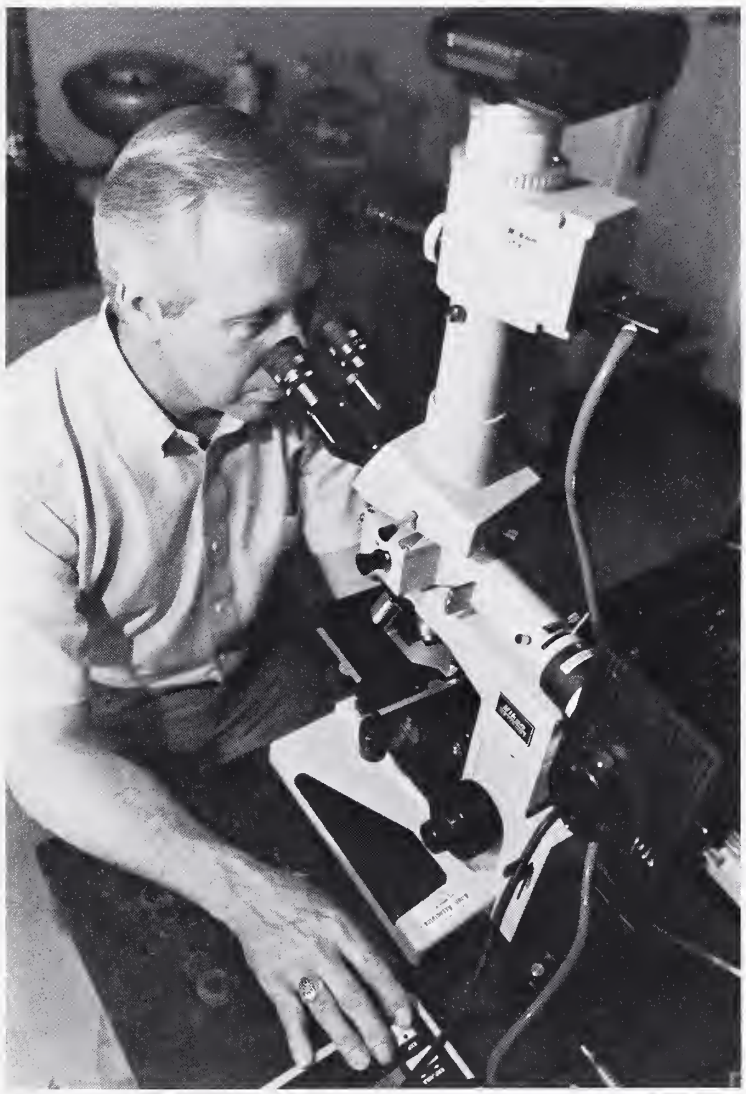
Recycling Grey Water

Gerba also has done an intensive study of the growth and survival of microorganisms in grey water—the wastewater from bathroom sinks, baths, showers, laundry, and dishwashers. He found that it could be used safely for underground drip irrigation on lawns and flower gardens. Other uses, such as surface irrigation, would require disinfection.

At the University's experimental conservation home in Tucson, for example, the grey water is collected in a sump, passes through two tanks containing water-purifying water hyacinths and through sand filters. The hyacinths use organic matter and bacteria as food, reducing contaminant levels by 99 percent. The sand filters take out more bacteria and reduce turbidity. By this time, bacterial levels are cut 99.9 percent from when the water was collected.

Gerba also compared microorganisms in the grey water from six other homes in Tucson. The home owners were an older couple, two young couples, and three families with young children. The total bacterial count was not significantly different among the households. However, the kind of bacteria he found in the water varied with the number and ages of the children, the kinds of diapers that were used, and the kinds of activities engaged in, such as gardening.

Particularly if someone in the household were ill, such grey water could contain bacteria that would present a public health hazard if reused without treatment. Viral contamination of grey water can be high, because viruses are very resistant to detergents and soaps and even to disinfectants.



Opposite top: A water-borne virus appears as a black spot on X-ray film. Below: Charles Gerba, environmental microbiologist at the University of Arizona, is the developer of quick tests for water contaminated with bacteria and virus. At left: Charles Sterling, veterinary parasitologist, University of Arizona, uses a microscope to examine disease-causing parasites crypto *and* giardia *found in water*

Other Contaminants

Disease-causing parasites—including *giardia, cryptosporidium* (*crypto*), and *E. histolytica*—are also found in water. *Crypto*, for example, can be a serious problem. In humans, this parasite can cause severe nausea and diarrhea lasting from 1 to 3 weeks. It also is one cause of a serious disease that is widespread in dairy calves. Calf scours results in an annual loss of at least $200 million to the cattle industry.

Most waterborne incidents of *crypto* infections have been in smaller towns served by surface water that is treated only with chlorine; this common water disinfectant is not effective against parasites. Gerba has started surveying the surface water for the three contaminants at 100 sites across the United States. Charles Sterling, working closely with Al M. Lane, Extension livestock specialist, and Edward Bicknell, Extension veterinarian, has developed highly sensitive tests for *crypto* and *giardia*. ▲

Hooked!

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Youth learn to fish, scuba dive, and snorkel at the Ohio 4-H Sea Camp held on Kelleys Island on Lake Erie. The camp, conducted by Ohio CES and Ohio Sea Grant, seeks to educate 4-H'ers in the wise use of Ohio's greatest natural resource.

An avid explorer of aquatic life near his home in Circleville, Brian Frank, 14, is zealous lecturing about fish in the food chain in Lake Erie, 150 miles away. He'd only been to Lake Erie twice, but Brian, along with 64 other Ohio teens, studied the world's 12th largest lake firsthand when he spent a week in July at the 1987 Ohio 4-H Sea Camp on Kelleys Island.

Campers there range from those hoping to become aquatic biologists to those who want to learn to fish, scuba dive, and snorkel—the three most popular activities at Sea Camp. Additional sessions include water safety, ecology, lure making, weather study, aquatic science, and boat operation. All are conducted by professional instructors such as Ohio Cooperative Extension Service specialists and agents and Ohio Department of Natural Resources personnel.

Ohio 4-H Sea Camp is conducted by the Ohio Cooperative Extension Service and Ohio Sea Grant with direction from Ohio 4-H agents, district specialists, and volunteer leaders.

Ohio Sea Grant is a state-federal program to enhance development and improve management of state and regional aquatic resources. It seeks wise use of those resources to strengthen the quality of life in surrounding areas through research, education, and Extension.

Denny Weilnau, Erie County 4-H agent, and Duane Plymale, south district 4-H specialist, co-directed the 1987 Sea Camp. Orrin Leimbach, a volunteer leader from Vermilion, and Carolyn Keller, Erie County 4-H program assistant, were the camp's activity coordinators. Fred Snyder and Dave Kelch, district Extension specialists, Sea Grant, conducted several of the camp sessions. Snyder is based in Port Clinton. Kelch works out of Elyria.

Snyder says: "Lake Erie is booming. Fishing is a major industry. Investment in condominiums has skyrocketed. The lake is cleaner and rejuvenated and is drawing people from across the Midwest."

Sea Camp began in 1985. It's open to Ohio teens ages 13-17. Each applicant must write an essay about why they want to attend camp and what they hope to learn. The campers applied through their county Extension office or through their district Sea Grant specialist.

Erie Reborn

"The camp reflects the renewed interest in Ohio's greatest natural resource," Kelch says. "There was a time when Lake Erie was considered dead, a victim of human activities. It wasn't dead but it was close to it."

Today the lake is a playground for boaters, anglers, sunbathers, swimmers, and campers. In 1985, Lake Erie sport fishing generated nearly $123 million in sales by Ohio companies, $43 million in personal income to Ohio residents, and 2,466 person-years of employment.

Much has been done to reduce pollution in Lake Erie, but human activity still threatens the lake and the communities around it. Programs help control toxic discharges into the lake, yet simply dredging a channel can stir up chemical-laden sediments.

In March 1987, for example, an advisory was issued by health agencies in Ohio, Pennsylvania, and Michigan because excessive levels of PCBs were found in Lake Erie carp and catfish. PCBs are a group of chemicals linked to cancer and other health disorders.

Ripple Effect

"We want the kids to see that a clean lake has a ripple effect," Kelch says. "A healthy environment does everyone good. That's why camp focuses on both natural history and resources. And with Ohio 4-H Camps mixing fun and education in areas such as conservation or leadership, we thought why not do the same in the area of marine education."

Snyder says that this holistic introduction of teens to Lake Erie has led local marine industries and other Lake Erie-related organizations to donate new boats and fishing equipment as well as personnel to the camp.

As teens examined the deep glacial grooves found in Kelleys Island State Park, Snyder explained his Sea Camp philosophy: "I consider Sea Camp a training session for future mariners. I don't want them to misinterpret that a cleaner lake is something to take advantage of. A healthy lake benefits an ecosystem stretching hundreds of miles from its shores."

Sea Camp was the first trip to Lake Erie for Susie Vargo, 16, of Plain City. "Fishing was the best, but seining a marsh and studying its plankton, fish, and tadpoles were fun. I'm interested in teaching and aquatic biology. This shows me I can do both. I've learned more here than I ever did before in a camp."

Julianne Barth, manager of the Big Island Wetland in Sandusky, donated her time to lead the aquatic science sessions.

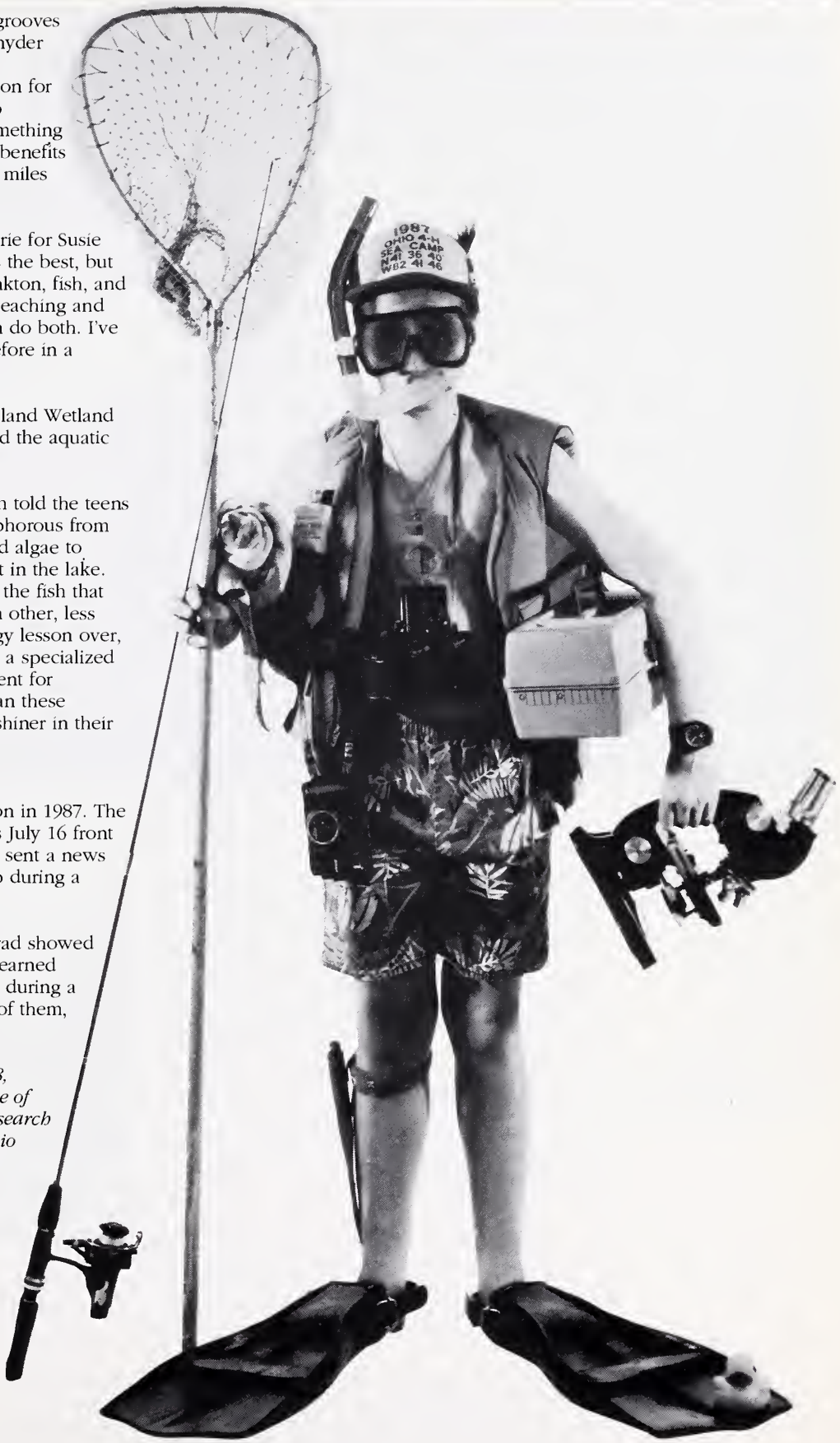
Standing knee-deep in the lake, Barth told the teens that during the 1950s and '60s, phosphorous from sewage and agricultural runoff caused algae to bloom and oxygen levels to plummet in the lake. This caused mayfly larvae to die and the fish that fed on them to die, move, or feed on other, less nutritional insects. History and biology lesson over, Barth sent a group into the lake with a specialized bucket to scrape up a layer of sediment for examination. "Where else but here can these youngsters hold a gizzard shad or a shiner in their hands," she says.

TV Coverage

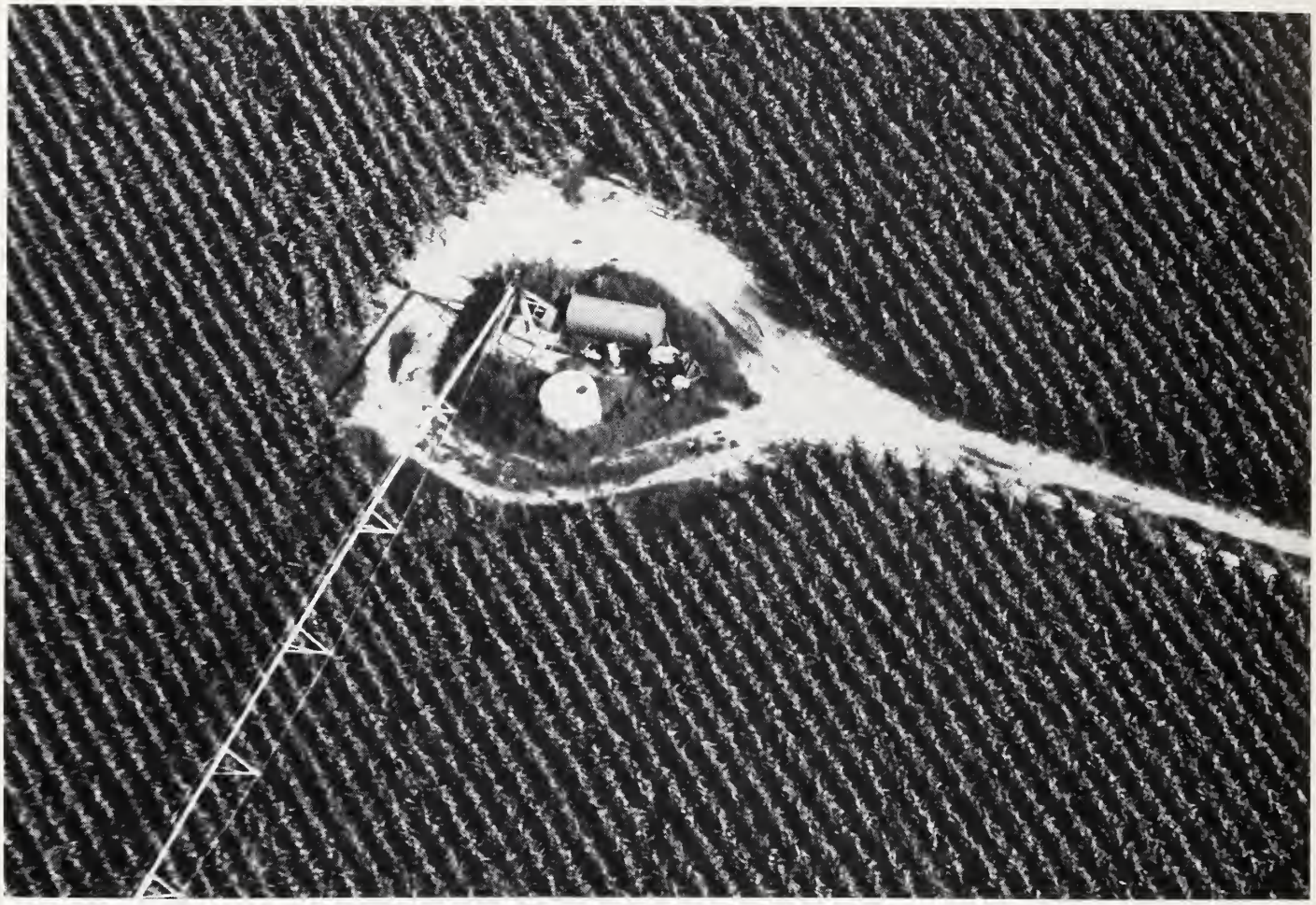
Sea Camp caught the media's attention in 1987. The *Toledo Blade* featured the story on its July 16 front page. WTOL-TV, Channel 11-Toledo, sent a news crew and aired a report on Sea Camp during a Sunday news segment.

On the charter boat fishing trip, Conrad showed that during camp she definitely had learned something: "I almost went overboard during a fight with a walleye. I did catch five of them, though."

Extracted from ***Ohio 21****, March 1988, published semiannually by the College of Agriculture, the Ohio Agricultural Research and Development Center, and the Ohio Cooperative Extension Service of the Ohio State University.* ▲



Education For Chemigation



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Chemigation—you won't find the word in most dictionaries, but it's one that is well known to agricultural producers in many parts of the United States. A combination of the words "chemicals" and "irrigation," it aptly describes the process of applying an agricultural chemical by mixing the chemical with irrigation water.

Although chemigation has been used in Nebraska for approximately 30 years, widespread adoption of the practice coincided with a major expansion of irrigated agriculture in the mid-1970s. As a result of the expansion, about 27,300 center-pivot systems had been installed in Nebraska by 1986. Many of the systems are located on sandy soils, where nitrogen fertilizers applied with irrigation water can result in lower nitrate leaching than when preplant applications are used.

At the height of the irrigation expansion in 1982-83, the Nebraska corn crop experienced unusually heavy infestations of corn borer. In 1983 alone, producers chemigated more than 200,000 acres with insecticide in efforts to control this costly pest.

Responding To Concerns

Concerns that insecticide use for chemigation might increase the potential for groundwater contamination surfaced quickly. In response, the Nebraska

Cooperative Extension Service appointed an interdisciplinary chemigation task force, which took several immediate actions:

• Conduct a workshop for state and local agencies to discuss chemigation issues.

• Update a fact sheet on chemigation antipollution equipment.

• Publish a new fact sheet, *Applying Insecticides Through Center Pivots.*

• Conduct an inservice training session for all Extension agricultural agents.

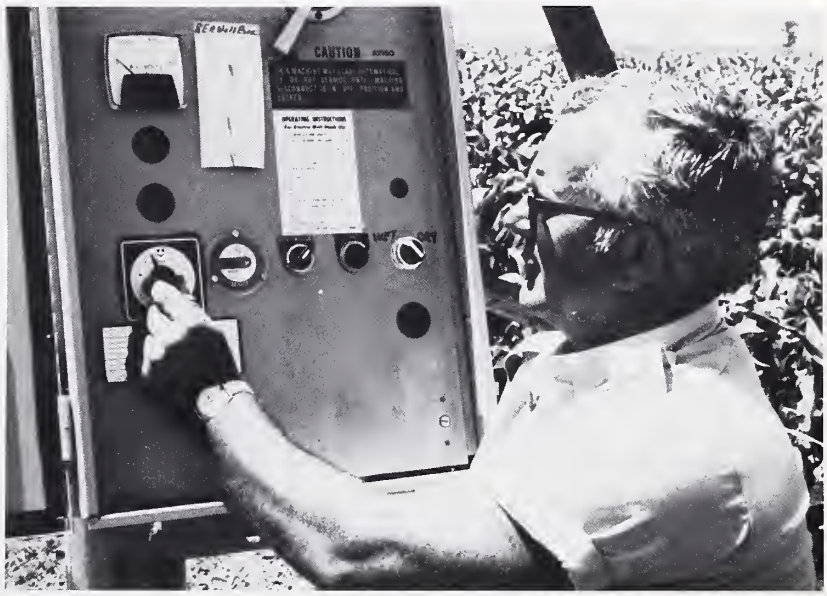
Legislative Action
Reflecting a continuing concern about the long-term potential for groundwater contamination from chemigation, the 1986 Nebraska legislature passed the Nebraska Chemigation Act. Several provisions of the bill had implications for Extension. Among other things, the law requires that each chemigation site must have a permit; specific antipollution safety equipment must be installed and inspected; and chemigation applicators must be certified by attending a training session and passing a written examination.

The antipollution equipment requirements enacted into law were those that had been recommended by the Nebraska Cooperative Extension Service. Natural Resources Districts (NRD's) issue chemigation permits and conduct equipment inspections. The NRD's are multicounty units established by the legislature; they have significant responsibilities relating to groundwater quality. Extension trained NRD personnel to conduct the equipment inspections.

Implementing The Training
The legislature gave the state's Department of Environmental Control (DEC) the responsibility for training chemigators. Because DEC had only a single individual to administer the Chemigation Act, the agency contracted with Extension to conduct the training and administer the required certification examination.

Less than 90 days after the contract was signed, Nebraska Extension specialists, in cooperation with DEC, implemented the chemigator training program. Each applicator received a notebook containing a basic chemigation manual (essentially the same as the EPA/USDA manual used in the pesticide applicator training program), a copy of the Nebraska Chemigation Act, a summary of that law, DEC rules and regulations for implementing the Act, a calibration workbook, and the publication *Protecting Our Groundwater a Grower's Guide.*

The 3-hour training program covered five topics: the decision to chemigate; Nebraska's Chemigation Act and DEC's rules and regulations, antipollution equipment requirements, chemigation management, and calibrating for chemigation. Each topic was supported with slide-tape packages. The trainers were 12 Extension specialists, representing agricultural engineering (irrigation), entomology, soil fertility, and weed science.



Opposite top: Bird's eye view of irrigation system adapted for injection of agrichemicals. Below: A Clay Center, Nebraska farmer sets out "catch" cans to measure the amount of water delivered by sprinkler heads in an irrigation system. Sprinkler heads must apply a chemical uniformly over the field. Above: A Henderson, Nebraska farmer carefully sets the speed of his irrigation system.

Evaluating The Training
A survey of approximately 1,000 applicators who attended the spring 1987 training brought responses from 578. Nearly three-fourths of the respondents rated the training as either good or very good. Seventy percent of the respondents had preregistered and received the training materials before the training session; 60 percent had studied the material.

Although some participants complained about being required to attend the training and take a test, most producers recognized the importance of protecting groundwater. One participant stated the situation quite succinctly: "We can't afford to contaminate the water. Our kids have to use it, and their kids after them. We have to keep it clean for them." ▲

Old Water For New Citrus

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Millions of gallons of treated wastewater from the booming Orlando metro area are now being used to irrigate central Florida citrus and protect trees from frost damage. Officially known as the Water Conserv II/Southwest Orange County Water Reclamation Project, it is one of the largest water re-use projects in the nation and the first in Florida to irrigate crops intended for human consumption.

To help launch the huge water re-use program—which will eventually distribute up to 75 million gallons of nutrient-rich wastewater daily on 15,000 acres of citrus—Extension agents with the University of Florida's Institute of Food and Agricultural Sciences (IFAS) worked with the city and county area citrus growers to get them signed up for the project.

"The IFAS Cooperative Extension Service has been involved in the water reclamation project from its very inception," says John Jackson, multi-county citrus Extension agent based in nearby Lake County. "And IFAS Extension worked right through the final stages of getting citrus growers to begin using the irrigation water.

"The cooperative nature of this project is a good example of how agriculture can be compatible with Florida's rapid urban growth," Jackson adds. "It's a project where everyone wins—urban areas get rid of treated wastewater,growers get an almost unlimited supply of free water, and the environment is protected.

Energy Costs Reduced

"Moreover, since the water is delivered to participating citrus groves under pressure, growers do not need pumping equipment and energy costs are reduced," Jackson points out. "This, in turn, enhances grove property values by $500 to $1,000 per acre."

In 1979, the U.S. Environmental Protection Agency ordered the city of Orlando and Orange County to stop discharging effluent into Shingle Creek by 1988 to protect fishing and wildlife in the area and improve water quality in connecting lakes.

As a result, the city and county opted for the combination citrus irrigation and rapid infiltration basin (RIB) sytem that began operating in December 1986. Treated wastewater from the city's McLeod Road treatment plant and the county's Sandlake Road treatment plant is now piped some 21 miles to the new $180 million Conserv II distribution center.

Growers participating in the project, Jackson comments, have to sign a 20-year agreement to take anywhere from 26 to 52 inches of water per year. This averages out to half an inch of water per week.

This is high-quality treated water, Jackson says, with about 5 parts per million phosphorous and 6 ppm nitrogen. The sytem is currently handling about 24 million gallons of water daily, with 18 of that going to citrus groves and 6 million going into rapid infiltration basins that allow the water to percolate through the soil into the Florida aquifer.

Jackson was also instrumental in getting 60 acres of citrus grove next to the Conserv II distribution plant set aside for research purposes. He helped organize the Mid-Florida Citrus Foundation,, a non-profit organization that leases the research site from the city of Orlando. Scientists from the IFAS Agricultural Research and Education Center in Lake Alfred are measuring how the treated waste water affects things like tree growth, cold hardiness, fertilization efficiency, herbicide treatments, rootstock combinations, and tree density. ▲

Conserving Their Future

A 9-year-old boy in Burlington, Vermont, stares intently at a screen, the graphics riveting his attention. This is not just another child "glued" to a television set. He is a 4-H camper learning about water resources and their conservation in a curriculum developed by the University of Vermont Extension Service.

Linda Marek, the Extension water resources specialist who helped to design the curriculum, explains that it teaches children about the water system and where they, as future adults, fit into the cycle. "If they don't understand how they fit in, they won't know how to protect the water from contamination," Marek says. "We have to make sure Vermont continues to have safe drinking water."

Water is one of Vermont's greatest natural resources, with over 240,000 acres of the state covered by lakes and ponds. Marek points out that, because Vermont's booming population is straining these public water resources, it is important for the state's future residents to know how to protect the resources from contamination.

The educational program focuses on three main topics: the hydrologic cycle, groundwater, and surface water. The counselor—trained by Vermont Extension—begin by teaching about the flow of rainfall onto the ground and through the earth. Then the children learn about ground and surface water and how both become polluted.

Hands On Learning

The counselors use hands-on learning as the chief part of the program. "We don't want to lecture to the kids. Instead, we try to keep them physically and mentally involved," Marek says.

One way to grab children's interest is through computers. The 4-H program uses software designed for children at the junior high school level developed by and purchased from IBM.

The computers are also equipped with moving color graphics much like video games to catch and maintain the children's interest. Many counselors report that campers are so interested that they have to be forced to leave the computer terminal.

In one part of the program, "Human Impact Upon Surface Water," children learn about dams and the problems they cause. The computer not only tells the children about problems such as erosion below the dam and receding coastlines but also shows them what happens with the graphics.

Another section of the program deals with urbanization and its effects on surface and groundwater. The children learn about the problems caused by thermal pollution from certain industries as well as sewage dumping from cities.

Firsthand Evidence

The 4-H program, though, is not limited to computers. Children also focus on the camp's own water system and the different resources of each camp location.

The counselors lead discussions at the camp's pond or stream to let the campers see firsthand the water source and the creatures living in it. Whaples says, "The campers study where the water comes from along with its distribution and disposal. We want them to know that it doesn't just come from a faucet."

Last summer the program was pilot tested at three 4-H camps in Vermont. Marek and Whaples visited the camps to observe how the program was being presented and received. They also participated in an evaluation, which elicited a very positive response.

4-H youth increase their knowledge about water resources through a special computer program developed by Extension at the University of Vermont.

"The curriculum is being refined for this summer," Whaples says. "It will not cover as much material as last summer, so the campers can learn more about specific aspects. The instructors are also being encouraged to use their individual water sites more to keep the children actively involved."

And the focus will be on the older campers. "We're getting into science and scientific processes, so it should be geared towards the older kids," Whaples explains.

In addition to the hands-on experiences and the computer program, the 4-H water conservation curriculum includes a teacher's manual and audio-visual support materials, such as videos on groundwater and surface water.

Both Whaples and Marek agree that water conservation is something that every child should learn about. As Marek explains, "Children will become the decisionmakers of the future so they have to know how to protect our national resources." ▲

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When Counties Take The Initiative

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Nearly every state in the Nation is paying attention to water quality. Research centers are popping up in major universities. Commissions are compiling studies. Agencies are analyzing progress. And water quality disasters, like last January's million-gallon oil spill into the Monongahela and Ohio rivers, grab media attention.

Most localities, though not content with their water quality situation, seem resigned to wait until state governments or Extension Service programs "trickle down" to their level. But three Minnesota counties aren't waiting. They've begun their own rural water quality project, monitoring for bacterial and agricultural chemical contamination in local water supplies.

Martin, and Watonwan counties, on their own initiative, and with widespread voluntary cooperation from farm operators, have devised an ambitious project known as WATER (Water-quality Assessment Through Education and Research).

"There just isn't enough government money available," says Watonwan County Extension Committee Chair Lila Evers. "A lot of people in our county realize that we can do some of this on our own. If we can get some government help, we'll be able to do that much more."

The project was developed jointly by the three counties' Extension Service staffs, Soil Conservation Service district conservationists, and representatives of the Soil and Water Conservation Districts. WATER also has access to the University of Minnesota's Center for Agricultural Impacts on Water Quality. A $9,300 grant awarded by the Southeastern Minnesota Initiative Fund assists the project.

Education And Water Testing

WATER educates rural residents about the potential for water quality damage inherent in both the use of agricultural chemicals and the presence of livestock operations. It also includes comprehensive county-wide testing of wells for nitrates, bacteria, sulfate, and pesticide contamination, and choosing sites for long-term monitoring.

Educational and testing elements have been linked. To get the program's special reduced water-testing fee, farmers had to attend at least one educational session. And attend they did! The reduced testing fees and the urgency of water quality concerns led to capacity crowds at nearly all the educational sessions. The pesticide scan was a particular incentive. Normally costing about $350, it was made available for $85. In Watonwan County, nearly a quarter of the farm operators participated. County Extension Agent Gary Wyatt noted that every township had at least 10 wells tested.

Dispelling Misconceptions

Most of the tests revealed no contamination. Martin County Extension Agent John Bohnker contrasted those results with public perception. "There's lots of concern out there," he says, "and a lot of misconceptions about where the problems are. Of the 40 wells tested for pesticides and nitrates, only one sample came up positive, and that was a surface water source.

"It was also reassuring to see that our soil types are permitting pesticides to break down before they cause any problems in our groundwater," Bohnker adds.

Across all three counties, only 8 percent of the wells showed nitrate levels high enough to require treatment (10 parts per million). Fewer than 5 percent showed significant levels of bacteria. Just 16 percent had sulfate readings high enough to affect the taste of the water and to warrant treatment. And only the one Martin County surface water sample showed any contamination from a pesticide.

Educational Content

Each county scheduled two educational sessions. They were led by experts from the Extension Service, Agricultural Experiment Station, and the State Departments of Agriculture and Health. The first session discussed the water cycle and likely paths for contamination, presented current data on water quality, discussed the health significance of home water supplies, and explained basic water sampling procedures.

Session two, about a month later, presented and evaluated the first sampling results and discussed sound soil and chemical management practices for minimizing future contamination risks. The program leaders emphasized the need for proper capping of abandoned wells, and they urged additional water testing.

Postive Evaluations

More than 86 percent of current participants have evaluated the program positively. They say they came away better informed, and they are supportive of the ongoing well-monitoring program. As they outlined their water-quality goals for the coming year, numerous participants said they would pay closer attention to reducing their use of chemicals and their cleaning and maintenance of tanks and other equipment.

Continuing Benefits

Besides the water tests that benefit individual farm operators, the water project is obtaining some long-term information for local and state officials. The project commitee plans to establish at least 10 nitrate monitoring wells in each county. In addition, the project will sponsor at least three well-capping demonstrations during the coming year.

"We're convinced that our continuing water quality education programs will contribute to long-term enhancement of the proper management of soils and chemicals," Wyatt says. ▲

Opposite top: Lila Evers, Watonwan County Extension committee chair, Minnesota, takes a basic water sample before water is sent through treatment equipment. Below: Participants at water quality education session in St. James, Watonwan County, choose from available USDA, EPA, and state publications. Above: At a livestock feedlot in St. James, Layne Evers (left) discusses plans for a manure management system with Gary Wyatt, Watonwan County Extension agent.

Programming For Consumers

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Richard A. Weismiller
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The driving force behind most water issues is the question of drinking water quality. People want safe, clear, good-tasting, odor-free water. They worry about potential contaminants that might cause cancer or other diseases. They want to know if there are radon problems with their well water. They want to know what standards apply to public water supplies.

They have concerns about getting private water supplies tested and how to find a reputable, certified, testing laboratory. They have questions about treatment systems being sold by phone or door-to-door. Extension has a unique opportunity to reach individuals, families, and communities with the information they want about the health effects, testing, and treatment of drinking water.

Program Objectives

Cornell University and the University of Maryland, with funding from the Extension Service, are addressing those critical topics in educational materials designed to meet several objectives:

- To improve public knowledge of chemicals, health effects, water-testing, and treatment methods;

- To provide people with skills to make decisions about drinking-water contamination and managing the risks involved; and

- To forge a working relationship between local Cooperative Extension staff and other professionals concerned with water issues.

The materials generated by this joint effort so far include three slide sets (health effects of drinking-water contaminants, water-testing methods, and water treatment) and fact sheets to support the slide sets.

A separate Cornell project, funded by the Ford Foundation interactive computer program on understanding chemicals, "Toxicology and Public Health: Understanding Chemical Exposure," was designed to help those who as part of their work must understand the health effects of chemicals and consider the implications of toxic chemicals.

The program requires no previous computer experience and allows busy, self-directed professionals to learn accurate, concise information in an informal manner.

Development And Testing

As the slide sets and fact sheets were being developed, they were tested with many audiences. An early version of a script on health effects of drinking water contaminants, for example, was used as part of an agent inservice training program for Ohio Extension agents.

All three slide sets were presented to varied New York groups: community leaders, local health officials, rural people with private wells, suburban people with private or public water supplies, water, testing and treatment vendors, and Extension agents in all program areas.

Comments from the participants and observations of the trainers led to further development of the materials, which then were reviewed by technical professionals in toxicology and engineering and by Extension programming experts. A University of Maryland media specialist was responsible for ensuring that the materials would communicate effectively with the intended audiences.

The interactive computer program was tested with technical professionals as part of a Cornell groundwater course. It was also used during inservice training for New York Extension agents.

Introducing The Materials

The new materials were introduced in Washington, D.C. at the National Workshop on Water Quality in February 1988, along with four *Water Treatment Notes* produced at Cornell and other complementary fact sheets from the University of Maryland.

The developers suggested that the materials be used as part of county regional workshops for well drillers, local health and environmental officials, and Cooperative Extension staff. The workshops could be accompanied by a product fair sponsored by testing and treatment vendors.

Proposed topics for the workshops included:

- The basics of hydrology,
- Proper well development,
- Health effects of drinking-water contaminants,
- Testing and treatment of water.

The interactive computer program was available for use during the national workshop. Since then, it has been used by Extension agents in New York as a major part of a 2-day indepth course, Understanding Chemicals.

Achieving The Objectives

The development and distribution of these educational materials on water quality has provided Extension with the tools for achieving the objectives set forth in the beginning of the project. As the materials are used with more audiences and in other parts of the Nation, they will be closely evaluated to assess their value in improving public knowledge, fostering decisionmaking skills, and helping Extension staffs develop closer working relationships with other professionals who are concerned with water quality. ▲

The Groundwater Gurus

From a homeowner's contaminated well to an entire county's groundwater management plan, Wisconsin's local officials face a bewildering variety of groundwater problems.

Where can these officials turn for advice and assistance on groundwater quality and management issues? Extension at University of Wisconsin, a familiar source of assistance to local governments, continues to provide answers. The Central Wisconsin Groundwater Center, established in 1985 with state funding, serves individuals as a central source of information and education on groundwater issues and provides technical assistance to local units of government.

In central Wisconsin, groundwater contamination problems have been recognized for several decades. The area's combination of sandy soils and a high water table makes it susceptible to contaminants from agricultural activities, residences, and businesses.

Focus On Local Solutions

The Center's philosophy is that many environmental issues, including groundwater, have aspects that can best be handled at the local level. The officials understand the needs of their constituents and their local finances better than anyone else. Center assistance focuses on providing assistance to appropriate groups in each community. The authors' experiences with groundwater problems in Minnesota and Montana have convinced them that local governments have the potential to work toward local solutions with the right kind of assistance.

Staff member Michael Bohn provides the Center with data collection and management from the Wisconsin Geological and Natural History Survey (WGNHS) located in Madison. With the development of a computerized database on groundwater quality from central Wisconsin counties, specialists at the Center are trying to find the right data, place it in the hands of local officials who need it, and help them interpret it, author Osborne points out.

Much of the data is collected during drinking water education programs in which residents of a targeted geographic area are invited to test their water at the Environmental Task Force Lab at Stevens Point. Then the residents participate in an educational program in which they are taught the significance of their individual water quality results and the relationships between land use, geology, and water quality in their community.

The database also contains water quality information for other samples collected by homeowners. Many homeowners received their sampling kits through their county Extension offices as part of a Center project called The Regional Laboratory. Groundwater quality reports for 1987 data are currently being prepared for presentation to participating counties.

Statewide Expertise

The staff has access to the expertise of other groundwater specialists statewide, including the Wisconsin Geological And Natural History Survey. In addition, other Extension specialists at the University of Wisconsin's Madison, River Falls, and Superior locations provide groundwater assistance in areas not routinely visited by authors Mechenich and Osborne.

Currently, Osborne is working with officials from the town of Hull in Portage County to analyze and interpret data from a groundwater monitoring project initiated there after a drinking water education program. The town officials want to prevent small problems from becoming larger, more costly ones.

Special Plans

Groundwater issues have become so pervasive in some central Wisconsin counties that special plans have been made to infuse groundwater protection into other activities of local government.

Thomas Osborne, director, Central Wisconsin Groundwater Center, examines computer printout with co-worker Chris Mechenich, Extension groundwater education specialist, to assist local government official with a groundwater management problem.

Marathon County, for example, has recently adopted a groundwater management plan and Portage County is in the process of adopting one. Some of the data used to establish the need for the plans was collected through the efforts of Tom Wilson of Marathon County, and John Leatherman of Portage County, both Extension business and resource development agents of the University of Wisconsin. These agents sponsored drinking water education programs.

These plans combine regulatory approaches at the county level with information and education activities. Examples of activities included in typical groundwater management plans are education for farmers on agricultural BMP's, limitations on septic system density, and designation of wellhead protection areas.

Ultimately, Center staff hope to see more central Wisconsin counties begin groundwater management planning. "Since groundwater quality is so closely tied to land use, and since primary responsibility for land use is at the local level," Osborne points out, "it is logical that counties should be the ones to implement groundwater management plans. Citizens may be more responsive to education or regulation that starts at the local level. In any event, when local officials or citizens run into sticky groundwater problems, we are ready to help." ▲

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Greener Pastures ...Cleaner Water

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Farmers in Monmouth County, New Jersey, are implementing measures to prevent the loss of soil nutrients and to keep their farms from being a source of bacterial contamination of waterways. Soil testing and conservation planning are the proven tools that are helping them keep nutrients in place, cut fertilizer costs, and save money.

Mobile Laboratory
Lowering farmers' fertilizer costs, enhancing crop production with fewer chemicals, and reducing agricultural nonpoint-source pollution are the aims of a mobile nutrient testing laboratory operated by Pennsylvania's Department of Environmental Resources (DER). The laboratory tests soil and manure samples to determine the nutrient application rates that will enhance crop production and help prevent nonpoint bacterial pollution from farms.

The laboratory was the chief attraction in a series of programs in Monmouth County's 95-square-mile Navesink River watershed. The educational and informational programs were designed to inform farmers, public officials, and local residents about simple, inexpensive ways to save money and prevent or reduce existing and potential nonpoint sources of pollution.

Interagency Effort
The water quality programs were sponsored by the interagency Navesink River Water Quality Improvement Project. Begun in 1986, the 15-agency cooperative effort works voluntarily to reduce and prevent existing and potential "nonpoint sources" of pollution (diffuse, not easily controlled sources such as stormwater runoff) from further degrading two vital waterways—the Navesink River's 2,622-acre shellfish estuary and the 2.6-billion-gallon Swimming River Reservoir, a drinking water source for 250,000 Monmouth County residents.

Nutrient Management
"Nutrients are to crops as yeast is to bread," said Greg Westfall, Soil Conservation Service district conservationist. "The application of excess nutrients, however, costs the farmer dollars and may cause pollution. That's what we're trying to prevent by educating farmers about the economics of nutrient management on farms."

County agricultural officials estimate that 50 percent of Monmouth County farmers use soil testing to apply fertilizers correctly. Richard Obal, Extension agricultural agent, says most county farmers use chemical

Robert Gaestel, New Jersey farmer, who was instrumental in the construction of the first horse manure composting facility in that state, addresses audience at groundbreaking ceremony. The composting facility was designed to be a viable alternative to chemical fertilizers.

fertilizers instead of composted horse or livestock manures because chemical fertilizers are more convenient, easier to apply, and less bulky, and many farmers do not have manure-spreading equipment. He points out, however, that composted manure was used widely before World War II in Monmouth County and is still a viable alternative for farmers to consider.

Horse Manure Composting
Farmer Robert Gaestel is constructing New Jersey's first horse manure composting facility. Navesink project officials view the facility as a much-needed outlet for the mounting piles of horse manure contributing bacterial contamination to the watershed.

In addition, the new facility will turn horse manure into a nutrient-rich soil conditioner that will improve soil structure, reduce soil erosion potential, support beneficial soil organisms, reduce chemical fertilizer use, cut fertilizer costs, and enhance the long-term productivity of the soil.

The composting operation may receive up to 43 percent cost-sharing under the Federal Soil Conservation Service (SCS) Navesink Watershed Plan, which was begun in 1985 to promote the installation of soil and water conservation practices.

The 79- by 24-foot composting facility, designed by SCS engineers with assistance from Rutgers University researchers, will handle the manure from 429 horses. Gaestel plans to sell the composted manure to landscapers and contractors. About 40 to 50 percent of the watershed's horse waste is picked up regularly by manure haulers serving Pennsylvania's mushroom farmers. Gaestel's facility will handle another 10 percent, leaving about 9;840 tons unremoved each year.

Impact On Shellfishing
"The water is very close to being opened for shellfish harvesting," says Project Manager Horzepa, who is also chief of the Bureau of Water Resources Management Planning in the New Jersey Department of Environmental Protection (DEP). "When it rains, the bacteria count in the river goes up. We're attempting to get pollution control when it rains."

"Gaestel's facility may help to lower the price of shellfish, or at least make it more plentiful and make New Jersey's shellfish industry viable again," says Michael Ferguson, a member of the local environmental commission. ▲

Home Front Attack On Water Pollution

Virginia Cooperative Extension Service (VCES) home economists are playing a singificant role in helping Virginia households fight water pollution. They are conducting needed research providing research-based data to help formulate public policy and disseminate research-based information to consumers.

Water-quality problems in the Chesapeake Bay and other bodies of water in Virginia have occurred, in part, as a result of enrichment from the nutrient phosphorus. This situation caused the state's public policymakers to investigate alternative strategies for controlling unwanted nutrients

One source of phosphorus is home laundering effluent that is processed through wastewater treatment plants and poorly functioning septic systems. One study has estimated that use of nonphosphate detergents could reduce the phosphorous loadings from municipal point sources in the Chesapeake Bay tributaries by about 25 percent.

Legislation to prohibit the sale and use of detergents having more than 0.5 percent phosphorus was discussed by the Virginia General Assembly in 1985 and 1986 and finally enacted in 1987 to become effective January 1, 1988.

Cost-Benefit Study
VCES home economists became involved in the issue of banning phosphate laundry detergents about 3 years before the law was passed. In 1984, the authors served on a five-member Virginia Senate task force to study the costs and benefits of such a ban.

Other members of the task force represented the State Water Control Board, the Chesapeake Bay Commission, and the Virginia Soil and Water Conservation Commission. The study focused on the impact on consumers as well as on the water quality aspect.

As the task force reviewed research related to the use of nonphosphate laundry detergents and the impact that a ban would have on consumers, it became evident that new research was needed.

Because about two-thirds of Virginia citizens live in soft-water areas, a chief problem was the absence of studies dealing with the use of nonphosphate laundry detergents in soft water. This need led to a joint Extension-research request for a project to obtain the needed data.

The 1-year project received about $18,000 from the Virginia Water Resources Research Center and the Virginia Tech Department of Housing, Interior Design, and Resource Management.

Conducted in the university's household equipment laboratory, the project compared the performance of three types of laundry detergents—phosphate-built powder, carbonate-built powder, and unbuilt liquid—in both soft and hard water.

As the Virginia legislators deliberated about the proposed ban, the VCES home economists shared periodic progress reports about the research with key senators. Thus, research-based information was made available to policymakers in a timely manner.

Extension Educational Programs
The results of the laboratory research project have been used as part of workshops to help home economics Extension agents increase their knowledge about nonphosphate laundry detergents. Several VCES educational programs designed for consumers have been used widely by Extension agents and volunteer leaders.

Educational materials that Extension has developed include

- "What, No Phosphates?"—a slide program with a continuous-loop cassette audiotape, for use at exhibits.

- Two fact sheets: "*Shopper's Guide: Nonphosphate Laundry Detergents,*" and "*Using Nonphosphate Laundry Detergents.*"

Extension home economists throughout the state also have presented consumer information on nonphosphate laundry detergents through television, radio, newspapers, and newsletters.

The State Agricultural Experiment Station funded an Extension-research request for a project designed to help identify what changes, if any, have occurred in home laundry practices and consumer satisfaction since the law went into effect. The results will be used in future Extension programs and will be available for reference when impact of the policy is reviewed. ▲

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Researcher at Virginia Tech, Blacksburg, prepares to test laundry detergent for phosphorous. Detergents containing more than 0.5 percent phosphorous—a contributor to water quality problems in Chesapeake Bay—can no longer be sold in Virginia.

Preserving A Valued Resource

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People in Michigan like to boast that their state leads the Nation in renewable freshwater resources. They are proud of their 3,288 miles of shoreline, 36,350 miles of rivers and streams, 35,000 inland lakes, and more than 150 waterfalls.

The Michigan Cooperative Extension Service is helping citizens identify and solve water quality problems so that this resource can continue to be a valuable economic and social asset. Preserving water quality and minimizing contamination problems have always been Extension goals. The formal water quality (WQ) program, however, did not begin until 1985.

Water Quality Committee

The WQ program has a permanent committee of 12 members—campus-based specialists and field staff members from the four Extension program areas and three subcommittees. They work in specific areas such as animal waste handling, crop and soil management, and nonagricultural areas including community and household waste management and disposal.

Extension's WQ programs have led to interagency coalitions and joint educational programs with Michigan's Departments of Agriculture, Public Health, and Natural Resources. And Extension has conducted field staff training

in cooperation with the Michigan Soil Conservation Service and the Soil Conservation Districts.

Extension has developed more than 20 new publications dealing with topics such as phosphorus, nitrogen, and soil sediment management; solid waste handling; environmental hazards associated with underground storage tanks; and crop irrigation. A newsletter keeps WQ committee members, field staff, and others up to date on new educational projects and issues.

Animal Waste Handling Standards

The program has attracted wide interest among communities. At times, interest stems from specific issues, such as the state's proposed animal waste handling standard. When the first draft touched off a political explosion, Extension was directed to develop interim guidelines.

Working with representatives from Michigan's agricultural industry and the Soil Conservation Service, WQ program members helped write the guidelines and then reviewed them in 17 regional meetings for farmers and other citizens.

Although the matter remains far from being resolved, the Extension team continues to play an important role in developing an effective water quality protection standard for Michigan agriculture.

Community Assistance

Another program for small local government units is the Community Assistance Program for Environmental Toxicology (CAPET), developed by WQ members in MSU's Center for Environmental Toxicology.

Funded by the C.S. Mott Foundation, CAPET is working with a few small communities (population 1,500 or fewer) that cannot by themselves afford to solve contamination problems. Eckhart Dersch, MSU Extension specialist and professor of resource development, organized the program so that these communities would have access to campus-based experts in such areas as toxicology, groundwater flow, waste disposal, and environmental law.

"Ideally, we like to be involved as soon as the community recognizes its problems and before sides are chosen and important decisions are made," Dersch says. "We can't solve their problems, but we can help them to move as quickly as possible toward a rational list of options.

Groundwater Quality

An example of Extension's broader outreach is the Tri-County Groundwater Meeting, which attracted about 250 civic and governmental officials from three southwestern Michigan counties in June 1987. The 1-day program, which explored known and suspected groundwater quality problems, was coordinated by Dersch; Harvey Liss, Extension program leader at KBS; and Dean Solomon, district Extension leader for natural resources and public policy.

The county Extension directors—Bill Plummer in Calhoun, Jan Hartough in Barry, and George Mansell in Allegan—used a survey to identify the discussion topics that would be of most interest to their county residents. Groundwater experts from MSU, state and county government, and nearby Western Michigan University at Kalamazoo were the featured speakers.

The session included the formation of "county huddles" in which community members worked with Extension facilitators to identify local problems and make plans for handling them. These groups have continued to function in the counties under the guidance of the local Extension directors.

Groundwater Task Force

The ability of community leaders to develop an action-oriented focus on local water quality issues will be further enhanced by the Groundwater Task Force that was created recently by the College of Agriculture and Natural Resources.

Task force members represent the Agricultural Experiment Station, the Cooperative Extension Service, and water quality preservation interests outside the university. The group's main job will be to help identify, coordinate, and channel resources to communities that need expertise in groundwater enhancement and preservation.

Education For Action

Communities will find additional assistance through the new Groundwater Education in Michigan (GEM) program. GEM was launched by the W.K. Kellogg Foundation in collaboration with the Institute of Water Research at MSU. It is a comprehensive effort to encourage communities to develop local action-oriented groundwater protection projects.

Its purposes are to increase public awareness and understanding of the groundwater resource, to promote individual and broad community involvement in developing groundwater protection initiatives, and to emphasize the use of pollution prevention strategies in individual and community behavior, including policy development.

All of these efforts together form a broad and potentially effective network intended to maintain Michigan's national reputation for its vast quantity and high quality of water resources. ▲

The Enemy Within: Hazardous Waste From Homes

Elaine Andrews
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"We have met the enemy, and he is us!" Ever since the 1960's, Pogo's famous phrase has been applied to myriad environmental problems. Never has it been more true than when used to describe the impact of hazardous wastes from homes. Since World War II, improved technical understanding of chemicals, fueled by consumer demands, has led to increased use of hazardous chemicals in household products.

Not only have these chemicals created a need for more home safety education, but also their disposal has contributed to both solid waste and water quality problems. Our ignorance of chemical hazards, coupled with the carelessness of our "throwaway society," has come back to haunt us with toxic substances in our drinking water.

What Is Extension's Role?
It is not easy to quantify the impact of improper disposal of household hazardous waste. The extent of the problem will undoubtedly be clear to future generations, thanks to the leaking landfills and other domestic pollution sources that we will leave them.

Wisconsin has found qualitative evidence of the impact of domestic wastes, such as well water contamination in locations where there has been little or no opportunity for industrial or agricultural impact. These findings provide corroboration for similar evidence from New York, Massachusetts, Minnesota, and Washington.

But other point and nonpoint sources of toxic contaminants may be a greater risk to health and the environment than improper disposal of household hazardous waste. Extension specialists and county agents must determine the best use of their scarce time and financial resources. Should educational material development and training time be devoted to the subject of household hazardous waste, or would it be better spent on other groundwater contamination issues?

The Teachable Moment
The answer is: It depends on the needs and interests of the local people. In Wisconsin, proper disposal of household hazardous waste has captured the imagination of the general public, health officials, solid waste managers, and landfill owners and operators. In effect, the 1980's have become the "teachable moment" for information about toxic substances.

Interpreting the complexities of toxic substance risk management is a formidable task. But the hazard of household wastes is something everyone can understand to some degree. Better yet, behaviors learned in relationship to household hazardous waste disposal can be transferred to community decisionmaking concerning management of other hazardous wastes and toxic substances.

In Wisconsin we know the "teachable moment" has arrived because of the depth of interest and the response. As of December 1987, 14 Wisconsin communities had sponsored 26 household hazardous waste collection programs. County Extension resource agents were heavily involved in four of these programs.

Resource agents, agriculture agents, and home economists have been involved in providing information, organizing public meetings, offering leader training programs, and finding ways to coordinate household hazardous waste disposal techniques with other difficult-to-dispose-of hazardous wastes in approximately one-third of Wisconsin's counties.

Managers, legislators, and educators from more than half of the state's 72 counties have contacted the university Extension environmental education specialist for information or assistance concerning disposal of hazardous wastes from homes or have attended short courses, workshops, or lectures.

Extension Provides Leadership
The University of Wisconsin Extension Environmental Resources Center (ERC) has provided state leadership in household hazardous waste education and management. ERC serves as a "clearinghouse" of scientifically accepted information and facilitates local and county program development. County Extension faculty identify program needs.

ERC informs agents of issues and resource availability; develops additional educational materials and resources; works cooperatively with state agencies to gain review, acceptance, and use of educational materials; and develops specialized educational programs for client groups who do not fall into the county agent network.

Educational Methods
Wisconsin's program has used a variety of methods to accomplish its educational goals:

- Using grant funds to purchase audiovisual materials for use by agents and specialists.

- Developing supplementary audiovisual materials with the cooperation of other state agencies and "in-kind" contributions from a private television station.

- Developing and publicizing a variety of educational and training materials appropriate for the general public.

- Collecting and publicizing print materials contributed to the Wisconsin Extension library by other states.

- Offering a variety of educational talks, workshops, and credit courses, coordinated through county Extension faculty and University Outreach. ▲

A Public Policy For Groundwater

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Groundwater contamination stemming from agricultural sources has become a major focus of governmental efforts and public concern. The Extension Service can be a vital link between governmental policies in this area and the farmers whose agricultural practices are affected by those policies.

This study sampled Iowa farmers to learn their views on five alternative solutions to groundwater problems. Although the farming community is only one of the groups with valid and important views about agriculturally related groundwater problems, farmers' attitudes are critical to Extension because farmers are the primary users of Extension's information and education programs.

Groundwater Policies
Five policies presented to Iowa Farmers in the study are listed below in an order that assumes an increasing level of Extension Service involvement and, coincidentally, an increased level of expected protection of groundwater quality.

Industry Self-Regulation With Goverment Monitoring
This policy relies on industry and agriculture to regulate their own activities to best serve the public interest. Governmental involvement would include monitoring groundwater supplies and publishing estimates of the health risks from contaminant exposure or ingestion. This policy probably would result in relaxing some existing licensing and regulatory requirements. Overall groundwater quality would be expected to decline.

Groundwater Use Linked to Level of Contamination
Under this policy, various groundwater uses (industrial, irrigation, drinking water, etc.) would be identified, along with acceptable contamination levels for each use. Under governmental regulations, groundwater sources serving each use would be allowed to become contaminated up to the established level for that use. Extension probably would be involved in identifying present and future groundwater uses and in coordinating groundwater usage with appropriate water supplies.

Human-Health-Based Standards
Maximum allowable contamination levels for groundwater supplies would be set according to acceptable risk levels for protection of human health. Typically, acceptable risk levels are set so that a lifetime (70 years) of drinking water at the maximum allowable concentration would increase the average death rate by no more than one additional death out of one million people. This policy would allow "reasonable" levels of groundwater contamination to occur without undue health risks. Governmental enforcement action would be necessary only when health-based standards were exceeded.

Barring Further Degradation of Groundwater
This policy would seek to prevent any additional contamination of groundwater. The government would take such actions as banning the use of some farm chemicals or restricting the application rates of others.

Provision of Pure Groundwater Supplies
A "groundwater purity" policy would require the most stringent constraints, not only to prevent further contamination, but also to clean up groundwater resources so that no artifical compounds imposing a health risk would be detectable. Governmental action might include strict regulatory requirements in chemical registration programs, and forced reductions in the use of existing chemicals.

Iowa Farmers' Opinions
This study asked a small statistically based sample of Iowa farmers to answer questions about the feasibility and desirability of each of these policy options. The responses indicate a serious concern about the quality of groundwater resources and a desire for governmental action. The policies promoting the highest levels of groundwater protection were viewed as almost twice as desirable as less stringent approaches.

Consideration of the feasibility of these policies, however, tempered, farmers' desire for maximum groundwater protection. The policies promoting no further degradation or use of health-based standards were considered the best choice.

Insights For Extension
These survey results should provide insights for the Extension Service. Farmers seem to recognize the severity and importance of groundwater contamination. They want groundwater protection even if agricultural changes become necessary. They understand that the economic and technical feasibility of various policies may limit the amount of protection possible. And they view government involvement as desirable and necessary to aid in the farming transitions necessary to achieve groundwater protection. These interpretations point to a legitimate and active role for Extension.

Farmers use, prefer, and rely on information from their county Extension agent, agricultural experiment station, or university Extension specialists. This confidence places a significant burden on Extension to provide accurate, complete, and valid information to guide farmers in altering their operations to protect groundwater.

Understanding the attitudes of farmers on these issues will help Extension fulfill its role as a vital link between farming practices and groundwater quality protection. ▲

Water Quality— An Oregon Enterprise

Hugh J. Hansen
Extension Agricultural Engineer,
Oregon State University,
Corvallis

Lenore Paulsen, Douglas County Extension home economics agent, Oregon, samples a glass of "quality" drinking water poured by Gerry Meyer, Douglas County sanitarian.

During the early 1980s, to plan and implement the Tillamook Bay Rural Clean Water Project, the Oregon State University Extension Service worked in cooperation with seven other agencies: Tillamook County Soil and Water Conservation District, Tillamook County Creamery Association, Tillamook Bay Water Quality Committee, Oregon Department of Agriculture, Oregon Department of Environmental Quality, USDA's Agricultural Stabilization and Conservation Service, and the Soil Conservation Service.

Interdisciplinary Initiative

More recently, Extension agents, specialists, and administrators have developed a statewide Extension interdisciplinary initiative in water quality. In 1987-88, the first year of the initiative, the focus has been on development of teaching and resource materials related to water quality for domestic use.

Leadership in development of a county Extension office reference notebook on this topic and accompanying agent training has been provided by Hugh J. Hansen, Extension agricultural engineer; Mary Ann Sward, Extension housing specialist, and James A. Vomocil, Extension soil scientist, Oregon State University.

Two inservice training workshops have been conducted to familiarize at least one agent assigned water quality responsibilities in each of the state's 39 county Extension offices. A series of nine fact sheets focusing on domestic water quality issues and concerns are being authored by the three specialists involved. The training and resource materials are geared for use in interdisciplinary programming efforts at the county level.

The primary goal of the initiative is to increase water quality awareness of Oregonians by 50 percent. In addition, the quality of domestic water will be improved for at least one-third of Oregon's 673,000 family units presently using domestic water sources of unknown or questionable quality.

Focus On Agriculture

The remaining 3 years of the initiative will address water quality issues related to agriculture. The program will develop additional agent reference notebooks, inservice agent training, and supporting fact sheets for public distribution. The agents and specialists working on the water quality initiative are coordinating efforts with another OSU Extension interdisciplinary group focusing on the management of Oregon's wetlands and riparian zones as related to the state's forestry, agricultural, fishing and recreation industries. ▲

4-H Goes Aquatic!

As participants arrived at Jamestown 4-H Center in Williamsburg, Virginia on that hot, August afternoon, expectations for an exciting week were building. The fourth annual Senior 4-H Marine/Aquatic Leadership Camp was about to begin.

The need for youth to increase their awareness and understanding of water-related issues is great. Threats to the quality of water and general environmental deterioration pose serious problems for present and future generations. Because of this threat, it is the goal of the 4-H Marine/Aquatic Educational Program that youth develop a sincere appreciation for and dedication to conserving water resources.

Camp Objectives
To meet the needs of senior 4-H youth, the camp provides leadership training in environmental education. Participants from across the state are selected by their interest and involvement in environmental issues and activities. During the camp week, they take part in workshops, tours, and field study sessions to learn firsthand about water resource issues.

Major objectives of the camp provide youth the opportunity to: 1) gain additional knowledge, skills, and positive attitudes about water-related resources; 2) develop leadership skills in environmental education; and 3) become familiar with environment-related resources and careers.

Originating from an earlier pilot program (see Extension Review, Summer, 1986), the camp has become a statewide model for environmental education programming.

Major funding for this program was provided through the National Science Foundation. The National Science Foundation grant also supports three additional 4-H programs: 4-H Marine Project publications, Adult Volunteer Leader Training, and a Special Marine Camp for Disabled Youth. In addition, scholarship funds are provided by the Virginia Sea Grant Program.

Camp Kickoff
Inspiring guest speakers are used to kick off the program. Ed Clark of the Virginia Wildlife Rehabilitation made a hit with campers and staff alike. With a live hawk, owl, and young fox in hand, Clark convinced his audience that public awareness and concern are necessary to save wildlife populations for the future.

As director of the Center, Clark's message emphasized that wildlife species are a valuable resource not to be taken for granted.

Guest speakers for previous camps included the late Captain Alex Kellam, retired Chesapeake waterman. As a tribute to him for his lasting impact on 4-H'ers, our camp is dedicated to his memory.

Program Variety
The first full day of camp offered a smorgasbord of workshops: wind surfing, seafood cookery, decoy carving, and CPR training were some of the hands-on learning experiences.

A choice of four, two-day field trips offered programs in maritime history and coastal development, barrier island ecology, industrial and commercial use of water resources, and estuarine ecology.

Virginia has a wealth of programming resources including The Mariners' and Virginia Marine Science Museums, Chesapeake Bay Foundation, Commission of Game and Inland Fisheries, Naval Bases, and state and federal refuges. Using such resources outside Extension not only expands program support but also benefits the resource provider by offering greater audience potential. Developing good resource contacts is a must for this type of program.

"What's in this net?" Barry W. Fox (left), 4-H Extension specialist, marine education, instructs 4-H'ers in fishery biology at the 4-H Marine/Aquatic Leadership Camp in Willamsburg, Virginia.

Leadership Training
A major emphasis of Marine Camp is leadership development. Early in the week campers selected specific topics for which they would develop presentations.

Winding Down
Excellent performances demand recognition, and several awards categories were used to recognize high achievers. With this, and the closing campfire, the reality came that camp was almost over.

In its aftermath, one can ask if all the planning, phone calls, letters, worry, and work were worth the effort. One 4-H agent told me that her "4-H Marine Camper came back a different person, and for the first time is taking on many leadership roles in her own 4-H program." ▲

Barry W. Fox
Extension Specialist,
4-H Marine Education
Virginia Tech,
Blacksburg

Clearinghouse For Quality

Daniel H. Walters
Former Director,
Technology Division,
National Small Flows
Clearinghouse,
U.S. Environmental
Protection Agency

The septic tank systems commonly used in rural areas and small communities are the leading contributor to the total volume of wastewater discharged directly into the soil. The nearly 23 million such systems in the United States treat and discharge almost 3 billion gallons of wastewater every day.

The settled and floating residue that remains in septic tanks, if pumped out every 3 to 5 years as recommended, would amount to more than 4 billion gallons of waste to be managed, treated, and disposed of each year. When septic systems are located on unsuitable soil or are poorly designed and constructed or inadequately maintained, the usual results are system failure and public health threats.

Many areas that have sewage treatment plants have problems also. A recent survey estimated that 2,000 small community treatment plants are not meeting effluent discharge requirements. About $2.5 billion would be needed to upgrade these facilities.

Communities Need Support
To resolve their wastewater problems, local officials of small communities and rural areas must be able to call upon all available resources for financial, technical, and managerial support.

The U.S. Environmental Protection Agency has established an information clearinghouse that can directly assist local officials and also support the institutions that work with them. And it can deliver technical information to consultants, advisory groups, assistance agencies, and contractors who are working with small communities and rural governments.

Wastewater Information Center
The 1977 Clean Water Act directed EPA to establish a national center for information related to wastewater systems and wastewater management strategies appropriate for small communities and rural areas. In 1979, EPA established the National Small Flows Clearinghouse at West Virginia University.

The three major objectives of the clearinghouse are:

- To provide information and assistance so that small communities can make sound wastewater decisions;

- To enhance the capabilities of the EPA regions and the states to assist small communities through the development of outreach programs; and

- To equip the technical community with the technological information it needs in order to accelerate the development and application of innovative technologies appropriate for small communities.

Clearinghouse Publications
The clearinghouse publishes two periodicals to further these goals. *Small Flows* serves the technical community with articles spotlighting

technologies, operation and maintenance, case studies, and people and institutions actively involved in small-flow technology. It also includes information about new publications, a calendar of events, and an order form detailing clearinghouse products and services such as design modules, case studies, videos, and EPA publications and databases.

The second publication, *Managing Small Flows*, addresses the same topics, but in a different way. Aimed at local officials, it gives decisionmakers the facts without being too technical. In addition, it discusses finance and management and emphasizes the "self-help" concept. Information about outreach agencies and important publications for local officials is an integral part of this publication.

Assistance For Outreach
The clearinghouse is supplying support and limited funding to states for efforts to develop outreach capabilities in the area of wastewater management. It works with the Cooperative Extension Service, the National Association of Regional Councils, Rural Community Assistance Programs, and others in delivering wastewater information to small communities.

By calling a toll-free number (800-624-8301), interested persons can request information, publications, and referrals and can be put on the mailing list for the two clearinghouse periodicals. Written requests should be addressed to: EPA National Small Flows Clearinghouse, P.O. Box 6064, West Virginia University, Morgantown, West Virginia 26505-6064. ▲

Identifying Pollution Risks

Mike Bohn and Gary Jackson Extension Water Quality Specialists, University of Wisconsin, Madison

An interagency, interdisciplinary project in central Wisconsin is developing a geographic information system (GIS) that will help individuals and local governments predict the effect of their land management decisions on the quality of local groundwater.

GIS is a computerized approach to analyzing and managing spatial data such as land uses, population, soils, geology, and water quality. It enables users to retrieve and combine data to create maps that reveal patterns useful in resource and land use planning.

The goal of the central Wisconsin GIS is to develop a system that can be used on existing personal computers to identify areas of highest groundwater pollution risk so that Extension can target those areas with information and education on the nature of the problem and help them take corrective or preventive actions.

Benefits Of A GIS

The GIS could be used, for example, to develop better recommendations for fertilizer and pesticide application rates on a farm field or other land management unit. Soil characteristics, geologic and hydrologic data, and past cropping history all should influence the application recommendations.

Factors included in the pilot GIS system include soil organic matter, type of surface geologic materials, depth to water table, depth to bedrock, prior cropping history, prior chemical applications, and irrigation water usage. By evaluating these data to determine the area's pollution vulnerability and then applying chemicals according to established guidelines for various levels of vulnerability, pollution risks can be reduced.

The easily understood GIS graphic output should be a powerful tool for groundwater protection that could be used by crop consultants, farmers, and land management agencies.

Developing A Database

In 1986, Wisconsin Cooperative Extension received a grant from the USDA Extension Service to assess procedures for evaluating farm pollution potential. The original plan was to use existing soil, geologic, and hydrologic information as a basis for assessing the pollution potential of individual farms.

But initial efforts quickly demonstrated that, except for soil survey data, such information is difficult to obtain and generally is not in a form that readily allows it to be used in a farm-specific evaluation. As a result, the pilot project was redirected toward organizing data into a usable format. Extension realized that the project could be accomplished only through substantial cooperation with other agencies.

They found willing cooperators in the Soil Conservation Service's Golden Sands Resource Conservation and Development (RC&D) Project and the Central Wisconsin Groundwater Center. The RC&D project obtained additional funding and expanded its advisory committee.

The expanded committee involves staff from county planning and zoning offices, Soil Conservation Service, Wisconsin Department of Natural Resources, county and state Extension, county land conservation committees, county health office, and the University of Wisconsin at Stevens Point.

Organizing The System

Two key assumptions in organizing the GIS are that agencies will share their data and that they will be willing to collect and organize data in formats usable on personal computers.

Participating groups maintain custody of their own data, but make it available as part of a shared database. The need for standardization of formats and procedures has necessitated extensive technical training for the resource professionals.

Lessons Learned

Before any such system can be operational at the local level for farm-specific use, some significant needs must be met:

- Inexpensive, powerful, government-supported relational database and vector GIS software for personal computers, along with software to facilitate conversion of data to common standards.

- Close coordination among agencies to assure compatibility among different spatial databases.

- Educational materials to familiarize GIS users with the conceptual basis of GIS, how to apply GIS to natural resource problems, and how to collect data with future GIS uses in mind.

Tool For The Future

The federal government is already considering the possibility of regulating agricultural chemical use according to the pollution potential of individual geographic areas. Under such a plan, states probably would have the option of accepting generalized vulnerability ratings developed nationally or performing their own site evaluations.

If more site-specific management recommendations are to be developed at the state and local level, regional geographic information systems like this one will be needed. They will provide a framework that can be used by local government officials, state policymakers, and individual land managers when evaluating the practices or restrictions needed to protect against groundwater pollution. ▲

Solving The Groundwater Quality Puzzle

Edward F. Vitzthum
Associate Coordinator, Environmental Programs, University of Nebraska-Lincoln

Four words are almost certain to capture the attention of federal and state lawmakers, regulatory agencies, researchers, Extension staffs, and most importantly, the people of the United States—*agricultural chemicals in groundwater.*

Nebraskans are especially sensitive to the problem. Groundwater serves domestic water needs for more than 90 percent of the state's population, rural and urban.

Thanks to a $1-million grant from the Burlington Northern Foundation through the University of Nebraska Foundation, a University of Nebraska-Lincoln team of researchers and Extension specialists is seeking some new perspectives on groundwater problems—and, they hope, some solutions.

Interdisciplinary Effort
The Burlington Northern Foundation Water Quality Project was launched in October 1984. The 5-year interdisciplinary research and Extension project—actually six related projects in one—is designed to examine the potential effects of several crop production practices on groundwater quality.

Chemigation Risks
The increasingly widespread use of chemigation was one factor that pointed to the need to protect Nebraska's water quality.

Because it is effective, efficient, and economical, chemigation is steadily gaining popularity.

There are potential drawbacks, however. If the system malfunctions, a chemical can be backsiphoned into the well or can leach into it from a spill. The result can be serious groundwater contamination.

Coping With Contamination
Several practices, including irrigation management, nitrogen management, and integrated pest management, are known to be effective in helping cope with groundwater contamination problems. The research team is seeking to develop new alternatives that will complement these proven practices.

The university's South Central Research and Extension Center (SCREC) has become the principal laboratory for the project. An area of approximately 110 acres has been divided into 180 rectangular main plots, each containing fractionally less than 6 acres. The 2,220-foot diesel-powered linear irrigation system can deliver 1,400 gallons of water per minute from the 2,550-foot-long supply ditch that bisects the project site.

Areas Of Emphasis
The project comprises five research/Extension projects in three broad areas of concern, plus a soil and plant analysis project:

Effectiveness of agricultural chemicals and their movement on and in the soil:

• A study focusing on nitrogen cycling and movement in soil. The study is examining the effects of tillage methods, nitrogen fertilization rates (with and without a nitrification inhibitor), and three different corn hybrids on nitrogen mineralization and the depth of fertilizer movement in soil over time.

• A herbicide-irrigation-tillage (HIT) study. This study is designed to determine the effects and interactions of two different herbicide treatments, two irrigation regimes, and four tillage systems as they relate to both crop production and groundwater quality.

• An insectigation study which parallels the HIT study. Tillage practices, insecticide formulations and application methods, and irrigation water levels are being studied to determine their effects on population of selected insects and on movement of the insecticides through the soil profile.

Blackflow prevention and chemical injection devices:

• A study to evaluate equipment designed to prevent the blackflow of chemicals into the water system and equipment used for chemical injection.

• A study of the aquifer cleanup and restoration methods that would be necessary if chemicals should accidentally backflow into the water system. A harmless tracer solution is injected into an irrigation well to simulate backsiphoning of an agrichemical. Multilevel sampling wells situated at predetermined distances from the irrigation well are used to track movement of the tracer in the aquifer. By pumping the irrigation well, the researchers can determine the percentage of the "contaminant" removed in a given time period.

Soil and tissue sampling:
• The work of the pesticide analytical laboratory in the Department of Weed Science has been designated as a separate subproject. The laboratory provides the extensive analyses of soil and plant tissue samples required in all the projects. Because soil samples must be taken before and after each treatment, the laboratory must process about 4,000 soil samples annually.

The Future Depends On Water
Now in its fourth year, the project is scheduled to continue through the 1989 crop season. The challenge is clear: to preserve the quantity and quality of water for the future while maintaining crop production capacity and profitability. ▲

Putting It All Together

Joe Makuch
Extension Water Quality Specialist, Chesapeake Bay Program, Department of Agricultural Engineering, Penn State University, University Park

Manure can be a valuable farm resource. Spread on cropland properly, it can increase crop production by improving soil structure and providing nutrients. But mismanaged manure can pollute streams and groundwater.

Manure Management for Environmental Protection, a manual published by Pennsylvania's Department of Environmental Resources (DER), is helping farmers obtain maximum benefits from manure while minimizing potential water quality problems. The manual is the result of a major revision project headed by Robert Graves, Penn State professor of agricultural engineering with Extension responsibilities.

The original manual, published in 1977, was oriented primarily toward dairy operations and thus did not adequately reflect the diversity of the State's agriculture. So in addition to a need for updated material in the dairy section, there was a need to add detailed manure management recommendations applicable to swine, poultry, and beef production.

Cooperative Effort

The spark for revising the original manual came in late 1984 from a DER agricultural advisory committee made up of representatives from federal and state agencies, the state's major farm organizations, the legislature, and Penn State. Funding from the Chesapeake Bay Program provided the necessary resources.

As editor, Graves consulted with a manure management work group. The director of natural resources for the Pennsylvania Farmers Association chaired the group, which also included Extension specialists and Soil Conservation Service (SCS) staff, who wrote and technically reviewed the new manual.

Penn State's Agricultural Information Services provided the expertise necessary to ensure that the manual was attractively designed and easy to read and understand. By May 1987, Pennsylvania had a comprehensive, usable reference to help farmers properly manage manure.

The Finished Product

The manual is really eight separate handbooks. Two of them, *Manure Management for Environmental Protection*, and *Field Application of Manure*, cover general areas of manure management, such as construction of manure storage, fly control, and proper application rates.

Separate handbooks cover each major type of livestock operation in Pennsylvania: poultry, swine, veal calf, beef, and dairy. The remaining handbook discusses manure management for horses, sheep, goats, and various small animals. The individual sections are made up of stand-alone fact sheets.

This format offers several advantages over a single, large volume. Farmers can get the handbooks and fact sheets that are specific to their individual operations. At the same time, Extension and other agencies have the complete manual as a reference for the broad range of questions they receive. This format also makes it possible to easily update and reprint separate sections as necessary.

The manual is also available on PENpages, the computerized information retrieval network of the Penn State College of Agriculture. PENpages can be accessed by anyone who has a home computer, modem, and appropriate software.

Getting The Word Out

Extension produced a brochure to inform farmers and others about the new manual and sent news releases to the farm press. Each county Extension Service, SCS office, conservation district, and DER regional office received the complete manual. Five orientation meetings introduced the regional and county staffs to the manual. The orientation sessions also fostered cooperation among the many agencies that work with farmers in manure management.

Using The Manual

"The manual serves as a good starting point for farmers to learn about nutrient management," says Mitch Woodward, Extension regional manure management agent with the Chesapeake Bay Program. "I take copies with me whenever I go on a farm visit. I also send copies of sections as followups to phone calls on manure management." Woodward sees the manual as a valuable tool in the effort to prevent water pollution from agricultural sources.

Another audience for the manual is local government officials. "Especially in areas with both high animal densities and a growing suburban population," says Woodward, "local officials are concerned with what happens when manure is improperly managed. They want to know how to prevent problems with odors, flies, and contaminated drinking water."

Woodward has worked with Graves and others to conduct training sessions for local officials on use of the manure management manual. "The sessions have also served to sensitize them to the realities and challenges that farmers face in properly managing manure," he says.

Putting together the manure management manual required commitment and cooperation from many individuals. But as a result, Pennsylvania farmers, and those who work with them, now have access to a single reference that will help them make better use of a farm resource while protecting water quality. ▲

The Water Sampling Of Clark County

Chris Mechenich
Extension Groundwater Education Specialist, University of Wisconsin Central Wisconson Groundwater Center, Stevens Point
and
Mary Ellen Sjolin
Extension Home Economist, Clark County, Wisconsin

Take 90 Extension homemakers and 15 other community volunteers, add them to the usual mix of local officials and technicians who work on groundwater issues in a county, and an exciting new product emerges. In this case, the product is the Clark County Groundwater Project—a locally supported effort to educate residents about current water quality and options for the future in this north central Wisconsin county. To date, the efforts of the Extension homemaker volunteers have resulted in the collection of approximately 1,400 water samples in a county of 32,000 people and 3,500 farms.

Clark County, Wisconsin's second largest dairying county, is 1,224 square miles of rolling hills and prosperous dairy farms. In late 1984, county conservationist Keith Foye and the Clark County Land Conservation Committee (LCC) became concerned about the lack of groundwater quality data for the county.

Foye contacted Fred Madison, soil scientist with the UWEX-Wisconsin Geological and Natural History Survey. Madison observed that the combination of soil types, geologic factors, and land uses made the county's groundwater potentially susceptible to pollution. But how great was the risk? "We really don't know," Madison says.

Early Samples

In 1985, Arv Dopp, the county agriculture agent, held a drinking water education program for four townships in the county. Residents were invited to collect samples from their private wells on a specified date, using bottles provided by University of Wisconsin's Stevens Point lab. The samples were analysed, and the results mapped. About a month later, an educational program was held to inform residents about the significance of the results.

The sample size was small — only 42 samples were collected. However, within that small sample Dopp saw evidence of potential problems. Twenty percent of the samples—one in five—tested positive for coliform bacteria, an indicator of pollution from surface water or the feces of humans or animals. In addition, 14 percent of the samples exceeded the U.S. Environmental Protection Agency drinking water standard for nitrate, thus posing a health risk for infants.

In addition to these human health hazards, Dopp also recognized a significant threat to the county's dairying industry. High nitrates in water, in combination with high nitrates in feed, could cause adverse health effects in dairy herds.

Beyond the immediate water quality concerns, most of the participants had little or no information about the status of their water wells. Sixty-seven percent—two-thirds—did not know when their water had last been tested. Over 50 percent had no information about the type of well construction they had, or the depth to water in their wells. Dopp became increasingly concerned about the quality of the rest of the estimated 5,500 private wells in the county.

Clark County Board Acts

In April 1987 these parallel efforts coalesced when Foye, Dopp, and Madison approached the Clark County Board, which appropriated $22,000 for a study of the county's groundwater.

Leadership And Visibility

Mary Ellen Sjolin, county Extension home economist, University of Wisconsin, quickly recognized that the Clark County Extension Homemakers group, with 528 members in 42 clubs, could be a vital force in the project.

To implement the project, Sjolin invited seven Extension Homemaker leaders, representing different geographic areas, to serve on a planning committee. The committee's tasks were to decide on promotional strategies, sample bottle distribution and collection methods, and evaluate educational opportunities and needs.

The group quickly mobilized a core of 105 volunteers. They received training from Madison, the county staff, and Chris Mechenich, Extension groundwater education specialist, Central Wisconsin Groundwater Center, on the reasons for the project, and the details of gathering all the information needed to produce the water quality maps. County residents were informed about the project through newspaper ads, radio programs, and 6,000 brochures mailed with ASCS, The Aging office, and Extension newsletters.

Early Benefits

With 20 percent of the county Extension Homemaker membership involved in the project as volunteers, and the county organizations as a cosponsor, Sjolin believes that the visibility and influence of the group has increased.

Four education programs are scheduled for July to let county residents know what's been learned about Clark County's groundwater resources. ▲

Bay Projects— Teaching Youth Resource Awareness

4-H club members place a piece of wax paper in front of them. The volunteer leader places a drop of an "unknown" liquid on the wax paper. (The leader knows that it is water but the 4-H'ers do not.)

The youth eye the drop critically and use a toothpick to move it around, as instructed.

"Why does the drop stay round? How does the drop behave as you pull the toothpick through it?" asks the leader.

The leader asks the 4-H'ers to dip their toothpicks into a "special" chemical (actually liquid detergent). Then, as they touch their toothpick to the drop, the drop disintegrates and spreads over the wax paper.

Gasps of wonder and amazement follow; then a lot of questions.

This is one of the activities from the 4-H Marine Project—"What is Water?"

Junior Project Publications
A series of 4 marine/aquatic education projects has been developed for youth ages 9-12. They provide a variety of hands-on and group activities related to water resources.

Originally sponsored by the Virginia Sea Grant Program in 1984, the four existing units and accompanying leader guide have been rewritten and reprinted this year by a grant provided by the National Science Foundation. In addition, five more projects are planned for 1989.

The second project, "A Stream Becomes an Ocean," follows the flow of water from mountain to ocean by picture and story. Participants also follow 95,000 cubic miles of water through the water cycle. The third project, "What is an Ocean?", describes major ocean features, how the oceans became salty, and how the ocean floor is mapped. Tides are also explained with pictures and activities. The final project, "Marine Resources," investigates seafood, mineral, and other water-related resources.

All of the projects use word puzzles and activities to emphasize important terms. In addition, games are used to stress important concepts covered by the units.

Chesapeake Bay Projects
• Collect, compare, and identify examples of underwater aquatic plants.

• Research how animals use aquatic plants.

• Study the amount of sediment carried by local streams and rivers.

• Use Best Management Practices to help reduce soil erosion in your yard.

• Set up a demonstration plot to show the proper use of home and garden fertilizers.

These are a few of the activities from a series of intermediate 4-H project publications about the Chesapeake Bay.

The Chesapeake Bay, North America's largest and most productive estuary, is in serious trouble. The Environmental Protection Agency's 6-year study of the bay found four major problem areas threatening biological production and water quality: soil erosion, loss of submerged aquatic vegetation (SAV) nutrient enrichment, and toxic pollution.

To help educate youth about these issues, the Virginia Department of Conservation and Historic Resources has funded the development of 4-H project publications about each of these issues. Presently, projects concerning soil erosion and SAV have been developed. Designed for youth, ages 12-14, the projects contain information about each environmental topic, suggested project activities, and describe how youth can help reduce pollution threatening the Bay. In addition, leader guides are provided for each project. The two remaining projects will be completed this summer.

4-H youth, under the guidance of a marine agent in a Virginia marine/aquatic education project, learn to carve scrimshaw and make articles that resemble those fashioned by American whalers out of ivory over a century ago.

Barry W. Fox
Extension Specialist, 4-H,
Marine Education,
Virginia Tech,
Blacksburg

Paul Davis, Extension Bay Education Coordinator, serves as the liaison with the Virginia Division of Soil and Water Conservation, and has been instrumental in getting the publications funded.

The author has relied on a number of researchers and specialists to review the publications. "The information in the publications is current and the issues are most critical," says Fox. "I feel it is important that we educate youth about the Bay as well as help them develop a greater awareness and appreciation for this magnificent natural resource," he adds.

Environmental Awareness
The rapid urbanization of America, loss of critical wildlife habitat, and increasing pollution pressures on the environment, make it imperative that youth develop a concerned attitude about the natural world.

To do this, the Bay projects combine information with hands-on activities. Participants are encouraged to go out and observe. Youth develop an understanding of what has happened to Bay resources and what will continue to happen unless the current rate of environmental deterioration is reduced. ▲

North Carolina—
50 Years Of Progress

For the past 50 years, water quality has been an integral part of the Extension Biological and Agricultural Engineering program at North Carolina State University. In the 1930s and 1940s, emphasis was on conservation measures to control erosion for improved water quality and increased farm productivity. In the 1950s and 1960s, emphasis was on irrigation and land forming to improve yield and surface drainage.

During the 1970s and 1980s, programs were added on livestock waste management; land application of agricultural, municipal, and industrial wastewaters; on-site wastewater management; nonpoint-source pollution control; and household water conservation. Recent years have seen a renewed interest in the priorities of 50 years ago—conservation techniques to improve water quality and increase farm productivity.

The success of Extension's water quality programs has resulted, in part, from (1) strong cooperation between Extension and research programs, encouraged by the fact that many faculty members hold joint Extension-research appointments and (2) strong interagency cooperation.

Livestock Waste Management

A major goal of Extension's livestock waste management program has been to nurture cooperation among commodity professionals, conservationists, technical service agencies, agricultural advisory associations, and regulatory agencies. The program emphasizes

• **Education**—A primary focus has been on methods for making maximum use of manure nutrients and methods for reducing wastes.About one-third of the 1,000 North Carolina dairy farms have used Extension-developed plans to build liquid manure storage systems.

• **Economic incentives**—Extension's emphasis on the need to match manure nutrients with crop needs has led to an inexpensive organic waste analysis service offered through the State Department of Agriculture.Use of this service by a 100-cow dairy farm in conjunction with sound management and agronomic practices can result in annual savings of $3,000 to $5,000 in fertilizer expenses.

• **Regulation**—Extension led the establishment of cooperative strategies for implementing the North Carolina regulatory program for livestock waste discharge elimination.

• **Nonpoint-source Control**–The emphasis on land application of wastes has necessitated Extension programs to evaluate the water quality impacts of runoff from such lands and to recommend best management practices (BMP's) for control of

nonpoint-source pollution. These BMP's have been shown to reduce runoff by about 50 percent, nitrogen and phosphorus losses by more than 90 percent, and sediment loss by more than 95 percent.

Water Quality
The water quality group, supported by grants and cooperative agreements, monitors water quality literature, analyzes data from nonpoint-source projects, and prepares reports on state-of-the-art technology. The group is conducting a national water quality evaluation project and provides analysis for many state and federal nonpoint-source projects.

The group advises Extension and other agencies about management, assessment, modeling, and other aspects of nonpoint-source programs and also develops and maintains databases. Projects at the state level include the development of educational materials for sediment control and pesticide management.

Water Watch
Through its water conservation program called "Water Watch," Extension provides educational and technical assistance for installation of low-volume plumbing fixtures. More than 100,000 North Carolina households are implementing Water Watch recommendations for a total annual savings of about $20 million.

Wastewater Management
Many factors, such as restrictive requirements in environmentally sensitive areas, difficult topography, and high water tables, have led to great demand for information on acceptable alternatives to standard septic tank systems. The department has responded by cooperating with the Extension soil science department to develop and demonstrate alternative systems and produce educational materials about them.

Land Application Of Wastes
Extension's educational efforts have led to widespread use of land application systems for wastewater and sludge. More than 1,000 farmers throughout the State are using either wastewater spray irrigationsystems or land application systems.

Farmers report that application of wastewater sludges results in savings of $50 to $70 per acre. The first 18 wastewater spray irrigation systems installed saved an estimated $7.2 million in construction costs compared to costs for comparable stream discharge systems. The fertilizer value for this wastewater resource is about $2.5 million per year.

Extension and the state regulatory agency have produced a series of publications to facilitate the planning, regulatory approval, installation, and operation of land application systems. Extension cooperates with health and regulatory agencies to provide training for certification of system operators.

Water Management
The total water management program emphasizes integrated water management systems for enhanced production and water quality. Key areas include irrigation, drainage, water conservation, water supplies, erosion, and water quality.

Water management programs help growers select and use efficient systems that are tailored to site-specific needs. Training programs emphasize use of practices that collectively improve production efficiency, water conservation, and off-site water quality. Educational programs include, for example:

- **Water Table Management**—promoting such practices as controlled drainage and subirrigation for poorly drained soils.

- **Training** for Extension agents and SCS personnel—focusing on soil and site evaluation to determine suitability for water management practices, including use of DRAINMOD (a computer-based water management simulation model).

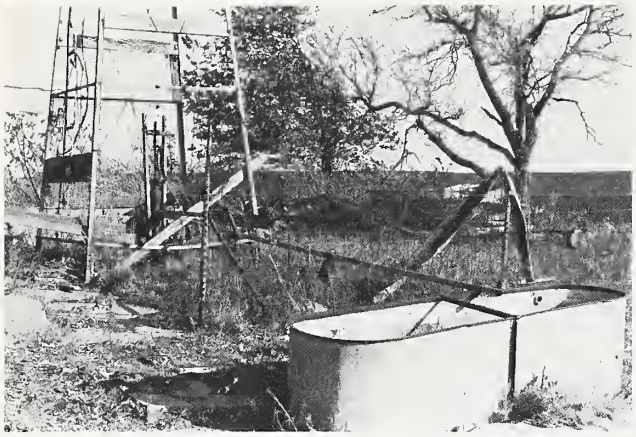
- **Water Control Structures**—working with the soil science department, SCS, and the Soil and Water Conservation Commission to encourage drainage control. The more than 1,500 structures already installed provide controlled drainage on nearly 60,000 acres and reduce nitrogen loadings to streams by nearly 1 million pounds annually.

- **Irrigation**—educating producers about (1) irrigation techniques that provide optimal water and energy conservation and (2) equipment selection and design. Extension advises growers not only about soil-water control, but also about using irrigation for frost/freeze protection, evaporative cooling for high-value crops, and for chemigation and fertigation. In the past 4 years, expanded uses of irrigation have added an estimated $2.25 million to the state's gross agricultural income.

- **Supporting The National Initiative**—North Carolina supports the Extension national initiative on water quality by a comprehensive Extension program, cooperative agency activities, and legislative funding. ▲

Co-authored by the following staff of the Department of Biological and Agricultural Engineering, Agricultural Extension Service, North Carolina State University, Raleigh: *James Barker, Livestock Waste Management Specialist; Robert Evans, Water Management Specialist; A. R. Rubin, Water and Waste Management Specialist; Ronald E. Sneed, Irrigation Specialist; Michael Smolen, Water Quality Group Leader; and Frank J. Humenik, Specialist In Charge.*

...and Not A Drop To Drink?



Morgan Powell
Extension Natural Resources Engineer, Kansas State University, Manhattan

Kansas officials are aware that abandoned wells may pose a contamination threat by direct connection to the groundwater aquifer below. Extension specialists from Kansas State University conducted a farmstead well survey in cooperation with the Kansas Department of Health and Environment.

Water quality—an important public concern—is one of nine national priority initiatives of the Cooperative Extension System. It is also one of six priority concerns for Extension at Kansas State University. Clearly, water quality has become a public issue.

In Kansas, public water systems serve four of five residents and groundwater provides more than half of that supply. For several years, the Kansas Department of Health and Environment (KDHE) has examined public water wells for volatile organic compounds (VOC's) and pesticides, as mandated by the new regulations of the Safe Drinking Water Act to be implemented during 1988-91. Because of what it found in the water, KDHE has shut down 40 of 1,700 public water supply wells checked to date. (There are 2,100 such wells statewide.)

Task Force Formed

Growing concerns about water in Kansas led Kansas Extension administrators and specialists to offer a public educational program on water quality. They formed a five-member Water Quality Task Force to examine problems related to private water supplies and the impact of agriculture on water quality. In 1986, Kansas Extension added five more professionals to the task force to include all Extension program areas. Household water quality has emerged as the primary program.

To help determine the scope of the problem in Kansas, scientists from Kansas State in cooperation with the KDHE conducted a random farmstead well survey. Of the 187 wells tested, 37 percent exceeded the maximum contaminant level (MCL) for some inorganics. Nitrate was the most common contaminant; 28 percent of the wells exceeded the safe drinking water standard. The survey also showed selenium and fluoride exceeded the standard in some wells.

Pesticides or VOC's, or both, were found in 10 percent of the wells. This figure is cause for concern because organics are of relatively recent use. Their presence may be increasing and may pose a greater problem in the future.

Kansas has about 126,000 private water supplies consisting of mostly wells, drawing from groundwater. An estimate based on the farmstead survey shows that 500,000 people, or about 20 percent of the population of Kansas, depend on private water supplies. The state has few regulations and no testing requirements for these systems. The user or owner is responsible for the quality of the water. Although the user or owner is also the operator and sanitarian, few well owners have their water supplies tested more than once.

Rush County Survey

A 1988 project in Rush County, Kansas, involved testing supplies from 186 water wells. County Extension Homemaker Club helped the Water Quality Task Force in the survey effort. Results for Rush County mirrored those of the statewide farmstead well survey; 28 percent of the wells exceeded the drinking water standard for nitrates and one well exceeded the limit by 13 times. Such wells are potentially hazardous to humans and livestock.

Although the Rush County survey did not include bacteria testing, about 25 percent of the wells would be expected to also contain bacterial contamination, based on bacteria tests from private wells by some laboratories.

Abandoned wells are another concern in Kansas. The number is uncertain, but Kansas may have 500,000. Abandoned wells represent a safety hazard and many also serve as a direct pathway for contamination of the aquifers below. The task force is concerned that these wells be found and plugged properly.

Last fall we trained about 150 agents, health specialists, and lay leaders in water quality. Our goal: To help them become community resource persons. In early 1988, the task force and Extension's Department of Communications began a weekly 30-minute radio program and a weekly newspaper question-and-answer column on water quality issues and topics.

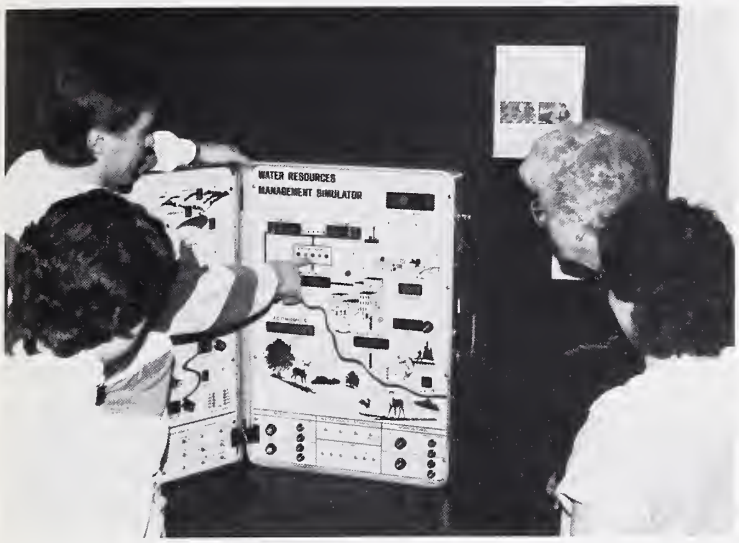
We have also launched (Water Education for Teachers), WET and will hold 10 training sessions this fall. We plan to offer 50 to 60 lesson plans and training for grade and middle school teachers. Yet another project will involve countywide followup meetings in response to anticipated increases in water well testing.

Future Educational Efforts

Safe drinking water is an important public issue. The Extension water quality program at Kansas State University addresses this question by helping people evaluate their problems and find solutions. For example, we will hold 24 meetings in 20 counties (one-fourth of the state's counties) this fall. At these water quality clinics, people can bring results from a test they will have made of their household water, and they can get ideas on how to improve its quality, if needed. ▲

Watershed In A Suitcase

John R. Amend
Professor of Chemistry, Montana State University, Bozeman
and
Jack Watson
Extension Water Specialist, The University of Arizona, Tucson



A Groundwater Management Simulator—a "watershed in a suitcase"—is examined by participants at a water management workshop. The simulator is used to model the hydrologic and economic behavior of a watershed, an aquifer, and a water use area.

Effective management of water is a problem that crosses the traditional disciplines of science, engineering, economics, and social science. Montana State University and the University of Arizona have been working with a number of other agencies in a long-term project to improve public and legislative understanding of the major water problems, associated hydrologic concepts, and strategies involved in management of the Nation's ground and surface water resources.

Computer Simulation
A unique feature of this project is its use of a Ground Water Management Simulator—a "watershed in a suitcase." This "user-friendly" program is used in workshops to model the hydrologic and economic behavior of a watershed, an aquifer, and a water use area involving both municipal and agricultural use of water.

The simulator poses supply, demand, and quality problems to workshop participants, who are placed in management situations involving real problems and alternatives. They are not offered solutions, but instead an opportunity to experiment with alternative solutions and to endure and evaluate the consequences of their actions.

After observing the results of the simulation, participants discuss the strong and weak points of their strategy, revise their management plan, press the reset button, and try again.

Workshop leaders become facilitators rather than lecturers. Scarce time with learners is used efficiently.

Because the response of water resource systems to both destructive forces and constructive management practices is often measured over generations, a public education program must deal not only with today's voters and policymakers, but also with the youth who must deal with these problems tomorrow.

Program Content
Knowledgeable public participation in development of water management policy requires an understanding of basic hydrologic principles as well as the economic and political aspects of water management. To provide this understanding, the content of this program is organized around six conceptual areas: the supply of water; the uses of water; water quality issues; water management strategies; economic factors in water management; and development of water management policy.

The Simulator In Action
All of these conceptual areas are included in the design, calibration, and operation of the Water Resources Management Simulator. The simulator may be easily programmed to represent the precipitation, stream flow, groundwater, and water uses that are characteristic of specific regions of the country.

To honestly model a natural resource system requires 10 to 30 variables. Since few people can handle more than three interacting variables at one time, this simulator provides control simultaneously to five groups of people, each with three controls and a different managerial role in the simulation.

One group, for example, is responsible for reservoir management. Another group selects the source of water for the municipality, drills the well if needed, and makes sure that there is a sufficient supply of water. A third group selects per-capita water use for the city and handles treatment of incoming water and waste water. Two other groups handle water-supply and water-use decisions for the agricultural area.

The groups must work together to supply water of adequate quantity and quality at the lowest cost. Their success is indicated by the computer's assessment of the cost/benefit results of their efforts.

The political aspects of water management are well illustrated by the roles these groups play and the cooperation that must exist between the groups to successfully manage the system.

Water Issues Are People Issues
Throughout the simulation, the workshop leader serves as a resource person, providing information as questions and "teachable moments" arise.

Participants are left with an understanding that water issues are people issues and that decisions made by ordinary people create the situations in which water managers must work. ▲

Protecting The Environment

Randy Killorn (left), Extension agronomist, Iowa State University, takes soil sample at a field demonstration with Joyce Hornstein, Extension associate. Marco Buske (right), area crop production specialist, assisted with plot supervision during the 1987 crop season.

Del Marks
Extension Communications Specialist,
Iowa State University, Ames

Crops that grow in cleaner environments and take smaller amounts of fuel to produce may soon become a way of life for Iowa corn and soybean farmers. An innovative program funded by the Iowa legislature and carried out by a consortium of public and private agencies is demonstrating how to use less energy in producing crops and how to reduce risks to the environment.

Field Demonstrations
Iowa State University (ISU) has been awarded two contracts in connection with the program: "Demonstration of Energy and Environmental Benefits Through Tillage, Nutrient, Pesticide, and Water Management," and "Education and Best Available Technology Assistance."

The ISU Agricultural Experiment Station and Cooperative Extension Service jointly conducted replicated field demonstrations at 59 locations in 32 of Iowa's 99 counties during the 1987 crop season. Work has started on a similar number of demonstrations this year at locations that include about 20 new counties. The long-range goal is to locate at least one demonstration in every county by the time the project ends in 1991.

Farmer Cooperators
About two-thirds of the 1987 demonstrations were on private fields of farmer cooperators; the rest were at various Iowa State University research centers.

The large number of farmer cooperators is an essential element in getting the demonstration information into the hands of other farmers, says Gerald A. Miller, Extension agronomist and coordinator of the Extension component of the program.

Focus On Key Concerns
Fertilizer production and application account for the largest amount of energy consumed in grain production. Fertilizers, pesticides, and fuels are some of the largest nonland variable expenses that the farmer can adjust. Therefore, these are key elements in the Extension demonstrations. The demonstrations also focus on the growing concerns for the farm family's exposure to toxic and hazardous chemicals.

The demonstrations are designed to increase the understanding of farmers and the general public about groundwater quality issues, including the condition of groundwater supplies and the causes of nonpoint-source contamination. They identify ways to maintain efficient production while reducing contamination of groundwater by chemicals, nutrients, and sediment.

Best Management Practices
Another phase of the project is the development of Best Management Practices (BMP's) that farm operators can use to protect groundwater and increase farming efficiency, energy conservation, and farming profitability. Two 1,100-acre watersheds were selected for BMP activities in 1987.

Some of the BMP activities include: insect scouting as part of an integrated pest management program; making good use of soil testing; assessing current and past crop management and land management practices; taking inventory of livestock; calibrating sprayers; implementing alternative tillage practices; keeping crop enterprise records; and sampling wells.

Attitude Survey
In conjunction with the BMP activities, Extension surveys farmer attitudes toward groundwater issues and conducts followup studies to determine changes that result from the educational efforts. Preliminary data on fertilizer application rates at 21 sites in 1987 indicated that, on the average, farmers applied 90 pounds of nitrogen per acre more than the crops could use to obtain optimum economic yields. These results were for 1 year only; the demonstrations will be continued for 3 more years to test the validity of the 1987 findings.

Statewide Effort
The Extension project is part of the statewide Integrated Farm Management Demonstration Program administered by the Agricultural Energy Management Advisory Council of the State of Iowa. Other participants include the Iowa Department of Agriculture and Land Stewardship, the Iowa Department of Natural Resources, the USDA Agricultural Research Service, and the Iowa Natural Heritage Foundation. ▲

The Long Island Sound Study

Norman Bender
Extension Program Leader,
and
Kathleen Rhodes
Extension Public Participation Coordinator,
and
Chester Arnold
Marine Extension Agent,
Connecticut Sea Grant Marine Advisory Program,
Groton

Tim Visel (left), Extension marine agent, dumps oyster "cultch" (clean oyster shells) from his boat onto an oyster bed in the Pattagansett River near Long Island Sound, New York, to stimulate oyster growth. Assisting Visel are Dennis Murphy (middle), first selectman of East Lyme and Craig Andrews, a volunteer. One of Extension's goals is a clean Long Island Sound that will allow for the continued growth of the oyster industry.

Long Island Sound is an estuary stretching 110 miles from the densely populated New York City area to the less developed eastern areas of Long Island and Connecticut. Often called the "Urban Sea," its coastline is home to over 5 million people.

Recently, concern over the health of the Sound led to the initiation of the Long Island Sound Study (LISS), a cooperative effort of federal, state and local public agencies, academic institutions, industry, environmental groups, and the general public. The study is part of the National Estuary Program, which was established by the 1987 Clean Water Act to preserve and restore the health of the Nation's estuaries. Areas where salt and fresh water mix, estuaries are highly productive in terms of marine life.

The 5-year Long Island Sound Study began by addressing two questions of concern to the public: "1) how healthy is the Sound today? and 2) Is the Sound getting cleaner or more polluted?"

Educating The Public

The LISS public participation and education effort addresses the need to integrate research findings and public concerns into LISS recommendations. Sea Grant programs in Connecticut and New York State were chosen by the U.S. Environmental Protection Agency to develop a public participation project that would: 1) broaden the study's contact with user groups; 2) strengthen the Citizens' Advisory Committee by expanding its representation; and 3) implement a broad program of public information to increase public awareness of current environmental issues, research findings, and proposed solutions.

Chester Arnold, marine Extension agent in Connecticut, initiated the project in 1987 by serving as acting public participation coordinator for Connecticut and New York.

Arnold, together with Kathy Rhodes who assumed the full-time coordinator's role in January, 1988, organized a variety of educational activities designed to reach hundreds of thousands of people involved with Long Island Sound.

Thousands of people learned about the goals of the LISS through Arnold's participation on a statewide public television program and in four radio interviews. And seventy State and local Connecticut officials from Stamford to Stonington learned about the LISS and its potential impacts upon their communities at a workshop co-sponsored by Connecticut's U.S. Representatives.

Fact Sheet Series

In addition, a fact sheet series which addresses critical issues was begun. The first fact sheet, *Hypoxia in Long Island Sound*,reviews the impacts and possible causes of low levels of dissolved oxygen in western Long Island Sound.

Rhodes and Arnold will be joined by a public participation coordinator for New York State in late 1988. This will allow coastal residents in both states to have regional access to project staff. A formal mechanism for the participation of user groups with the LISS is the Citizens' Advisory Committee (CAC). Sea Grant Marine Advisory staff assisted the Committee in expanding its membership base to include 25 members representing a wide variety of municipal, industrial, environmental and educational interests.

Involving Scientists

Slide presentations for symposia, festivals, and conferences are being developed by Public Participation Staff, Rhodes, and Arnold, as well as by the members of the Citizens' Advisory Committee, and offered to civic groups and municipal commissions.

Road Tour

The successful Long Island Sound lecture series format, initiated at the University of Connecticut, Avery Point Campus, will be sent on a "road tour" to reach the public in western Long Island Sound (Fairfield County, Connecticut, and Westchester County, New York) and along the Long Island, New York coastline (Nassau and Suffolk Counties). The series will tap the expertise of marine researchers and resource managers from the University of Connecticut, State University of New York system, and local, state and federal agencies.

Summary

Connecticut's and New York's Sea Grant Marine Advisory Programs are developing new ways of bringing together marine researchers, educators, resource managers, environmental and civic association representatives, and the public to share knowledge and concerns. The public education efforts will continue with increased emphasis on documenting public views regarding alternative solutions for protecting the environmental quality of the Sound. ▲

New Answers For Nevada Water Problems

Lora Minter
Extension Publications Writer,
University of Nevada-Reno

Because of the explosive population growth in the Las Vegas Valley, experts agree that southern Nevada will face a water crisis by the year 2000. If water conservation efforts are not taken to heart, the steady stream will slow to an undependable drip.

Many decisionmaking Las Vegans are aware of the impending crisis. A 1986 poll conducted by the College of Agriculture at the University of Nevada showed that water management was the leading concern among the interviewed civic leaders and government officials.

Research Priority
In response, the college's Plant Science Department and Southern Nevada Cooperative Extension moved water efficiency issues to the top of the research list.

Dale Devitt, a soil and water scientist based at the University of Nevada-Las Vegas, devotes a large part of each day to researching water—its quality, quantity, and clarity.

Calculating Water Saved
Devitt has started an innovative experiment at two Las Vegas golf courses, Spanish Trails and the Sahara Country Club, and at Horseman's Park. At these sites he has developed irrigation systems that use meteorological data to predict evapotranspiration (the total water loss from the soil, including direct evaporation and the water lost from plant surfaces). As a result, Devitt will be able to determine the actual amount of water saved by comparing the quantity of water he applies to the amount of water that employees at the site apply.

Once crop coefficients are calculated they will be distributed to the valley's 500,000 water users by Extension Horticulturist Robert Morris (in cooperation with the National Weather Service, local media, and the local water district). This new information will allow consumers, turf managers, and personnel in government agencies to cut water costs by increasing their efficient use of water. "We are estimating potential water savings as high as 50 percent," Morris reports.

Drip Irrigation
Devitt is experimenting to discover whether drip irrigation can increase water use efficiency. He believes subsurface drip irrigation has potential to increase efficiency in very windy areas and in areas where turf is utilized 24 hours a day.

Water Allocation
A long-standing problem in Northern Nevada continues to be the question of water allocation.

To partly resolve water conflicts, the Bureau of Reclamation has proposed certain Operating Criteria and Procedures (OCAP) to be followed by the farmers and ranchers of the Truckee Carson Irrigation District (TCID).

Rangesan Narayanan, associate professor in the college's Agricultural Economics Department, and Tom MacDiarmid, a graduate research assistant, have been working on research that will provide information to the TCID. Their study has resulted in relevant economic analyses that can be used in making long-term decisions that affect the Newlands Project. Rangesan and MacDiarmid chose to investigate one method of increasing efficiency—concrete lining of canals.

Optimization Model
Through statistical analysis and data provided by the TCID, Rangesan and MacDiarmid compiled all the physical data for the area and constructed a computer optimization model. The model describes the Carson Division's irrigated agriculture area and the main canal system between the Lahontan Dam and Stillwater Wetlands surrounding Fallon.

According to MacDiarmid, the computer model will choose the canal segments that need to be lined by comparing the dollars earned by the acreage served to the costs of lining the canals. ▲

Extracted from articles in ***AG-FORUM****, a quarterly newsletter published by the Agricultural Information Office, College of Agriculture, University of Nevada-Reno.*

Sewage System Strategies

Roger E. Machmeier
Former Extension Agricultural Engineer, University of Minnesota, St. Paul

When Minnesota's Shoreland Management Act was passed in 1968, the Extension water quality specialist already had established an educational program on onsite sewage treatment for homeowners and local government officials.

Because the act gave particular emphasis to onsite sewage systems, local officials requested more intensive training on all aspects of such systems. Extension responded with a 3-day workshop which proved so popular that it will have been presented approximately 100 times by the end of 1988.

The workshops provide local government officials with the information they need in order to issue permits for the installation of onsite sewage treatment systems and to inspect the construction of those systems, and they help sewage treatment professionals keep up to date on the latest technology and do a better job.

Developing Effective Standards
When the Minnesota Pollution Control Agency proposed changes in the state standards for onsite systems in 1973, their plan met with severe objections. In 1974, agency personnel began making presentations at Extension's onsite sewage treatment workshops. The proposed standards for individual sewage treatment systems were discussed at the workshops each year, modified as appropriate suggestions were made by workshop participants, and finally adopted by the state in 1978.

Workshop Format
Workshops have been held throughout Minnesota in locations selected on the basis of local interest and in consultation with local government officials such as zoning administrators, sanitarians, and inspectors.

The staff of special programs at the University of Minnesota handles all the arrangements; the Extension engineer provides the technical content and makes workshop presentations; and staff members from the university's soil science department and the Minnesota Pollution Control Agency conduct the workshops.

Broad Range Of Topics
Workshop topics have been adjusted over the years to ensure that they cover the full range of information needed by people who work with onsite sewage treatment systems. The first day provides basic information on designing a drainfield trench system in soils which are suitable for sewage treatment.

The second day covers sewage system design for problem soils; mound design and construction; preliminary site evaluation procedures using soil surveys, maps, and other pertinent information; field site evaluation procedures, including soil borings and percolation tests; septic tank construction and operation; and pumping stations.

The third day includes a discussion of small collector systems serving up to 12 residences and using a common soil absorption system. Septic tank cleaning and the land application and utilization of septage is the final workshop topic, with emphasis on the importance of proper maintenance of onsite systems.

Voluntary Certification
At the conclusion of each workshop, the Minnesota Pollution Control Agency gives a 4-hour written examination for participants who wish to become certified in the field of onsite sewage treatment. Certification is not mandatory statewide, but since the program began in 1980, 17 of Minnesota's 87 counties have instituted a certification requirement.

Positive Results
Local officials and experienced contractors have observed a dramatic improvement in both the level of knowledge about onsite sewage treatment and the quality of system installations. As a whole, the improved practices have not only had a profound effect on the design, installation, and maintenance of onsite systems, but also have proven cost-effective.

Basic Program Requirements
Minnesota has learned that a program such as this one has several fundamental requirements:

- An Extension specialist who is technically competent in the area and who will keep up to date on new technology;

- A sound set of state standards around which to develop an educational program. The standards must be dynamic and always open to challenge and change. Extension may need to be the catalyst for developing these standards;

- A broadly representative advisory committee to make recommendations to the state agency responsible for onsite systems;

- A commitment in time and money by the state agency responsible for onsite systems, and a close working relationship between that agency, local government officials, and sewage system installers;

- Demonstration-research to prove the local applicability of new or unfamiliar technology; and

- Informed taxpayers who are willing to provide the land-grant university and the State agency enough money to put sound onsite sewage treatment technology into effect. ▲

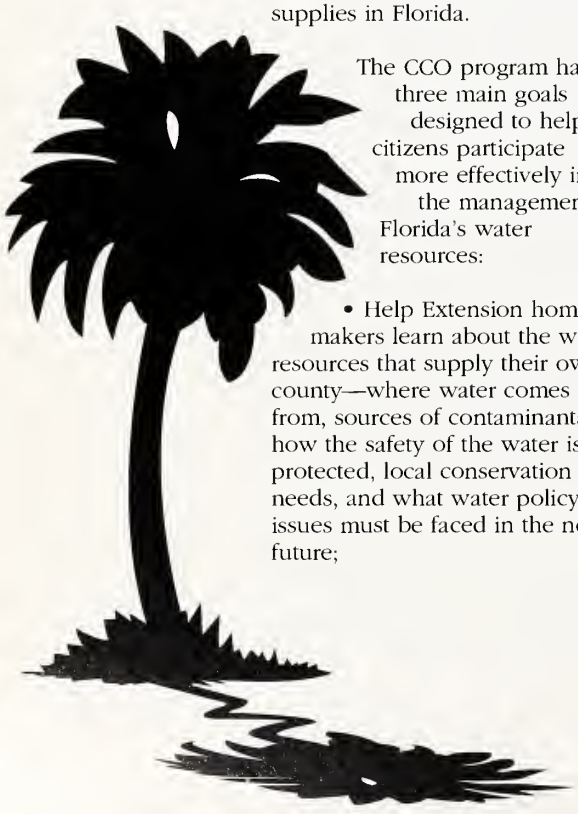
Florida Focus On Water Quality

Virginia Peart
Special Advisor To The Florida Extension Homemakers Council, and
Extension Housing Specialist, University of Florida, Gainesville

Although Florida is considered to be a water-rich state with more rainfall than most other areas of the country, groundwater is limited in many areas. Why is water quantity a problem? The population has escalated from 3 million in 1950 to about 12 million in 1988. It continues to grow at the rate of 700 to 900 new residents per day. Sixty percent of these new residents settle in the already densely populated coastal areas.

Florida also has widespread water quality problems. The sandy soils permit contaminants that have been used or disposed of on land surfaces to move into the aquifers that are the source of water for the state.

Recognizing The Problems
The Florida Extension Homemakers Council (FEHC) has made the state's water problems a high-priority concern. Through its Citizenship and Community Outreach (CCO) programs, the Council is attempting to make its 8,400 members aware of the importance of citizen responsibility for the preservation, development, and fair allocation of water supplies in Florida.



The CCO program has three main goals designed to help citizens participate more effectively in the management of Florida's water resources:

- Help Extension home makers learn about the water resources that supply their own county—where water comes from, sources of contaminants, how the safety of the water is protected, local conservation needs, and what water policy issues must be faced in the near future;
- Lead local citizens in preserving the quality and quantity of local water supplies through individual and group action; and
- Promote appropriate water policy development in local, district, and state agencies.

Planning for the 3-year Water Quality and Public Policy Program started in 1986. Leadership came from CCO Chair Doris Glover, Polk County; Polk County Agent Advisor Ann Rye; and Florida State Specialist Advisor Virginia Peart.

Initial activities included identifying county CCO chairs, establishing a time schedule, developing a situation statement, and planning activities to equip potential Homemaker Leaders to plan and present state, district, and county programs on water quality and public policy.

Training The Trainers
Early in 1987 each county CCO chair and county Extension home economist received an explanation of the 3-year program and an invitation to enroll in the June training session.

That meeting consisted of two 3-hour workshops. The first included a discussion of current news concerning water problems, a slide presentation on "Florida's Water Resources," and an illustrated talk entitled "Causes and Consequences of Water Contamination in Florida."

The second day's workshop dealt with water management in Florida. Beginning with background presentations on the laws and institutions that serve as the basis for water management, the session progressed to an exploration of "Water Policy: How Does It Happen?" Participants in that segment of the workshop included a state legislator, a representative of a state regulatory agency, and a county commissioner.

The program ended with a discussion of "What FEHC Can Do in Your County." Participants received a packet containing information on how to order slide sets and fact sheets, copies of community action guides on groundwater and drinking water, and the addresses and telephone numbers of the five Florida water management districts and the six district offices of the Florida Department of Environmental Regulations.

Putting Training To Work
The trained leaders are now carrying the message about water issues to others throughout the State. A water management workshop that took place in Tampa in January 1988 is a good example. The 2-hour program on water management in Southwest Florida was presented by a panel of speakers from the University of Florida, the Florida West Coast Regional Water Supply Authority, the Southwest Florida Water Management District, and the Pasco County Citizens Water Advocacy Council.

Participants learned about the hydrologic cycle, how to minimize water quality impact, how water is allocated in their area, and indoor and outdoor conservation. Other areas are planning similar workshops and other activities designed to involve citizens in water issues.

Program Impact
As the program continues in its second year, FEHC members are building confidence in their abilities to understand Florida's fragile water resources. During the third year (1989-90), the county CCO chairs will be evaluating the program's success and writing their final reports. However, the interest they have generated may lead them into more efforts to participate in the protection of Florida's water quality. ▲

A Water Quality Weekend

Marcus R. Butterfield
Extension State 4-H Leader,
University of Delaware, Newark

Extension 4-H specialists at the University of Delaware wished to teach younger 4-H'ers such basic concepts of water quality as the hydrologic cycle, the movement of both surface and groundwater, and how groundwater becomes polluted.

To accomplish this, they decided to hold younger-member weekends—overnight camping programs for 8-to-12-year-olds—involving approximately 200 4-H'ers in three counties.

Once the campers were gathered, 4-H agents gave presentations to several classes of approximately 25 to 30 4-H youth each. The 4-H agents began each class by explaining to the youth that water is one of the three essentials for life. They showed campers information about the earth's supply of water. They discussed such terms as "surface water," "groundwater," and "aquifers." They gave the campers a description of the hydrologic cycle.

Taste-Testing Panels

Following this introduction, each participant was given three water samples in three-ounce paper cups. They asked youth to role-play as members of an "international water-quality taste-testing panel." The 4-H'ers were instructed to taste each water sample, make notes about it, and then rank the taste of the sample on a scale of one to three.

Based on their rankings, the 4-H'ers took a show-of-hand vote on which sample rated first, second, or third and then discussed their three selections.

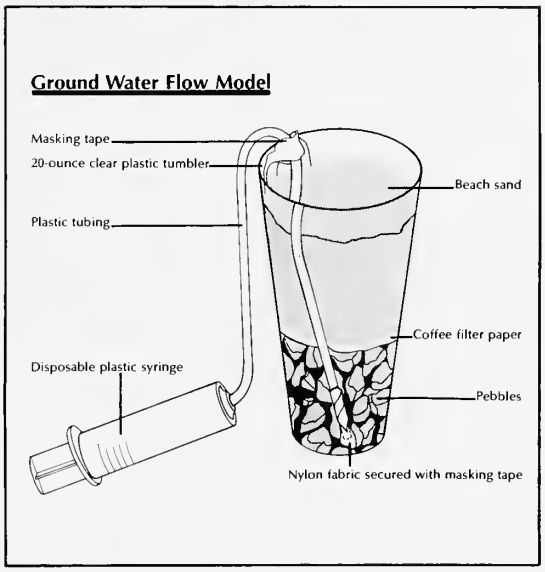
At this point, the sources of the water were then revealed to the "taste-testers." (Two of the samples had been drawn from the water supply at each of two Extension offices, and the third was bottled spring water.) This exercise clearly demonstrated to the group that there was a distinguishable difference in water quality in terms of taste. It also provided an opportunity to point out that good-tasting water isn't necessarily good-quality water. One of the samples had a higher-than-normal nitrate level, yet was one the youth had rated high on taste.

Maps And Flow Models

The second major activity of the program was designed to help the class understand the movement of groundwater. Using a geological map of the state, leaders explained aquifers and groundwater movement to the youth.

To help the 4-H'ers visualize the movement of pollution through the ground, small groups of five or six 4-H'ers built a ground water flow model. This model was made of a 20-ounce, clear plastic tumbler, a 12-inch length of clear plastic tubing, a small piece of nylon fabric, masking tape, small pebbles, clean beach sand, and a 3-inch circle cut from a coffee filter.

The piece of nylon was fastened with masking tape over the end of the tube to act as a strainer. The tube was then taped to the inside of the tumbler,



with the strainer at the bottom. The tumbler was filled approximately one-third with the pebbles, topped with the filter paper, and then filled nearly to the top with clean beach sand.

A recycled window-washing pump-spray bottle filled with water was used to make "rain" fall onto the sand. A disposable syringe connected to the plastic tubing provided a pump by which water could be drawn from the bottom of the model.

Working as a team, the 4-H'ers established a flow of water from the sprayer though the sand, into the pebbles, and back into the syringe.

Leaders then applied a drop of red food coloring to the top of the sand, to represent any of several kinds of pollution: improperly managed animal waste, a faulty septic system, an oil spill, improperly disposed household chemicals, or hazardous waste.

Pollution Made Visible

As they continued to cycle water through their model, the 4-H'ers could see the red coloring moving down through the sand and into the water coming from the bottom of their model. The participants could thus easily see the impact of surface problems affecting the groundwater supply.

The concluding discussion centered around what these young people, as individuals, could do to prevent groundwater pollution through the proper handling and disposal of household chemicals. Each 4-H'er was given a chart showing the recommended disposal methods for a variety of home and garden chemicals.

The 4-H'ers responded enthusiastically to the class. The simplicity of the program makes it easily adaptable to a variety of other settings such as other 4-H clubs or primary school classrooms. ▲

Connecticut—
A Community Response

Roy F. Jeffrey
Community Resource Development Agent,
New London County Extension Office,
Norwich, Connecticut

Detection of contaminated groundwater during the early-to-mid-1980s left residents of many Connecticut communities concerned about the safety of their drinking water. By 1985, an estimated 10 percent of the population (150,000 citizens) had been exposed to contaminated water sources.

With a new awareness of this issue, and limited experience and knowledge about how to prevent contamination at the local level, over 300 community officials responded to a comprehensive educational program about community groundwater management developed by Extension at the University of Connecticut.

Connecticut has long been a national leader in the environmental protection arena.

Although these and other state-level programs went a long way in reducing the potential for groundwater contamination, opportunities for future contamination still existed. Local communities needed to do much at their level to protect groundwater sources.

As contamination episodes became more publicized, it became evident that a needexisted for an education program on groundwater for local officials if communities hoped to comprehensively deal with protecting their groundwater resources.

Program Developed
Beginning in 1985, the University of Connecticut Cooperative Extension Service, through its Community Resource Development Program, developed a short course for local decisionmakers on groundwater management. During 1986 and 1987 the short course was offered on a two-evening basis at several locations across the state.

Rating Schedule
Since a variety of potential groundwater contaminants exist, Extension used a rating schedule developed by the Connecticut Department of Environmental Protection (DEP) which identified and ranked contaminant sources according to land use.

Three-Step Process
The short course emphasized that a groundwater protection program should consider not only planning matters, but also other day-to-day land use and operational/management activities by the commercial, industrial, residential, and government sectors that are not necessarily affected by planning and zoning matters.

With the practial knowledge gained through the CES program, informed local decisionmakers are better able to consider groundwater concerns as they deal with a variety of community issues. ▲

Mike Sowell
Community Resource Development Agent,
Frederick County,
Maryland

Water Conservation In Frederick City

In Frederick City, Maryland, Extension is responding with workshops and demonstrations to illustrate the benefits of water conservation to individuals and to the community as a whole.

Growth Necessitates Conservation
The population of Frederick city increased between the 1970 and 1980 censuses and growth is expected to continue. The city's water supply, which comes from the Monocacy River, is limited.

The mayor's office, anticipating the need for water conservation, approached Extension for guidance on reducing water consumption. Working with the mayor's representative and a registered plumber, Extension began developing a pilot water conservation program.

Selecting Cooperators
The pilot program was to be conducted with 120 homes representing a cross-section of dwellings throughout the city. Homeowners in these representative dwellings would be encouraged to install water-saving devices such as low-flow shower heads, aerators, and toilet dams. The devices would be left in the homes for 18 months, during which time the water consumption would be monitored.

Thirty-three residences served as the final basis for the analysis.

Measuring Results
During the first year, 33 homes saved a total of 236,000 gallons of water and $1,091 in water, sewer, and energy bills—an average of 7,200 gallons of water and $33 per household.

The devices paid an equivalent of the installation cost in about 7 months making them a reasonable investment for any household.

This data enabled the committee to project potential savings in water and sewer costs for the city's entire residential population. If 10,000 households (about three-quarters of the total) installed and used water-saving devices, the city could reduce water consumption by approximately 800,000 gallons daily and could save $150,000 in treatment costs over a 4-year period. The 10,000 homeowners collectively could save $1.2 million in water, sewer, and energy bills during the same period.

Adopting The Program
When Extension presented the findings of the pilot project to city officials, they unanimously agreed to implement a comprehensive water conservation program throughout the city.

In the first year more than 1,000 homes have been equipped with water-saving devices. The program is expected to last 5 years, and has the objective of involving 10,000 households. ▲

75th Anniversary
Of The Cooperative Extension System

In 1989, the Cooperative Extension System will celebrate its 75th anniversary. It was established in 1914 as a partnership of the U.S. Department of Agriculture and the land-grant universities. National kickoff will be a special videoconference May 8, 1989, which will link all states and territories.

The theme for this 75th anniversary celebration for Extension is: "Investing In America's Future." Anniversary activities will continue throughout the year with each state and territory participating.

The Fall 1989 issue of *Extension Review* will be a highly photographic celebration of our 75 years as a System, focusing on a week in the life of Extension 1989. Other planned national events include Congressional and Presidential resolutions, a time capsule, an anniversary videotape, and an Extension history.

States and counties will receive special posters, and states will receive PSA's for radio and television and publicity/promotion kits. Camera copy of the anniversary logo has been mailed to states and counties. ▲

Investing in America's Future

United States
Department of Agriculture
Washington, DC 20250