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Director's Memo

Research Framework Now Available

The *Research Framework for Citizen Advisory Priorities* was recently presented to our advisory committee. This framework serves as the third step in developing a research program to address Nebraska's water problems.

The first two steps, reported on in past editions of *Water Current* were 1) the workshop on Nebraska water problems and 2) the workshop on water research and information. In the first workshop, a group of well-informed Nebraska water users were asked to collectively identify the most pressing water problems in the state that demand research and informational programs in order to solve. The group decided that 13 problems deserve the status of "most pressing".

In the second workshop, scientists were gathered to review the 13 problems. These professionals were also asked to delineate needed research and informational programs that will be required to develop workable solutions to the problems.

With the input from water users and scientists that was gathered at the workshops, the "Research Framework for Citizen Advisory Priorities" was written. It outlines seven programs designed to obtain research information that will help solve the 13 pressing water problems. These seven programs are:

·1 Water Quality (Nitrogen management for the protection and improvement of ground water quality)

·2 Water Quantity (Technical, economic and political considerations of potential water development in Nebraska)

·3 Water Quantity (Surface and ground water interactions)

·4 Water Resources Management-Land Use (Best management practices for land and water in fragile areas of Nebraska)

·5 Water Resources Management-Conservation (Water conservation through ground water management and irrigation scheduling)

·6 legal, Institutional, Economic, Social and Political Considerations (Legal and institutional structure for water management in Nebraska)

·7 Basic Research

The framework will be presented to funding agencies to describe Nebraska's water research needs and briefly describe how such research could be organized. It also gives the scientific staff at the university an indication of the types of research that would receive favorable consideration for funding.

I feel the framework will be a most useful tool in helping NWRC focus on needed research.

—Bill Powers
NWRC Director

Overview Highlights Project

Results of 11 NWRC administered research projects were presented at the 1982 Research Overview held Oct. 21-22 in the East Campus Union at UNL. Most of the studies were funded by the now disbanded Office of Water Research and Technology, which was a part of the U.S. Department of Interior.

The projects in the overview have been completed or are nearly complete. They include:

—NU associate professor of soil science Gary Hergert discussed his study of nitrate movement beneath irrigated corn fields in the Sandhills. He found that about 40 pounds of nitrates were released per year from decomposing corn residues on unfertilized check plots.

Hergert said to be cautious in applying this finding from his project at the Sandhills Agricultural Laboratory near Tryon, Neb. to other areas of the Sandhills. Variations in clay, silt and sand layers at different sites make comparisions difficult, he explained.

The irrigated corn plots in the study that had been fertilized with 90 pounds of nitrogen per acre per year contributed 5055 pounds of nitrate below the rooting zone, Hergert added. Plots receiving 180 pounds of nitrogen per acre per year lost 90-100 pounds of nitrate.

The highest average concentration of nitrate that Hergert measured was 8 parts per million (ppm). This level is below the human health standard of 10 ppm for this pollutant, he said.

Hergert noted that beneath the rooting zone of native range grasses, nitrate levels of 1-2 parts ppm were observed. He attributed the presence of nitrate under rangeland to the release of nitrogen from native grasses as they decompose.

Hergert's results also indicate that nitrate is moving toward the ground water at a rate of 5-7 feet per year.

The soil scientist said that more research must be done to determine the fate of the nitrate after it enters the ground water.

—Ty Harrison, associate professor of life sciences, revealed the results of his research on the water use of native grasses in the Sandhills. Harrison found that native grasses on the ridges of dunes and in dry valleys transpire more water than grasses on the slopes of dunes and in swales. His measurements showed that the native grasses use most of the water available from precipitation, leaving little to recharge the underlying aquifer.

Harrison said that determining water use patterns of native grasses is important to estimate the amount of potential recharge and consequently the proper spacing of irrigation wells in the Sandhills.

—Associate professor of agricultural engineering Elbert Dickey studied conservation tillage systems. He found that conservation tillage can reduce water erosion by 50 percent of that occuring from clean tillage systems such as moldboard plowing. Dickey defined conservation tillage as any combination of tillage practices that leaves 20 percent of the soil surface covered with residues between harvest and the establishment of a crop canopy the following spring (See related story in this issue).

—Associate professor of agricultural economics Ray Supalla studied the economic affects of restricting irrigators to 6 or 10 inches of water per year in the Upper Big Blue ground water control area. His results indicate that the restrictions would not have a substantial impact on average net farm income between 1980 and 2020.

Supalla attributed his finding to the prolonging of irrigated agriculture in the control area because of restrictions. However, he said that the restrictions would decrease personal income on a statewide basis. This is due to decreased demand for agricultural inputs such as energy for pumping water and fertilizers that are supplied by the non-farm sector.

He also indicated that these findings may prove unrealistic in practical applications because of the difficulty of managing irrigation when ground water restrictions are imposed. More research is needed, he noted.

—Norm Klocke, assistant professor of agricultural engineering, studied the use of irrigation scheduling techniques in ground water control areas. He said that when to efficiently used restricted supplies of water, soil moisture readings should be used in conjunction with weather information to schedule irrigations.

—J. David Aiken, associate professor of agricultural economics, reviewed ground water allocation laws among Missouri River Basin states. The most stringent controls are in Colorado, he said. The most lenient laws are in Missouri (See related story in this issue).

—Jerry Eastin, professor of agronomy, studied the effects of drought on the development of corn, sorghum and millet. His findings will be used to breed drought-tolerant varieties.

—Daryoush Razavian, NWRC water scientist, discussed a study in which a computer model of water quality and runoff was adapted to a medium-sized Nebraska watershed. He said the model is useful in predicting the impacts of the best agricultural management practices on reducing sediment and pollution in streams.

—Three scientists who worked independently reported progress in controlling blooms of blue green algae in farm ponds. The decomposing algae release toxic substances into the water and deplete oxygen, causing fish kills.

Gary Hergenrader, professor of forestry, fisheries and wildlife, said his study showed that algae-eating fish can be protected from predators and used to keep algal populations at desirable levels. Associate professor of life sciences Eugene Martin succeeded in controlling certain strains of algae in farm ponds by infecting them with virus and bacteria. The research of Jim Rosowski, professor of life sciences, dealt with the manipulation of nutrients in water to disrupt the bloom cycle of algae.

Computer Used to Irrigate

An NWRC researcher has programmed a portable microcomputer to automatically control an irrigation system at NU's field laboratory near Mead.

The computer takes its commands from George Meyer, who also is an assistant professor of agricultural engineering. He tells it when to turn on the pump and start the solid-set irrigation system used in the study.

Irrigation dates for each of the system's 24 sets are entered into the computer's memory bank well in advance of the needed waterings, Meyer said. The dates are determined by irrigation scheduling procedures.

The electronic device also monitors the flow of water at the well and turns the pump off when the amount of water that Meyer specified has been applied.

With more research and development, Meyer said he hopes to ultimately program the computer to read soil moisture blocks in the field, determine moisture stress in the crop and record information from an on-site weather station. With these capabilities, the computer will be able to schedule irrigations without human assistance, he believed.

It is also possible that the computer could calculate the amount of water the crop needs at each irrigation, the agricultural engineer suggested. However, much more programming will be needed before this can be accomplished, he said.

Assisting Meyer in the development of the system are Paul Fischbach, professor, and James Lamb, research associate, in the Department of Agricultural Engineering. NWRC is funding this 3-year study as part of its effort to increase the efficiency of irrigation and conservation of water through improved technology.

The agricultural engineers mounted the portable microcomputer in a protective box and placed it in the 20-acre field that the irrigation system serves, Meyer said. The computer is connected to a standard electrical outlet, but a battery-powered backup system has been added so it can continue operating during power outages.

This past summer, the agricultural engineers travelled 60 miles round trip from Lincoln to Mead to electronically encode the irrigation dates into the computer. They hope to eliminate the travelling next summer by sending instructions via telephone from a computer terminal in Meyer's Lincoln office to the irrigation computer at the field laboratory.

The telephone link will also allow the agricultural engineers to eavesdrop at any time of the day on the computerized irrigation system to see if it is operating on schedule, Meyer said.

During the first summer of the study, Meyer, Fischbach and Lamb worked several "bugs" out of the irrigation computer to make it more reliable. The device now continuously monitors pressure sensors that have been added to the irrigation system. It also measures the rate that the water is flowing through the pipes.

Whenever the computer notices a sudden drop in pressure or an increase in the flow rate, which are indicators that a major leak is occurring, the irrigation system is automatically shut off, Meyer said.

A wind gauge has also been connected to the computer. The irrigation system is temporarily shut off when the gauge indicates that winds exceed 10 miles per hour. High winds reduce the efficiency of sprinkler irrigation.

"With more development, computerized irrigation can become trustworthy enough to be of practical use for center-pivots and perhaps even surface irrigation," Meyer said. "This is a very new application of microcomputers and it needs maybe one to two more years to develop and thoroughly test."

"The economics of computerizing an irrigation system also need to be evaluated now that we have shown that it can be done."

Conservation Tillage Studied

NU agricultural engineers working on a NWRC project have further confirmed the soil conservation benefits of minimum tillage.

Elbert Dickey, associate professor and project leader, said the five conservation tillage systems he and his colleagues investigated reduced soil losses from 50 to 90 percent during a 2 1/2 inch artificial rainstorm. The measurements were made on the 10 percent slopes at NU's Northeast Station near Concord.

Substantial reductions in erosion also were observed from conservation tillage research plots on five percent slopes at NU's Rogers Memorial Farm near Lincoln, Dickey added.

The tillage systems were compared to moldboard plowing and included the chisel plow, disk, rotary tilling, till plant and no-till methods. Unlike moldboard plowing, which buries the bulk of crop residues, these conservation tillage systems left 20 percent or more of the soil surface covered with residues, Dickey said.

Residues on the surface shield the soil from driving rains and also retard runoff, the agricultural engineer explained.

"The results from the study up to this point show that only a 20 percent cover is needed to reduce erosion by 50 percent from that which would occur from moldboard plowing or any cleanly tilled field," Dickey said. As much as 90 percent of the erosion from moldboard plowing can be eliminated with 75 percent or more of the soil covered with residues, he added.

In addition to saving soil, minimum tillage also saves fuel, Dickey said. Fuel requirements for moldboard plowing were about 5.3 gallons per acre compared to 1.7 gallons per acre for the no-till system.

The study will continue through September, 1983.

Aiken Says Law Vague

A NWRC researcher has called Nebraska's ground water export statute "vague" and recommended new legislation that would help block massive out-of-state diversions of ground water.

J. David Aiken, who is also an associate professor and an NU extension water law specialist, added that in its present form, the export statute gives Nebraska "little to hang its hat on" in litigation involving ground water exports.

The U.S. Supreme Court weakened the export law last June in its highly publicized *Sporhase vs. Nebraska* decision, Aiken added. The ruling rescinded the reciprocity section from the statute, leaving a "poorly defined" clause as the primary protection from large-scale exports of ground water out of Nebraska, he said.

The section that remains in the statute gives the Nebraska Department of Water Resources (DWR) authority to deny a permit for exporting ground water if the use of the water is inconsistent with ground water conservation and use, and the "public interest" in Nebraska.

"We need to spell out the criteria in this clause," Aiken stated. "What is consistent with the conservation and use of ground water in Nebraska? What exactly is the public interest?"

Aiken explained that the Supreme Court rejected Nebraska's reciprocity clause because it violated the interstate commerce provisions in the U.S. Constitution. However, the court determined that Nebraska could deny the export of water for conservation purposes if conservation measures were applied equally to both Nebraskans and non-Nebraskans, he added.

Except for perhaps the protection of domestic uses of water, Aiken believed that Nebraska would have to legally justify any discriminatory measures that would protect agriculture and other water users from ground water exports.

The NU water law specialist suggested three non-discriminatory legal alternatives to "spell out" Nebraska's criteria for ground water conservation and use as well as probably satisfy the U.S. Supreme Court.

Aiken explained that each alternative would require the DWR director to grant a permit for any use of water that exceeded a specified limit. He used as an example an annual limit of 3,000 acre-feet or more, which is large enough to exclude most agricultural uses but small enough to include massive ground water exports.

The first alternative would require the DWR to deny any permit for uses of 3,000 acre-feet or more of ground water if the use lowers the water table below historic levels, Aiken said. This alternative is the most restrictive and probably would not be acceptable to Nebraska legislators because it could significantly restrict irrigation development, he added.

The second alternative, which is similar to the first, would deny a permit if the use of the water lowered the water table below a "reasonable" level. This approach, Aiken said, would not significantly restrict irrigation development in Nebraska.

"I think they (legislators) ought to do something like this. This approach is common in other states and is used even in Nebraska for large, industrial ground water uses," Aiken said.

The third alternative would allow a ground water user to lower ground water levels below historic or reasonable levels if the user "buys the right to interfere with other ground water uses," Aiken said. The purchaser would have to secure the consent of the sellers and compensate them for lowering the water table.

Without the enactment of legislation to clearly define ground water use, conservation and public interest, the existing export statute eventually will be subjected to a court test, Aiken believed.

"Because the law is so vague, each interest supporting and opposing the export will try to get the court to define it in a way to benefit them. The court could interpret the clause in a manner that is unfavorable to Nebraska interests and allow large scale exports of ground water out of the state," he said.

Sandhills NebGuides

Irrigation development in the Sandhills is the subject of a series of eight new University of Nebraska Cooperative Extension Service NebGuides.

Paul Gessaman, extension agricultural economist-natural resources at NU and author of three of the new publications, said the Sandhills NebGuides serve two purposes. They address public concerns about the introduction of irrigation and row-cropping in the region and also will help ranchers determine if irrigation is a feasible method of expanding the carrying capacity of their ranching operations.

Extension farm management specialist Robert Perry and Gary Hergert, extension soils specialist, were also authors of other NebGuides in the series. Perry and Hergert are based at NU's North Platte Station.

The first of the eight new publications covers resource management issues that have been raised by the introduction of an intensive system of irrigated agriculture into an area that has been historically devoted to ranching. The types of irrigation development and the reasons for the development are also discussed, Gessaman said.

In the second NebGuide of the series, public management alternatives are considered, Gessaman added. The alternatives include control of irrigation development in the region by the establishment of ground water management or control areas, rural zoning or mandatory conservation measures.

The third NebGuide is devoted to a rancher's management alternatives. The risks and benefits of buying or leasing more land versus using irrigation to expand forage production are examined, Gessaman explained.

Soil, climate and water availability factors that must be considered in selecting a proper site for irrigation in the Sandhills are detailed in the fourth NebGuide.

The remaining NebGuides in the series deal with the financial aspects of using irrigation to expand forage production on Sandhills ranches, said Perry.

Detailed information, examples and worksheets are offered to help ranchers determine the financial feasibility of using irrigation, Perry added. Various methods of investing in irrigation are also considered as are procedures for evaluating both a net change in income due to irrigation and a rancher's capacity to repay irrigation investment costs.

The series of eight Sandhills NebGuides are free and can be obtained from local NU county extension offices. Ask for publications G82-605 through G82-612.

OWRT Functions Transferred

The Office of Water Research and Technology (OWRT) in the U.S. Department of Interior was terminated on Sept. 30, 1982 and its responsibilities were transferred to other Interior agencies.

OWRT has been a major funding source for NWRC. The federal agency was created in to administer the network of 53 state water institutes in the U.S. that was established with the passage of the Water Resources Research Act of 1964. NWRC is part of this network.

The U.S. Geological Survey will assume the duties of OWRT's Water Resources Scientific Information Center. The Bureau of Reclamation will take over the competitive matching grant program for research and development until present funds are depleted or more funds appropriated. The Office of Water Policy will also be involved with the network of institutes.

Federal Funding Possibilities

NWRC and other state water institutes in the U.S. have received fiscal year 1983 funding until Dec. 17., 1982. The money was appropriated by Congress in a continuing resolution.

At present, funding is at the fiscal year 1982 level. However, by deferral back to Congress, the Office of Management and Budget (OMB) could request a change in the amount. If a change is requested, Congress must act within 45 days.

In other funding developments, Senate Bill (S.) 1095 was passed. This bill authorized funding for state water institutes, while House Bill (H.R.) 3532 has been amended to provide funding for the institutes. This amendment is essentially the same as S.1095. The amended bill H.R. 3432 has not been acted upon by the House.

Congress is not scheduled to reconvene until November 29, 1982. There will be no further action on appropriation or authorization legislation for state water institutes until late November.

New Staff Members

NWRC is pleased to announce the appointment of A.J. Brandt as Staff Secretary III. A.J. is taking over for Barb (Mitchell) Noble who was recently married and moved to Kansas City.

A.J. comes to NWRC from the UNL Department of Psychology where she worked for a year and a half. Her major responsibilities are bookeeping and serving as secretary for the Universities Council on Water Resources. NWRC is the home office for the council.

We also wish Barb Noble the best of luck. She joined NWRC in 1978 and, needless to say, will be missed.

A welcome is also extended to Vicki Halstrom, Staff Secretary 1, who is working half time. Vicki is NWRC's receptionist and typist, and has worked for the Nebraska Game and Parks Commission before coming to us.

We welcome A.J. and Vicki to NWRC and hope you will soon become acquainted with them.

—Bill Powers
Director

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