Approved 4-4-1990
Date

MINUTES OF THE Senate COMMITTEE ON Energy and Natural Resources.

The meeting was called to order by Vice-Chairman Don Sallee at
Chairperson

8:05 a.m./p.m. on March 29, 1990 in room 423-S of the Capitol.

All members were present except: Quorum was present.

Committee staff present:
Raney Gilliland, Legislative Research Department
Don Hayward, Revisor of Statutes
Pat Mah, Legislative Research Department
Lila McClaflin, Committee Secretary

Conferees appearing before the committee:
Walter R. Woods, Director, Agricultural Experiment Station, KSU
George E. Ham, Asst. Director, Kansas Agricultural Experiment Station
Hyde S. Jacobs, Asst. to the Dean of Agriculture; Director, Kansas Water Resources Research Institute
A. Paul Schwab, Soil Chemist, Dept. of Agronomy
John Hickman, Extension Specialist & Coordinator, Environmental Quality, Department of Agronomy

The Chairman opened the discussion on HB 2919 - concerning state parks; changing the name of Melvern State Park to Eisenhower Veterans Memorial State Park. The Chairman recommended the word "veterans" be struck from the name of the park. Senator Yost moved the bill be amended to "Eisenhower Memorial State Park". The motion was seconded by Senator Sallee. Motion carried. A motion was made by Senator Sallee that HB 2919 be passed as amended. Senator Lee seconded the motion. Motion carried.

The Chairman called on Dr. Wood from Kansas State University to brief the Committee regarding the research being done on water at KSU.

Dr. Wood introduced George Ham, Hyde Jacobs, A. Paul Schwab, and John Hickman. He stated the scope of reports today involve: 1) experiment station research thrusts; 2) The Kansas Water Resources Research Institute 3) chemical movement in soil; 4) safe use of agricultural chemicals.

Each of the conferees reported on the research being done in their department. and copies of Water Quality Research Developments a report to the Kansas Legislature and Water Quality Educational Programs were distributed (Attachment I and II).

A motion was made by Senator Daniels to adopt the minutes of March 27, 1990. The motion was seconded by Senator Hayden. Motion carried.

The Chairman thanked the committee for their attendance and diligence in working the bills before the Committee this session. He stated he did not plan to have further meetings this session.

The meeting adjourned at 8:58 a.m.

1990 SENATE ENERGY AND NATURAL RESOURCES COMMITTEE

Date March 29, 1990

PLEASE PRINT GUEST LIST

NAME	REPRESENTING
Walt Woods	KSU
Robert Angelo	KDHE
Joyce Wolf	Ks. Audubon Council
Jack Peterson	KSU
Hyde Jacobs	KSU
Paul Schwab	KSU
John Hickman	KSU – CES
George Ham	KSU – AES

WATER QUALITY RESEARCH Developments

A Report

to the

Kansas Legislature

by the

Kansas Agricultural Experiment Station

Kansas State University

attachment I
E&NR
3/29/90

CONTENTS

KSU
KANSAS STATE UNIVERSITY

Director of Agricultural Experiment Station

Waters Hall
Manhattan, Kansas 66506
913-532-6147
FAX: 913-532-6563

January 22, 1990

To Members of the Kansas Legislature

Dear Friends:

In Kansas, water is the lifeblood of agricultural, municipal, and industrial growth. This report highlights selected water quality research programs and facilities in the Kansas Agricultural Experiment Station (KAES) at Kansas State University.

Although most groundwater in Kansas meets drinking water quality standards, detectible amounts of pesticides are found in some surface waters and farmstead wells. I'm convinced that vigorous water quality research and technology transfer programs are crucial to future agricultural, municipal and industrial growth in Kansas.

The safe use of fertilizers, pesticides, and agricultural chemicals is an important and continuing KAES research thrust. Because protection and efficient use of water is crucial to economic stability, water and environmental quality are prime considerations.

To advance that research, specialized facilities have been installed to expedite rapid sampling and testing of soil and water samples. Lysimeter facilities (specially instrumented soil columns) have been constructed to provide for precise measurements of water and chemical movement in soil.

We invite comment about these or any other Experiment Station research program. We want to provide research programs that assure environmental quality and support economic growth.

Sincerely,

Walter R. Woods
Director

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EXECUTIVE SUMMARY

Research facilities: Specialized water and environmental quality research facilities in the Kansas Agricultural Experiment Station include the State Soil Testing Laboratory; monolithic weighing lysimeters for quantifying water and chemical movement; field plots dedicated to safe, efficient, and profitable use of fertilizers, pesticides and agricultural chemicals at four branch stations and 11 experimental fields; livestock feeding and waste treatment facilities and pesticide extraction and analytical facilities.

Faculty: Faculty expertise in water and environmental quality is concentrated in the Colleges of Agriculture, Engineering, Arts and Sciences, Veterinary Medicine, and Human Ecology. Associated K.S.U. research centers include the Kansas Water Resources Research Institute, Center for Hazardous Substance Research, Kansas Evapotranspiration Laboratory, USDA Wind Erosion Laboratory, Konza Prairie Natural Research Area, and University Analytical Laboratory.

Irrigation: Water use efficiency is an important KAES research thrust because agriculture is the largest withdrawal user of water in the state. Research is directed at irrigation scheduling, low energy precision application and drip irrigation on vegetables and field crops. The experimental data show that effective irrigation and application methods can be used to conserve water and energy and to reduce nutrient loss due to overwatering.

Hazardous waste: Significant research has been implemented in managing hazardous wastes, including stabilization, biodegradation, airstripping and thermochemical, and adsorption methods. Identifying essential functions of proposed processing schemes and obtaining essential experimental data which lead to improved process and plant design is an important interest.

Tillage systems: Conservation tillage systems are widely used to retain surface residue, minimize erosion and reduce nutrient loss in runoff and below the root zone. Overall objectives are to maximize farm profitability, minimize chemical and energy inputs and protect the resource base. For example, in ridge tillage experiments herbicide applications are reduced by as much as 50 percent.

Chemical movement: Specialized field and laboratory facilities monitor pesticide, nutrient and water movement through or below the root zone. Early studies focused on movement of nitrate and atrazine and later expanded to other chemicals used in cropping systems.

Plant genetics: KSU plant breeding programs increase the genetic resistance to attack by insects and diseases by the state's major food, feed grain and forage crops and for alternate crops like pearl millet and sunflowers. Incorporating genetic resistance is cost-effective, specific to target pests, compatible with non-target organisms and leaves no harmful residues.

INTRODUCTION

Mission: As the state's land grant university, Kansas State University is committed to meeting the priority research, education and technology transfer needs of its citizens. Thus, basic and applied research in agriculture and related areas to help ensure an adequate supply of wholesome food and fiber products, preserve the resource base, and assure water and environmental quality are integral to the mission of the Kansas Agricultural Experiment Station (KAES).

Scope: KAES directs significant effort to research in water and environmental quality and to developing, testing, and promoting environmentally safe agricultural systems. This report focuses on KAES research efforts in water and environmental quality.

Water in Kansas: Water is the lifeblood of agricultural, municipal and industrial growth, and the state's history is replete with efforts to develop, manage and conserve this essential resource. Although more than 60 percent of the state's residents use groundwater for drinking water, more than 50 cities use small impoundments, more than 50 use streams, and more than 30 use a major reservoir. About 90 percent of the irrigation water and about 75 percent of the self-supplied industrial water used in the state is groundwater. Over 500 public water-supply systems use groundwater sources.

Most groundwater in Kansas meets the state's drinking water standards. However, water quality is a growing concern. Detectible amounts of pesticides are found in several Kansas reservoirs and lakes, and in some farmstead wells.

The protection and efficient use of our water resources are crucial to economic stability and to agricultural and industrial production in Kansas.

Research thrusts: KAES is the major research arm of Kansas State University. Some of the research thrusts in water and environmental quality include: safe use of fertilizers, pesticides, and agricultural chemicals; fate and effect of agricultural chemicals; integrated pest management; physical, chemical, and biological processes and their environmental consequences; erosion and sediment control; profitable, sustainable agriculture; best management practices; groundwater contamination, chemical movement and remediation; waste treatment; weed and pest control investigations; soil and water management; and soil and cropping systems.

KAES recently initiated, on a trial basis, an in-house grants program, whose priority concerns included water quality and sustainable agriculture. The objective was to capitalize on the special interests of KAES faculty in preventing contamination, abating pollution, reducing chemical inputs, conserving natural resources, and enhancing social well-being.

Research expertise: Significant research expertise in water and environmental quality exists among faculty in agricultural economics, agronomy, animal sciences and industry, biochemistry, biology, chemistry, agricultural engineering, chemical engineering, civil engineering, nuclear engineering, entomology, forestry, grain science and industry, horticulture, human ecology, plant pathology, and veterinary medicine.

Cooperative research in water quality and water resources is conducted with the University of Kansas through the Kansas Water Resources Research Institute at KSU and the Water Resources Institute at KU. Cooperative efforts are also underway with the Kansas Geological Survey, U.S. Geological Survey, Soil Conservation Service, and other state and federal agencies.

Specialized facilities: Specialized KAES facilities for water and environmental quality research include:

- Monolithic weighing lysimeters
- Pesticide extraction and analytical facilities
- Field plots dedicated to pesticide runoff and leaching studies
- Pesticide leaching columns in greenhouse facilities
- Neutron activation analysis
- Experimental plots devoted to safe, efficient and profitable use of fertilizers, pesticides and other agricultural chemicals.
- Livestock feeding and waste treatment facilities
- Waste Water Analytical Laboratory
- Granulated activated carbon removal of pesticides
- Field research at four branch stations and 11 experiment fields, with irrigation research conducted at five of those sites
- State Soil Testing Laboratory
- University Analytical Laboratory
- Center for Hazardous Substance Research
- Kansas Water Resources Research Institute
- Kansas Evapotranspiration Laboratory
- Konza Prairie Natural Research Area
- USDA Grain Marketing Research Laboratory
- USDA Wind Erosion Laboratory

OVERVIEW

Walter R. Woods
Director, Kansas Agricultural Experiment Station

Introduction

Although most ground and surface water in the state meets the state's drinking water standards, water quality is a growing concern. We are committed to the thesis that protection and efficient use of water are crucial to economic stability and to agricultural and industrial production in Kansas.

Strengthening Research Capability

The Kansas Agricultural Experiment Station has, over time, systematically strengthened its capability to conduct research related to water and environmental quality. This has been accomplished by internal reallocation, by cooperation with other agencies such as the Kansas Department of Health and Environment, Environmental Protection Agency, and U.S. Geological Survey, and by focusing faculty assignments, particularly when replacement faculty are recruited. In recent years new faculty have been employed in soil microbiology, soil physical chemistry, soil fertility and soil physics. All have been directed to increase research effort in areas related to water and environmental quality. In addition, faculty in agricultural engineering, civil engineering and biology have increased their research emphasis in water and environmental quality.

Research Facilities

Traditional research facilities at Kansas State University include the Kansas Water Resources Research Institute, Kansas Evapotranspiration Laboratory, Konza Prairie Natural Research Area, USDA Wind Erosion Laboratory and field research facilities at Manhattan, four branch stations and 11 experiment fields. Recently, EPA established a Center for Hazardous Substance Research at Kansas State University.

In addition, water quality laboratories in the departments of agronomy, agricultural engineering, and civil engineering have been modernized to facilitate rapid extraction and analysis of soil and water samples. Two lysimeter facilities, one at Manhattan and one at the Kansas River Experiment Field, have been equipped with lysimeters to expedite the measurement of chemical and water movement in relatively undisturbed soil. The lysimeter facilities at the Kansas River site involve cooperative work with EPA and USGS.

Early work at the newly established lysimeter sites involved atrazine and nitrate movement through soil. That work has been

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expanded to include other herbicides commonly used in cropping systems in the area.

Scope of Reports

Our reports today involve:

- Experiment Station research thrusts
- The Kansas Water Resources Research Institute
- Chemical movement in soil
- Safe use of agricultural chemicals

We intend to maintain strong research efforts in areas such as water use efficiency, conservation tillage systems, non-point source pollution and best management practices. Concurrently, however, we wish to respond to the emerging areas of remediation, treatment of hazardous waste and the fate and effect of pesticides and nutrients in the environment. We also intend to maintain strong plant breeding programs with emphasis on minimizing the use of fertilizers and pesticides by incorporating genetic insect and disease resistance.

EXPERIMENT STATION THRUSTS

George E. Ham
Associate Director, Kansas Agricultural Experiment Station

Introduction

The Kansas Agricultural Experiment Station supports several research projects which deal directly and indirectly with water quality. These projects entail Kansas-focused projects as well as regional research projects. Cooperation with other agencies also enhances our capability to investigate the impact of agricultural systems on water quality.

Water and Environmental Quality

Fate of chemicals: Physical, chemical and biological processes act jointly to determine the fate of nutrient elements and chemicals in soil. Within the last 18 months, a multidisciplinary water quality research team has been organized by reorienting faculty positions as retirements and resignations occurred. The team includes a soil microbiologist to examine carbon and nitrogen dynamics in soil; and a soil chemist to study nutrient cycling, transport and efficient fertilizer use, especially nitrogen; and a soil physicist to investigate

water and solute transport in soil. Their research will help clarify processes like chemical and biological degradation, transport and leaching and volatilization, immobilization and nutrient and chemical uptake in plants.

Conservation systems: Other researchers are examining existing management practices to minimize the impact of agriculture on the environment. This includes such management practices as conservation tillage (including ridge-till), accurate fertilizer and pesticide placement, minimal chemical use, improved water management, precision fertilizer recommendations, improved soil and plant tests and biological control of pests.

Chemical movement: An ongoing KAES project concerns the leaching of atrazine and nitrate in sandy and finer-textured soils at five field locations. This research involves soil and water sampling, monitoring tracer movement, and determining water and chemical movement through the soil profile. Closely related water quality research activities are funded by the Kansas Water Resources Research Insitiute and U.S. Geological Survey. KAES scientists also participate in three Western Regional projects which are investigating the water quality degradation potential of agricultural systems. Those projects include: 1) W- 155 (Characterization and Management of Soil Water and Solutes in Field Soils) and 2) W-170 (Chemistry and Bioavailability of Waste Constituents in Soils); 3) W-82 (Pesticides and Other Organics in Soil and Their Potential for Groundwater Contamination). KAES scientists have participated for many years in North Central Regional Project NC-98 (Nutrient Management in Conservation Tillage to Improve Productivity and Environmental Quality).

Enhancing Water Quality Research

Chemical transport research facilities: A multi-disciplinary study of transport of agricultural chemicals through soil is a result of the in-house grants program for FY 1989. Project leaders include an agricultural engineer, a civil engineer and an agronomist. This project will facilitate the establishment of a long-term research site to study the movement of potential contaminants like nitrate, atrazine and alachlor in and through soil. Minimizing the potential for groundwater contamination is of critical concern.

Minimizing chemical use: Another funded project deals with low, moderate and conventional use of herbicides for five tillage systems for soybeans and grain sorghum grain in a two-year rotation. Ridge till is a cropping system that appears to have great potential for reducing herbicide use. The allelopathic effect of oats is also included in the study as a potential method to reduce herbicide use.

Experiment Station Goals

The long-term goals of KAES research thrusts are to improve our understanding of the basic processes that control the fate and transport of fertilizers, pesticides and other chemicals, and to develop crop production systems that minimize adverse environmental impacts.

THE KANSAS WATER RESOURCES RESEARCH INSTITUTE (KWRRI)

Hyde S. Jacobs
Assistant to the Dean of Agriculture; Director, KWRRI

Introduction

The Kansas Water Resources Research Institute is a state- and federally-funded research institute headquartered at Kansas State University. It supports research and educational programs at both K-State and the University of Kansas (KU). The mission is threefold — research, student training, and information dissemination. The KWRRI policy committee is composed of representatives from K-State and KU. Coordination is achieved through KWRRI at K-State and the Water Resources Institute at KU. Working relations between the two universities are excellent.

Before the institute can expend federal funds made available through the Water Resources Research Act of 1984, a 2:1 match is required; that is, every federal dollar expended must be matched by two state dollars.

Research Program

From 1984 to 1989, 47 percent of the institute's research projects were directed to water quality problems, 32 percent to aquifer and river system analysis, 16 percent to water and resource management and 5 percent to water law. The results of each research project are summarized in project completion reports. However, publication in professional journals is a most important way to disseminate research results. Publication in professional journals is also an important measure of the quality of the research program. From 1984 to 1989, KWRRI scientists completed 38 research projects. During that time, those principal investigators published 54 research reports on directly related topics in professional journals. There is a multiplier effect because projects started with KWRRI funds are often extended by other funding agencies.

The 1990 Research Program

Over time, water quality problems have grown in complexity and importance, and in 1990, KWRRI will fund seven new projects — all involving water quality. The following water quality problems will be addressed:

- Waterborne pathogens
- Pesticide movement in soil
- Denitrification
- Atrazine biodegradation
- Atrazine degradation products
- Hydrogeology of hazardous waste sites
- Surface water quality trends

Subject matter disciplines for the 1990 program include bacteriology, soil chemistry, soil microbiology, sanitary engineering, civil engineering and geology.

Project Selection

Research priorities are based on state, regional and national water resources research needs. Water resource scientists on each campus are informed of KWRRI project priorities, selection criteria and deadlines. Before final approval, projects are subject to both peer and user review.

Response to State Needs

KWRRI is committed to respond to priority water resources research needs, particularly priority research needs in Kansas. In 1989, KWRRI responded to a request by the Kansas Water Office to identify factors that should be included in any study of water transfer in the state. The report, prepared jointly by KWRRI faculty at K-State and KU, provides a summary of pertinent water law, a review of research reports, and recommends areas of needed research.

Subsequently, KWRRI contracted with the Kansas Water Office to complete: (1) a legal review of the operational aspects of the water transfer law, (2) guidelines for parties seeking water transfer, and (3) guidelines for use by the water transfer hearing panel. This report will also be prepared jointly by faculty at K-State and KU and is scheduled for completion in July, 1990.

CHEMICAL MOVEMENT IN SOIL

A. Paul Schwab
Soil Chemist, Department of Agronomy

Introduction

Kansas State University has responded to concerns about groundwater quality by initiating several innovative projects. Contamination of water by agricultural chemicals — pesticides, herbicides, and nitrates — has prompted research to determine how chemicals reach water supplies and how contamination can be avoided. The movement of pesticides and herbicides in soil is being studied in the laboratory, greenhouse, and the field to determine the effects of tillage, precipitation, and soil type on chemical migration. Special emphasis is placed on regions with susceptible aquifers like the Great Bend Aquifer in central Kansas and the Equus Beds near Wichita. Specialized facilities are being instrumented in Manhattan to thoroughly quantify the movement of chemicals in water under normal agricultural conditions. The Agricultural Experiment Station has invested in equipment and field facilities that promise to place Kansas State University among the leaders in research in chemical movement in soil.

Nitrates

Nitrate movement in soil is being examined because of the widespead use of nitrogen fertilizer. Nitrate contamination in ground and surface waters is also common. However, there are many potential sources of nitrate in water other than agriculture, so all studies examining chemical movement in soil must be carefully planned and executed. On-going projects are examining the effects of manure, long-term fertilization, tillage and irrigation on nitrate movement in soil. The concentration of nitrate expected to arise from natural processes is being studied on the Konza Prairie, an important pristine site adjacent to the university.

Cooperative Efforts

The movement of chemicals through soil is dependent on climate, rainfall, soil properties and management practices. A multidisciplinary approach is being practiced at Kansas State University, with projects involving researchers from many departments including agronomy, geology, civil engineering, agricultural engineering, biology, and plant pathology. Formal research agreements have been executed with the Kansas Department of Health and Environment, Kansas Geological Survey, the U.S. Geological Survey, and the Soil Conservation Service. Research results are disseminated through scientific publications, the popular press, extension special-

ists, and university publications. New courses are being developed for graduate and undergraduate students using the latest research and technology.

Research Results

The results from K-State water quality research have direct applicability to the general public and the agricultural community. Previously it was thought that sandy soils would be subject to leaching but, perhaps, finer-textured soils would not. However, all soils appear susceptible to nitrate leaching; and, if excess nitrogen is applied, it is likely to move as water percolates through the soil. To prevent contamination, the application of all forms of nitrogen, including fertilizers and manure, must be managed properly. Atrazine movement is limited to sandy soils and very low concentrations have been detected at depths as great as 15 feet. Heavy-textured soils do not appear to allow much atrazine migration. In those soils, the decomposition of atrazine is rapid enough to limit the threat to groundwater contamination. Alachlor does not appear to move through soil and also tends to degrade rapidly.

Application

The results of our research should be useful to farmers and ranchers, regulatory agencies, and the general public. We hope to continue to study the characteristics of susceptible chemicals, develop best management practices and provide data with which informed management and regulatory decisions can be made.

SAFE USE OF AGRICULTURAL CHEMICALS

David A. Whitney
Soil Fertility Scientist, Department of Agronomy

Water Protection

At Kansas State University, surface and groundwater protection is an integral research objective in projects dealing with the use of fertilizers and agricultural chemicals. A water and environmental quality protection objective is always implied even where it is not directly stated.

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Soluble Nutrients

With fertilizer application, the primary concern for groundwater quality protection is proper management of soluble or leachable nutrients like nitrate-nitrogen. The level of soluble nutrients in the soil should be minimized whenever the soil is not supporting an actively growing crop. Nutrient management is especially important on soils subject to ready movement of water through the soil. In this discussion, nitrate-nitrogen is used as the primary example of research with soluble nutrients.

Research Thrusts in Nitrate Management include:

Nutrient management: A key component of nitrogen management is to add only that amount of fertilizer which will optimize crop yield. Any excess is regarded as an environmental hazard. Because environmental conditions vary widely, it is difficult to project optimum nutrient needs in Kansas under non-irrigated conditions. Consequently, numerous nitrogen rate and source studies are conducted at research fields and experiment stations across the state. The objective is to enhance our understanding of nutrient-environment interaction, make precise fertilizer recommendations, and protect soil and water resources.

Fertilizer application rates: Depending on the crop rotation and amount of applied manure, nitrogen rate adjustments are key components in effective nitrogen management. Research has clearly shown that corn or grain sorghum following soybeans or other legumes need less fertilizer to obtain equivalent yields than do crops grown without a legume in the rotation. Additional research is needed, however, to quantify the release rate and absolute amount of nitrogen supplied by legumes. Research is also focused on nitrogen cycling in cultivated versus native plant systems. The objective is to determine just when nitrogen is released from the legume so cropping systems can be optimally matched to nitrogen release. That project is a cooperative effort involving personnel from agronomy, biology, the Kansas Rural Center, and the Land Institute.

Residual nitrates: Residual nitrates in the soil profile can be substantial when drought or other environmental hazards result in sharp yield declines. We are working to refine nitrate testing procedures. A North Central Regional Research Project (NC-98) is evaluating a pre-sidedress soil nitrate test as a tool for identifying sidedress nitrogen needs. Results from those studies will be compared with data from other states to ascertain the usefulness of the pre-sidedress nitrate test.

Contamination of surface waters is closely tied to erosion and sedimentation. No-till, conservation tillage systems and other conservation practices are being researched and recommended to

control soil erosion. Those tillage systems, however, may create potential problems because the fertilizer is not incorporated into the soil and may dissolve into run-off water.

Immobilization of fertilizer nitrogen in surface residues is another potential problem. Researchers are exploring ways to minimize these problems by injecting plant nutrients below the soil surface. Results have shown a consistent advantage to injecting rather than broadcasting liquid nitrogen fertilizer on no-till grain sorghum. Yield advantages of 10 to 15 bushels per acre more than cover the expense of knifing liquid nitrogen into the soil.

Our research demonstrates that whenever nitrogen use efficiency is improved, economic return is enhanced and environmental quality is improved.

WATER QUALITY RESEARCH FACILITIES AND RESEARCH THRUSTS

Water Use Efficiency

Irrigation scheduling: Effective irrigation scheduling conserves water and energy and enhances water quality by reducing nutrient loss due to overwatering. Precision soil moisture measurements are costly and time-consuming, so researchers in North Central Kansas simplified the process. After extensive comparisons, they recommend irrigation scheduling by stage of growth rather than by soil moisture measurements. Based on 8-year averages, corn irrigated three times — at 8 weeks, 9 weeks and 10 weeks after emergence — yielded within 11 bushels (94 percent) of the fully irrigated treatment which required as many as five or six irrigations. Similarly, soybeans irrigated twice at pre-selected stages of growth yielded within 1 bushel (94 percent) of the fully irrigated treatment while saving up to two irrigations annually.

Irrigation scheduling and surge irrigation research is being conducted at the Southwest and Northwest Research-Extension Centers at Garden City and Colby cooperatively with agricultural engineering.

Low energy precision application (LEPA): A LEPA system is being used at the Southwest Research-Extension Center to study crop water use and crop performance under sprinklers. The low pressure spray head installed 1 to 2 feet above the ground has three modes of operation. The chemigate mode is capable of spraying both water and pesticides on the crop canopy with ability to control insects at pesticide application rates much lower than conventional

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rates. The chemigate mode offers considerable potential for reducing environmental risk.

Drip irrigation: Research to determine the feasibility of drip irrigation with field corn is being conducted at Garden City and Colby. Although expensive, drip irrigation systems can increase irrigation efficiency to 75 to 95 percent. This minimizes deep percolation of water and nutrient loss. Researchers are studying drainage patterns in the root zone where design variables are lateral spacing, lateral length and time of water application. The effect of nitrogen management with respect to corn yield, water use, nitrogen uptake, loss of nitrate is also being determined. Cooperating departments include agronomy, agricultural engineering, agricultural economics and the Northwest and Southwest Research-Extension Centers.

Drip irrigation for vegetables, fruits and ornamentals: The use of plastic mulches during intensive vegetable production reduces water loss and controls weeds, and reflective mulches repel some insects. With trickle irrigation, the amount of water and chemicals applied can be rigorously controlled. The use of trickle irrigation and plastic mulches are being studied to determine how water and nutrients can be applied most effectively to enhance production, provide for timely harvest and preserve soil and water quality. Research with sweet potatoes, fruit production and ornamentals is also underway.

Horticultural and landscape crops are usually irrigated and heavily fertilized. These high-value crops require timely operations and skilled management. Research by K-State horticulturists is designed to help home and commercial horticulturists apply technological innovations which enhance profitability and maintain environmental quality

Off-season irrigation: Research at the Southwest Research-Extension Center, in cooperation with the Department of Agronomy shows that off-season irrigation for corn is less efficient than in-season irrigation. Water applied in the growing season is more likely to be used for plant growth, less subject to loss by drainage and evaporation and less likely to carry nutrients below the root zone. Additional research to improve water use efficiency is also underway with many of the state's important crops.

Managing Hazardous Wastes

Stabilizing solid waste: Factors affecting the stabilization or solidification of hazardous wastes include the type and amount of pozzolanic materials, kind of solidifying agents and properties of the waste materials. Those characteristics are being studied in order to experimentally determine the feasibility of solidification/stabilization processes for typical hazardous wastes. Establishing the necessary data bases for optimally treating such wastes is a related objective.

Biodegradation technology: Although bioremediation has many potential applications, a better understanding of the technology is needed for many field applications. Microcosm studies are being conducted to study the effects of soil moisture and oxygen transfer on biodegradation in the vadose zone. Mathematical models for bioremediation in the three-phase environment of the vadose zone will be formulated.

Air stripping: When properly designed, air injection or air venting procedures can be used to remove many volatile contaminants. This research will provide preliminary design protocols for using air stripping as a remedial measure. Simple computer codes are being developed to calculate gas flow patterns using various venting arrangements. Numerical simulation is being used to investigate the effect of injection and withdrawal well placement.

Thermochemical treatment: A bench-scale incinerator has been designed and constructed to thermally destroy hazardous wastes like chlorinated compounds. Experimentally derived data will be used to develop models for the design and operation of hazardous waste incinerator systems.

Computer-aided design and control systems for treating and minimizing hazardous wastes: Because hazardous waste treatment systems are complex and non-linear, it is important to identify the essential functions of proposed processing schemes, design guidelines, safety regulations, cost and other factors. That information will then be organized into a set of rudimentary heuristics for the design and operation of hazardous waste treatment systems. To minimize waste and optimize design, object-orientated programming will be employed to encapsulate heuristics and other essential information in appropriate decision aiding systems. Potential systems will be studied using the knowledge engineering environment running on a XEROX 1108 Artificial Intelligence Workstation.

Adsorption of hazardous wastes: Although soil can be an important disposal medium, little information about adsorbate-absorbent interactions with hazardous organic compounds and soil constituent is available. In this study, Fourier transform infrared photoacoustic spectroscopy will be used as the detection scheme for the adsorbed species. Currently, the adsorption of naphthalene onto alumina is being investigated.

Remediation

Soil microbiology research: Because of the overriding importance of microorganisms in the nitrogen cycle, researchers have adopted multiple objectives: (1) to characterize the ecology of denitrifying organisms in the vadose zone, because denitrification is a potentially important decontamination mechanism; (2) to assess the availability of various forms of soil nitrogen in order to improve nitrogen use efficiency from both mineral and organic sources of nitrogen; and (3) to develop an improved soil nitrate test for Kansas

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and the surrounding region. This interdisciplinary research is being conducted cooperatively with the U.S. Geological Survey, a North Central regional committee, and Kansas State faculty.

Residue disposal: The feasibility of ensiling grass and newsprint clippings for disposal on land is being investigated. Such materials could improve soil moisture storage and infiltration and enhance forage or crop production.

Conservation Tillage

Conservation tillage systems: Conservation tillage systems are widely used to retain surface residue, minimize erosion and reduce nutrient loss in runoff. Residues retained on the soil surface slow evaporation, increase infiltration and moisture storage and enhance yield potential. Capturing the full potential of conservation tillage systems requires: (1) timely management, (2) effective weed control, (3) adequate soil fertility, and (4) crop rotation. Although conservation tillage systems may be best adapted in sub-humid areas, KAES scientists are working to develop improved farming systems for use throughout the state.

Wheat diseases: Conservation tillage practices that retain surface residue have been adopted in many regions of the state. However, wheat emerging through surface residues in central and south central Kansas may be subject to infection from pathogens like tan spot and cephalosporium stripe. Research shows that wheat in reduced tillage systems in this area benefit significantly by periodic rotation to another crop. Rotation out of wheat for just one year reduced early-season tan spot by 55 percent when compared with continuous wheat under no-till or chisel tillage systems.

Weed control on sandy soils: Sandy soils present special weed control problems. Sandy soils without crop or residue cover are highly susceptible to wind erosion. When tillage is used to control annual grasses, crop residues needed for wind erosion control may be destroyed. In addition, crops grown on sandy soil are often prone to herbicide injury. Researchers at the Sandyland Experiment Field recommend the use of crop rotations and selective herbicides to solve this problem. In this farming system, two years of wheat are followed by two years of grain sorghum. Prior to planting wheat, weeds (mainly annual grasses) are induced to germinate by tillage and the emerging weed crop is controlled with atrazine. Atrazine applications are carefully timed to prevent damage to the subsequent grain sorghum crop.

Studies are also in progress to: (1) replace wheat in the rotation with a crop that fixes nitrogen yet competes effectively with annual grasses, (2) develop safe and effective weed control and production practices for alternate crops like rapeseed or canola oil, Austrian peas and other promising crops, and (3) monitor atrazine and nutrient movement and prevent groundwater contamination. Specially instrumented plots have been established to monitor atrazine and nutrient movement.

Wheat-sorghum-fallow rotations: When comparing various cropping systems for dryland fallow areas of Kansas, the wheat-sorghum-fallow rotation has been the most risk-free in terms of consistent production, net return and optimum use of rainfall and stored soil moisture. This conservation tillage system integrates the use of crop rotations, tillage and herbicides to control weeds, reduce erosion and minimize runoff. Farm benefits are enhanced because water use efficiency (compared to clean till systems) is increased about 15 percent due to reduced tillage and by about 18 percent due to the use of fertilizers. Increasingly, researchers are instrumenting plots and implementing studies to determine the fate and effect of the agricultural chemicals used in the farming system.

Soil fertility and conservation tillage: The potential for reducing erosion with reduced tillage systems is well established. Many soil fertility questions remain, however, because of the influence of large amounts of residues retained in or on the soil surface. These questions involve environmental quality and the use of nitrogen fertilizer, in particular, how nitrogen use efficiency is impacted, not only by soil type and climate, but also by nitrogen source, rate and application method. K-State researchers are addressing those questions on several stations and fields using a variety of tillage methods, nitrogen sources, application methods and nitrogen rates. The objectives are to maximize profitability and to maintain and protect the resource base.

Ridge tillage: Ridge tillage is an example of such research. In ridge tillage, herbicide use is reduced 50 percent by growing the crop and banding the herbicide on narrow ridges. Savings in tillage costs approximate $20 per acre and savings in herbicide costs approximate $6 per acre. Corn grown in ridge tillage systems yields within 4 bushels (142 vs 146 bushels per acre) of that grown in conventional systems.

Field and Analytical Facilities

Water quality laboratories: Water quality laboratories in the agronomy, agricultural engineering, and civil engineering laboratories have been modernized to facilitate rapid extraction and rapid testing of soil and water samples for pesticides and other contaminants.

Macro-weighing lysimeter: A macro-weighing lysimeter facility is being constructed at Kansas State University to expedite the measurement of chemical and water movement through soil. The lysimeters will contain relatively undisturbed soil blocks representing soils from the Equus Beds and Great Bend Prairie Areas. The research installation will be used to obtain information on the effect of crop and soil management on chemical movement and the potential for groundwater contamination.

Open end lysimeters: Seventeen open end lysimeters were constructed on the Kansas River Experiment Field to monitor

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herbicide movement under irrigated and non-irrigated conditions. Agricultural herbicides tested included Atrazine, Dual, Treflan, Lasso and 2,4-D. Each lysimeter is instrumented with small suction lysimeters to obtain moisture samples after herbicide application. This project is a joint effort between Kansas State University, the U.S. Geological Survey and the Environmental Protection Agency.

Non-Point Source Pollution

Computer models: Research and extension agronomists and computer systems personnel have developed a computer management model for corn. The model projects the influence of hybrid maturity on growth stage, harvest date and crop water use. Use of the model will help increase water use efficiency primarily through improved use of rainfall and by reducing drainage and nutrient loss from the root zone. Similar models are being developed for grain sorghum and sunflowers.

Simulating agricultural non-point source pollution: The agricultural non-point pollution simulation model (AGNPS) was applied to five small agricultural watersheds to evaluate its use as a water quality planning tool for the Soil Conservation Service. The model simulates erosion losses with reasonable accuracy and can be used to evaluate the effect of changes in crop management practice and feedlot control systems. The model has limited ability to evaluate the effects of dams and ponds and does not consider groundwater pollution or pesticide effects.

Pesticide and Nutrient Movement in Soil

Atrazine: A field research site to monitor atrazine movement in soil was established at the Kansas River Valley Experiment Field cooperatively by the departments of agricultural engineering and agronomy and the U.S. Geological Survey. Data from this study are to be used to verify computer models for predicting pesticide movement and will assist EPA in outlining test procedures to register new products. The research data suggest the need to incorporate atrazine at application time to minimize pesticide loss in runoff water.

Atrazine and alachlor: This study examines the migration and degradation of atrazine and alachlor (a component of Lasso) using five experimental sites. Although soil properties differ at each site, each is managed using typical agricultural practices. The rates and mechanisms of pesticide movement are being examined as well as the potential for groundwater degradation. The research is a cooperative effort between the departments of agronomy, agricultural engineering, and the U.S. Geological Survey.

Long-term effects: Studies concerning the effects of fertilizer nitrogen, phosphorous and potassium on corn and sorghum production have been conducted at the same site at Garden City for 29 years. Similar long-term plots, with and without herbicide treat-

ments, and where crop residues have been systematically removed or burned, also exist. These plots represent a valuable historical record of the long-term effect of fertilizers, herbicides and residue removal on soil properties.

Nitrification inhibitors: Research results show that anhydrous ammonia applied with a nitrification inhibitor were held in the non-leaching ammonium form for 4 to 6 weeks after application. This delay maintained preplant applied anhydrous ammonia in the root zone through the early, wet season until plant roots were actively growing and using the nitrogen.

Safe and Effective Use of Agricultural Chemicals

Starter fertilizer: Most fertilizer phosphorous entering lakes or streams is adsorbed and transported by eroding soil particles. Research at the East Central Kansas Experiment Field demonstrated that phosphorous knifed 4 to 6 inches deep was agronomically more effective than phosphorous applied in the seed furrow, broadcast or banded 2 inches to the side and 2 inches deeper than the seed. The deeper placement of phosphorous concentrates the nutrient in a zone where it is available to the crop but not susceptible to erosion.

High phosphorous soils: While generally not a problem in groundwater, elevated phosphorus levels in surface waters can lead to algal blooms and reduced water quality for fish, wildlife and recreation. Because the chemistry of high phosphorus soils is not well understood, the phosphorus fractions in soil are being characterized using electron microscopy, x-ray diffraction or infrared spectroscopy.

Fertilizer placement: Recent data suggest that fertilizer nitrogen recovery in grain sorghum can be substantially increased by proper nitrogen placement. Under no-till grain sorghum, nitrogen use efficiency was 35 percent with broadcast nitrogen compared to 70 percent with subsurface-banded nitrogen.

Phosphorus management can also increase the recovery of fertilizer nitrogen by the grain. In studies with wheat, phosphorus applied with the seed nearly doubled (25 to 48 percent) the nitrogen use efficiency compared to broadcast phosphorus. Field research projects have been implemented to further evaluate these management effects on the recovery of fertilizer nitrogen and phosphorus by sorghum and wheat.

Corn-soybean cropping sequences: Data taken in the Kansas river valley over a 10-year period show that corn following a previous soybean crop yields an average of 51 bushels per acre more than corn following corn when no nitrogen was applied. The data suggest that soybeans will supply to a subsequent corn crop the equivalent a pound of nitrogen for each bushel of soybeans produced. Thus, nitrogen applications to corn following soybeans should be significantly reduced to avoid over-fertilization and possible groundwater contamination.

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Synchrony and legume nitrogen contributions: These studies are being conducted cooperatively with the Land Institute and the Kansas Rural Center. They are designed to quantify the synchrony between the mineralization of organic matter, legume supplied nitrogen and nitrogen uptake by wheat and grain sorghum. Test crops include continuous wheat, continuous grain sorghum and combinations of those crops in rotations that include forages and legumes in conventional and no-till systems.

Reducing herbicide rates on soybeans: Research is being conducted in southeast Kansas to determine if herbicide rates can be reduced without reducing yield or profitability. Because area soils contain dense subsoils, herbicides are more likely to be lost through runoff than by leaching. Weed control strategies include reduced rates of selected herbicides, tillage, cultivation and crop residues. The problem is a difficult one because both broadleaf and grassy weeds are troublesome.

Fertilizer timing and placement for grass: Tall fescue and smooth bromegrass are grown on more than two million acres in eastern Kansas. Much of that acreage is fertilized with nitrogen to enhance the quantity and quality of the forage. However, less than half of the applied nitrogen is recovered in the forage. Research studies show that subsurface placement of nitrogen has increased its recovery by as much as 15 to 30 percent. Research to minimize the cost and enhance the response to subsurface nitrogen applications in cool season perennials is continuing.

Interseeding tall fescue with legumes: Research has demonstrated that animal gains on fescue pasture seeded with ladino clover have equaled or exceeded gains on fescue pastures fertilized with as much as 80 pounds per acre of nitrogen annually. Research to enhance stand longevity, find improved methods of seeding, and to test other legumes is underway.

Integrating Management Systems

Weed competition: Weeds compete with crops for moisture, nutrients, and light on nearly every crop acre and cause greater monetary loss than all other agricultural pests combined. Annual crop losses range from 10 to 30 percent under normal growing conditions and as high as 50 percent when resources, especially soil moisture, are limiting. Weed control research is part of the farming systems research at each branch station and experiment field throughout the state. The emphasis is on low- cost, effective systems that optimize crop production and assure environmental quality.

Mycorrhizal symbiosis: Mycorrhizal symbiosis is an association between certain fungi and most crop plants. In this relationship, the fungi adsorb water and nutrients and translocate them to plants. This relationship reduces the need for fertilizer and increases drought tolerance. Mycorrhizal plants also display greater tolerance to soilborne diseases. Recent discoveries suggest that the

fungi bind soil into aggregates, thereby reducing wind and water erosion. The fungi are naturally occurring, but high-input agriculture has reduced their numbers and effectiveness. Researchers are studying the function of mycorrhizal fungi in prairie and range plants where the symbiotic relation is unimpaired by the use of fertilizers or herbicides. Developing cropping strategies to enhance mycorrhizal symbiosis is a long-term objective.

Alternatives for inorganic fertilizer: The use of animal manures is a possible alternative for inorganic fertilizers. A significant interaction between the use of composted manure and nitrogen fertilizer on fields at Tribune led to a laboratory study of the kinetics of nitrogen mineralization and nitrification. The results of the study could suggest more effective ways to use plant nutrients while maintaining environmentally sound practices.

Water Quality Protection

Farmstead wells: A farmstead well survey conducted in cooperation with the Kansas Department of Health and Environment showed that nearly half of the wells did not meet the criteria for safe drinking water. Nitrate was the most prominent pollutant although 10 percent of the wells contained detectible amounts of organic chemicals. The study has been extended to determine if contamination can be related to distance from feedlots, well age, well construction, depth to water and similar factors. There is little evidence to indicate that fertilizer and pesticides used on cropland are a contamination problem of rural wells. However, preliminary results suggest that the distance to feedlots or similar hazards should be at least twice as far as generally recommended.

Hydrologic studies at Konza Prairie: Long-term trials show that early-season burning controls encroachment by weeds, brush and trees and enhances the vigor and longevity of tallgrass prairie. Plots have been established in the Konza Prairie Research Natural Area to measure the effects of burning tallgrass prairie on infiltration and overland flow. The project uses solid-set rainfall and overland flow equipment to measure infiltration, overland flow velocity and the quality of surface runoff. Results show that the loss of sediment and nutrients from unburned prairie was extremely low.

Plant Breeding Programs

Insect and disease resistance in crops: Plant breeders work to improve the state's crops — wheat, grain sorghum, corn, soybeans, alfalfa, melons, dry beans, sunflowers and pearl millet. Each crop is subject to attack by a variety of plant pests. Incorporating genetic resistance to insect and disease pests has many advantages. Genetic resistance is cost-effective, specific to target pests, compatible with non-target organisms, and leaves no harmful residues.

For example, K-State recently developed two new alfalfas with resistance to nine diseases and pests. One population, KS71, has tolerance to alfalfa weevil; the other, KS153, has tolerance to frost damage. Each new wheat release — Newton, Arkan, Dodge, Norkan and Karl — carried important pest-resistant genes. Many of the first greenbug-resistant grain sorghum hybrids used germ plasm released by K-State. Such releases affect pesticide use significantly. For example, as much as 25 percent of the Kansas sorghum acreage is treated for greenbug control. Developing hybrids resistant to today's greenbug biotypes could eliminate the need for about 150 tons of insecticide annually.

Bush-type melons: Changing the growth habit of melons from vine to bush types has environmental advantages. Bush-type melons can be readily grown using reduced row and plant spacings and a plastic mulch. With proper management, bush-type melons produce greater yields, minimize exposed soil, reduce erosion, and can be fertilized precisely through trickle irrigation.

Drought-tolerant turfgrasses: Turfgrass is normally fertilized and watered heavily, especially in home lawns, golf courses and other recreational areas. Work is underway to determine the optimum and minimum water requirements of turf varieties and to minimize water and fertilizer applications. The mechanisms by which plants adapt to drought stress are being studied and, where possible, will be adapted to reduce residential use of water and fertilizer.

By-Product Utilization

The wet milling industry uses large quantities of water to wash flour dough, separate starch from protein and recover gluten. Large quantities of gluten are imported or obtained domestically. The wash water contains dissolved flour and has a high biological oxygen demand, so disposal is a problem. The wash water also contains significant amounts of dissolved gums or pentosans. The gums act as hydrocolloids and have a great capacity to bind water, retain moisture in baked goods and increase the viscosity of liquids.

Research has been initiated to recover these gums from the waste stream and characterize them chemically and functionally. Their potential in replacing synthetic and imported gums in baked foods, salad dressings and other food products will also be evaluated. Constituent recovery is expected to add value to the product and reduce the pollutant load.

WATER QUALITY EDUCATIONAL Programs

A Report

to the

Kansas Legislature

by

Kansas Cooperative Extension Service

Kansas State University

Attachment II
E&NR
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KSU
KANSAS STATE UNIVERSITY

Cooperative Extension Service

Office of the Director
Umberger Hall
Manhattan, Kansas 66506
913-532-5820

January 22, 1990

To Members of the Kansas Legislature

Dear Friends:

Because of local concern, the Kansas Cooperative Extension Service has identified water quality and natural resource conservation as system wide issues. Those concerns are heightened by reports of detectible amounts of pesticides in both surface and groundwater.

It is my personal conviction that adequate supplies of good water quality are essential to future growth in agriculture, municipalities, and industry throughout the state. The following steps have been taken to strengthen Extension programs in water and environmental quality.

* Designated an Environmental Quality Coordinator
* Organized Program Development Teams for Water Quality, Non-Point Source Pollution, Safe Use of Chemicals, and Soil and Water Conservation
* Designated Agency Liaison Representatives to Enhance Communication

This report provides an overview of selected educational programs in water and environmental quality. We want to insure that those educational needs are promptly addressed and fully coordinated with other agencies and interest groups.

We invite your comments and suggestions on these or any other Extension programs.

Sincerely,

Walt Woods

Walter R. Woods
Director

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3/29

EXECUTIVE SUMMARY

Water and environmental quality: This report to the Kansas Legislature highlights educational programs in water and environmental quality conducted by the Cooperative Extension Service.

Program planning: Extension programs are implemented through a system of county Extension councils, citizen-based program development committees, county agents, and Extension specialists. Program development teams in (1) non-point source pollution, (2) domestic water quality, and (3) safe use of chemicals (chemical task force) provide leadership for educational programs in water and environmental quality. Responsibility for program coordination — between Extension program development teams and between Extension and water resource agencies — has been delegated to a newly appointed environmental coordinator.

Safe and effective use of herbicides: Kansas farmers apply about $125 million worth of pesticides annually. However, only one in four applications will likely be within plus or minus 5 percent of the intended application. Many Extension programs are directed at safe and accurate application by ground and aerial applicators.

Non-point source pollution: County Extension agents and district conservationists were provided training to help them (1) understand environmental impacts, (2) conduct educational meetings, and (3) evaluate and encourage adoption of water protection plans. The 3-day training sessions focused on best management practices, minimizing environmental degradation and maintaining profitability. More than 300 individuals attended.

Pesticide applicator training: To enhance environmental quality, all private or commercial applicators of restricted use pesticide must pass an exam and be certified. As a result, about 30,000 private and 4,500 commercial applicators have received basic training in the proper use of pesticides.

Forestry management: Properly managed woodlands, particularly those close to streams or on erodible land, exert a positive influence on stream and environmental quality. Extension foresters provide technical assistance to landowners and advice concerning conservation plantings and filter strips.

Horticulture: Extension horticulturists have developed a series of demonstrations on water and environmental quality. The demonstrations involve intensive vegetable production, nutrient management, drip or trickle irrigation, plastic mulches, minimizing pesticide use, and turf management.

Environmental engineering: Kansas State University was recently named one of five national centers for hazardous substance research by the Environmental Protection Agency. Educational and technical assistance is provided to minimize the production of

hazardous wastes, in hazardous waste technology and in measuring and mitigating radon gas.

County Extension programs: Many counties encourage water testing as part of their water quality education programs. In several cases, individuals found water of impaired quality and took remedial measures including chlorination, drilling new wells, and plugging old wells.

INTRODUCTION

Mission: The mission of the Kansas Cooperative Extension Service is to provide practical and useful information to the people of Kansas through informal, out-of-school, non-credit educational programs — programs based on scientific knowledge, applied principles, and recommended practice.

Cooperative Extension helps organize educational programs in every county in the state. The objective is to identify priority educational needs and meet those needs with research-based educational programs.

Responding to issues: Cooperative Extension has adopted a statewide planning process involving county Extension agents, specialists, county Extension councils, and county program development committees. This comprehensive planning effort resulted in interdisciplinary, issue-based programs focused on seven priority areas:

- Agricultural Profitability and Competitiveness
- Economic Revitalization
- Water Quality
- Conservation of Natural Resources
- Human Health and Well-Being
- Youth at Risk
- Developing Human Resources

The true wealth of Kansas is its people and its soil and water resources, and much of that wealth is connected with agriculture. Farmers use organic wastes, fertilizers, and other agricultural chemicals to supply essential nutrients for crop and livestock production, control weeds and insects, reduce costs, and increase profitability. However, agricultural practices and environmental quality are interdependent and directly affect human and animal health and safety and plant growth.

In Kansas, most groundwater meets the state's drinking water standards and most surface water can be readily treated for drinking. However, detectible amounts of pesticides are found in several Kansas reservoirs and lakes and in some farmstead wells. Warning signs are evident and water quality is a growing concern. Concerted action is required to protect this essential resource, now and for the future.

This report summarizes Extension educational efforts targeted to water and environmental quality.

Water and environmental quality: Education will play a key role in protecting our water resources.

Protection strategies that are technically and environmentally sound will be the key to preserving the resource base and to assuring water and environmental quality. Cooperative Extension has

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taken several steps to assure that educational programs in water and environmental quality are adequately addressed and fully coordinated with other agencies and groups. Those actions include:

- **Administration:** Extension administrators meet monthly to consider water and environmental quality programs and needs.
- **Environmental quality coordinator:** An Extension environmental quality specialist and coordinator has been appointed to coordinate Extension educational thrusts and facilitate inter-agency cooperation.
- **Program development teams:** Program development teams (PDTs) have been organized to provide leadership in:
  - — Non-point pollution
  - — Domestic water quality
  - — Safe use of chemicals (chemical task force)
- **Agency liaisons:** Liaison representatives have been designated for state and federal agencies and private groups to maintain and enhance inter-agency relationships.

OVERVIEW

Walter R. Woods
Director, Kansas Cooperative Extension Service

Introduction

The Cooperative Extension Service has adopted a planning process that is responsive to statewide educational issues. The priority issues most directly impacting agriculture include: agricultural profitability and competitiveness, economic revitalization, water quality, and conservation of natural resources.

This report focuses on education developments in water and environmental quality in the Cooperative Extension Service.

Meeting the Challenge

I'm personally convinced that good quality water will be the economic lifeblood that sustains agricultural, municipal, and industrial growth throughout the state. It is clear that protection strategies will be key in preserving our soil and water resource base and in assuring long-term water and environmental quality.

Cooperative Extension has implemented a number of actions to strengthen educational programs in water and environmental quality, including:

- Monthly water quality coordination meetings
- Designating an environmental quality coordinator
- Organizing program development teams for water quality, non-point source pollution and safe use of chemicals
- Designated agency liaison representatives

We want to assure that educational needs in water and environmental quality are adequately addressed and fully coordinated with other resource agencies and interest groups.

Soil and Water Conservation

Today, water and environmental quality concerns are center stage and high priority, as they should be. Those challenges will grow and must be met with sustained effort. However, in the long term, agriculture faces another critical problem which will also grow in importance. Agriculture is the state's largest withdrawal user of water. Farmers, ranchers, and irrigators withdraw about 85 percent of the state's water. We believe that soil and water conservation should be a companion priority with water and environmental quality. At K-State, our research and Extension efforts to improve water and environmental quality are closely tied to programs to conserve soil and water resources.

Reports and Programs

Today's report concerns:

- Extension thrusts in water quality
- Non-point pollution
- Environmental quality
- Domestic water quality

Nineteen multi-disciplinary program development teams have been organized as part of Extension's issue-based program initiatives. Nine program development teams address agricultural profitability and competitiveness initiatives; three, water quality; two, economic revitalization; and two, human health and well being. Soil and water, youth at risk, and developing human resources initiatives are each addressed by a single program development team.

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EXTENSION THRUSTS IN WATER QUALITY

Don D. Pretzer
Assistant Director of Extension, Agriculture & Natural Resources

Introduction

The Kansas Extension educational water quality plan of work is divided into three basic sections: (1) non-point source (NPS) pollution;(2) domestic water quality; and (3) chemical task force (pesticide registration and pesticide application training).

Non-Point Source Pollution

Clean water supplies and continued agricultural production are important to Kansas and to the nation. The use of agricultural chemicals is a potential NPS pollution risk. Sediment and suspended solids are a major surface runoff problem. A recent survey of NPS pollutants in streams, lakes, and groundwater indicate instances of sediment, fertilizer, and pesticide contamination (Table 1).

Table 1. Non-point source pollution by nutrients, pesticides, and suspended solids, Kansas.

Pollutant	Streams	Lakes	Groundwater
Percent of sites impaired			
Nitrate N	21	—	14
Phosphorus	92	50	0
Pesticides	42	13	2
Suspended solids	70	13	0

Without use of agricultural fertilizers and pesticides, U.S. food production could decline by 50 percent, causing significant food price increases. The risk of NPS pollution to Kansas water supplies can be minimized through the use of sound agricultural management practices. Water quality protection has been identified as the most pressing environmental objective for the 1990 farm bill.

The Kansas Department of Health and Environment is administratively responsible for the state's assessment and management

plans in regard to the Clean Water Act. The Kansas Cooperative Extension Service will help review the assessment and management plan and will assist in developing best management practices.

Domestic Water Quality

The 1980 census showed 126,000 private water supplies in Kansas. About a half million people (20 percent of the state's population) depend on private water supplies. A recent Kansas farmstead well survey showed 28 percent of our wells contain nitrates above the safe drinking water standard.

Pesticides and volatile organic chemicals (VOCs) were found in 10 percent of the wells. Recent Kansas Department of Health and Environment data show about 25 percent of private water tested is considered bacterially unsafe. When inorganic, organic, and bacteria-contaminated water is combined, over half of our private water supplies do not meet safe drinking water standards.

Many people using private water supplies are uninformed and unaware of the conditions and possible health implications of their water. A small percent of these wells are tested each year. Almost none are tested regularly. Extension can play a vital role in encouraging water testing and in selecting proper treatment.

Chemical Task Force

Pesticide registration and re-registration at both the federal and state levels is a dynamic process. New data and re-evaluation of "old" data used to support pesticide registration often require that the pesticide be placed in a special review to resolve questions on environmental concerns, human health, applicator safety, and risks and benefits of the use of the pesticide. The purpose of the USDA/State National Pesticide Impact Assessment Program (NAPIAP) is to provide objective data for evaluating the benefits and risks of selected pesticides. The National Pesticide Information Retrieval System (NPIRS) is used in Kansas to provide computer-accessible information relative to NAPIAP requests and the safe and legal use of pesticides.

Program Development Teams

Multi-disciplinary program development teams play an important role in planning, implementing, and evaluating Extension initiatives. The development team takes the lead in: (1) providing visionary leadership, (2) identifying priority educational issues, (3) planning and coordinating the plan of work, (4) marketing and implementing the program, and (5) reporting program impact.

Water quality program development tea
program development teams, including:

- Beef profitability
- Swine profitability
- Dairy profitability
- Grazinglands profitability
- Horticulture food crops
- Crops profitability
- Sheep profitability
- Sustainable agriculture
- Ornamentals and turf
- Soil and water conservation
- Economic and business development
- nutrition and health
- Food quality

NON-POINT SOURCE POLLUTION

David L. Regehr
Extension Specialist, Weed Science, Department of Agronomy

Non-Point Pollution Program Development Team

A non-point pollution program development team has been organized by Cooperative Extension to support its system-wide water quality and soil and water conservation initiatives. Members of the non-point pollution team provide leadership in planning, implementing, and evaluating county, area, and statewide programs in non-point source pollution. The object is to help Kansas farmers and ranchers use agricultural systems that enhance profitability, protect water quality, and prevent non-point source pollution.

Training County-Based Staff

A major activity for this program development team in 1989 was planning and presenting area training sessions for county Extension agricultural agents and district conservationists. The planning committee, composed of K-State, Soil Conservation Service, Kansas Department of Health and Environment, and State Board of Agriculture staff, focused the sessions on safe and effective use of fertilizers and pesticides. Environmental quality and groundwater protection were recurring themes.

More than 300 Extension agents and district conservationists attended one of the five 3-day training sessions held across the state in the fall of 1989. Each participant received a complete set of conference proceedings. This included subject matter presentations and graphs, charts and other reference material.

Non-Point Pollution Educational Themes

Pesticide characteristics: Extension meetings in non-point source pollution are designed to help producers cope with the environmental implications of fertilizer and pesticide use. For example, weed control herbicides are traditionally selected on the basis of the weed specie, crop, soil type, and cost. Farmers and ranchers are being encouraged to build groundwater and environmental protection characteristics into each farm plan and each agricultural practice. The USDA Agricultural Research Service is developing a data base characterizing the leaching and surface runoff potential of pesticides. Critical characteristics include the pesticide's solubility in water, adsorption to soil colloids, and longevity in the soil environment. This data base allows the use of environmental quality as a criterion for pesticide selection. Information on potential environmental impact is being incorporated into Extension's weed management recommendations and publications.

Best management practices: Atrazine is probably the most widely used herbicide for corn and sorghum production in Kansas. Although it is an effective herbicide, traces of atrazine are now found in several large and small water impoundments. In some locations the concentration approaches the "human lifetime health advisory" (HAL). Consequently, educational efforts focus on the use of best management practices for atrazine and other agricultural chemicals — practices that minimize use and reduce the potential for loss either by runoff or leaching.

Coordination

The non-point pollution team serves as a focal point for integrating non-point pollution principles in all Extension programs related to agricultural production, protection, and marketing. Special attention is focused on tillage, erosion and runoff control, safe use of agricultural chemicals and water and environmental protection.

Cooperative Extension's mandate is to serve as the educational link between agricultural research and the farmer/producer. Through cooperative efforts and effective coordination, the non-point pollution team also strives to serve the educational needs of other state and federal agencies.

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ENVIRONMENTAL QUALITY

John S. Hickman
Extension Specialist & Coordinator,
Environmental Quality, Department of Agronomy

Introduction

Underlying the quality of life and economic viability of Kansas is a wealth of natural resources: water, soils, grasslands, forests, agricultural crops, livestock, and wildlife. In the last year, there has been a dramatic increase in public awareness and concern over the quality of our natural resources. During this same period, the Kansas legislature funded the State Water Plan and Congress passed the Clean Water Act. Each of those actions has far-reaching environmental implications.

Natural systems are highly interdependent. Costs and benefits of management decisions are distributed among resource owners and their neighbors, and between present and future generations. To address the relationship of resource management and environmental quality requires integration of science, technology, sociology, and economics. The Cooperative Extension Service at Kansas State University is developing and delivering educational programs to address these basic issues.

Coordinating Environmental Programs

The environmental quality coordinator is a new position in the Cooperative Extension Service to facilitate and coordinate programs addressing environmental quality. The object is to plan, implement, and evaluate Extension educational programs with emphasis in surface and groundwater quality and point and non-point source pollution. Environmental quality issues will be coordinated with other Extension specialists as well as relevant state, local and federal agencies.

Interagency Cooperation

Coordination among state, federal and local agencies involved in environmental quality is essential. The Kansas Cooperative Extension Service has appointed staff members to enhance communication with other agencies. In addition, two committees have been developed to help coordination with various agencies. The Cooperative Extension Service will also help review best management practices, regulations, and other issues related to environmental quality. For example, Extension assisted in the review of a pesticide data base and soil pollution potential ratings for the Soil

Conservation Service (SCS). Extension also assisted in reviewing the rules and regulations for the Non-Point Source Pollution Control Fund. In the near future, we expect to review best management practices written by the Kansas Department of Health and Environment and the Soil Conservation Service.

Extension also will play a role in implementing the State Water Plan. Some of the programs funded from the State Water Plan, such as the Non-Point Source Pollution Control Fund and the Local Environmental Protection Grants Program, involve information and education at the local level. Extension at the state, area, and local level can deliver information and educational programs in these areas.

Environmental Quality Programs

The primary thrust of program development teams in environmental quality include: 1) non-point source pollution, 2) domestic water quality, and 3) pesticide applicator training by the chemical task force. To foster interaction, each program development team is multi-disciplinary. We consider this essential, because we want water and environmental quality principles to be an integral part of most Extension programs. This is particularly true for programs in crop and animal production and protection, soil and water conservation, and nutrition and health. Administrators and team leaders meet monthly to foster interaction and keep abreast of current activities.

Many related programs also will address environmental quality issues. For example, publications have been and are being developed for public distribution through meetings, Extension offices, and by cooperating agencies. Information on how pesticides reach groundwater and surface waters was incorporated into seven commercial pesticide applicator training sessions last year. Environmental quality issues will also be addressed in a series of 21 public policy meetings on the 1990 farm bill.

Summary

Extension programs in environmental quality will help the people of Kansas better understand the complex issues related to the quality of our natural resources and will help achieve an atmosphere of cooperation between the various interests affected by this issue.

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DOMESTIC WATER QUALITY

Michael H. Bradshaw
Health & Safety Specialist,
Human Development and Family Studies

Introduction

Approximately 500,000 Kansans rely on private wells for their water needs. Is their water safe to drink? Does it meet EPA safe drinking water standards? We know little about the quality of private wells. What little we know leads us to believe that many people are drinking water that does not meet the same safe drinking water standards required for municipal water systems.

Farmstead Wells

In 1986, the Kansas Department of Health and Environment, with Kansas State University, conducted a statewide study to evaluate the condition of farmstead wells. The study revealed that many were contaminated. Information collected subsequently from wells tested during statewide Extension water quality clinics revealed that 45 percent of wells tested were above the EPA guidelines of safe levels of nitrate or bacteria.

Most of the private water system problems can be corrected, and further deterioration of groundwater can be prevented.

Water Quality Task Force

To address the growing concerns over the quality of our domestic water, Extension organized a water quality task force in 1985. The task force was asked to identify educational program needs which would help to address water quality issues. Several Extension educational programs, identified by the task force, have been introduced this past year to help reduce problems associated with private water systems and to prevent further contamination of our groundwater. One such activity, an agricultural best management practice program, was introduced to help protect ground and surface water. This program was incorporated into our traditional educational programs for agricultural producers. For example, in programs in which agricultural chemicals were discussed, specailists added information on the importance of best management practices to protect our surface and groundwater. This educational message on protecting surface and groundwater reached 5,890 producers this past year.

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Water Quality Programs

Water quality clinics were conducted by Extension personnel to help homeowners evaluate and correct problems with private water supplies. Extension specialists taught 1,275 people who had obtained water tests, how to inspect their wells, protect their water supply, and correct water problems associated with bacteria or nitrate contamination.

County Extension agents have worked with farm families to provide educational programs which promote best management practices, health benefits of safe water, and testing of private water supplies. These programs reached 9,614 individuals across Kansas this past year.

Agent Training

Over a two-year period, 100 Extension agents participated in a special water quality training program. County agents are being trained to help rural families who have questions about their private water supplies.

Publications

Extension specialists worked with the Kansas Department of Health and Environment specialists to develop publications to help Kansans better understand private water systems, how to protect water quality, and how to correct problems. Publications completed this past years were:

"Is Your Drinking Water Safe?"
"Questions to Ask Before Buying Water Treatment Equipment"
"Commercial Laboratories Certified for Water Quality Tests"
"Understanding Your Water Test Report"
"Plugging Abandoned Wells"

Media Program

Task force members produced a monthly question and answer newspaper series on water quality.

Extension specialists are working with personnel from the Kansas Department of Health and Environment to develop a newspaper supplement for distribution to local papers. This water quality tabloid also will be distributed to rural Kansans who have private water systems.

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WATER QUALITY EDUCATIONAL DEVELOPMENTS

Safe and Effective Use of Pesticides

Pesticide application accuracy: Kansas farmers apply an estimated $125 million worth of pesticides, but only one in four applications may be within plus or minus 5 percent of the intended rate. Extension demonstrations, sprayer workshops, and in-depth schools were organized to help private and commercial applicators with application techniques, sprayer calibration, and alternative control methods. An initial survey of commercial ground rig applicators showed an average over-application error of 22 percent. Subsequent surveys showed that the tendency to over-apply pesticides declined and overall application accuracy increased. It is estimated that one such program favorably impacted 240,000 acres.

Chemigation: Chemigation, the application of agricultural chemicals through irrigation systems, is rapidly becoming an accepted method of application. If applied properly, chemigation is a cost-effective, timely and safe method of application. However, groundwater can be contaminated if the system is not properly operated, calibrated, or equipped. Chemigation schools detailing calibration methods, operating parameters, and required safety equipment were organized by Extension agents and specialists. The farmers in attendance (approximately 300) operated about 400 center pivot systems and farmed about 55,000 acres.

Improved insect management in grain sorghum: The major recurring sorghum insects are greenbugs and chinch bugs. Seasonal losses vary widely, from none to as high as 50 percent. This educational program focused on three areas: (1) reducing unneeded planting time treatments, (2) monitoring programs to detect pests and reduce losses, and (3) non-chemical pest control alternatives. Farmers were reluctant to reduce chemical use without assurance that planting time treatments could be safely delayed. A county-by-county pre-season insect survey was conducted annually by Extension professional and survey results were reported to producers. Suppliers reported a decline in sales from more than 5 million pounds annually to less than 1 million pounds folowing the insect survey.

Emergency applications of pesticides frequently are needed on sorghum. Cooperating farmers in north central Kansas were encouraged to carefully monitor insect numbers and to utilize early warning services in scheduling the application of pesticides. Greenbug infestations were severe and participating producers saved an estimated 26 percent in sorghum yields on 130,000 acres. Similar savings were realized in northwest Kansas when a comparable problem arose.

Extension specialists keep abreast of the availability of greenbug-resistant hybrids and their susceptibility to change based on changes in greenbug biotypes. This enables farmers to use greenbug-resistant hybrids wherever possible and significantly reduce the use of pesticides.

Aerial application of pesticides: Starting in 1985, computerized spray deposition pattern analysis equipment was made available for use by all aerial applicators in Kansas. The objective was to provide educational materials, calibration slides, deposition measuring equipment, and technical assistance to improve application results, efficiency, and accuracy. The leader of the Kansas program organized a series of aerial applicator training programs for Extension leaders in other states and received the USDA Award of Merit for this leadership. This program has impacted about 600,000 acres of Kansas crop and range land. Most cooperating aerial operators had never had their spray deposition pattern analyzed using computerized equipment. Demand for the program, which includes instruction on protecting ground and surface water and managing load/mix sites, is increasing. Coordination with the developing National Agricultural Aviation Association (NAAA) Operation SAFE, Phase II program will be increased. The NCAA Operation SAFE, Phase I program was significantly influenced by this educational effort.

Best management practices for nitrogen: Maintaining environmental quality, particularly safe drinking water supplies, is a major objective of Extension soil fertility and soil management programs. Because nitrogen is the most widely used fertilizer in the state, best management practices for nitrogen are emphasized in Extension meetings and publications. Helping farmers apply fertilizers at the proper time, rate, and point of placement is a major educational thrust, not only for nitrogen but for all plant nutrients. When legumes or manure is used, producers are advised to adjust fertilization rates downward. The profile nitrogen test is promoted as a measure of residual available nitrogen. One producer, using the profile nitrogen test for the first time, reduced his 1989 fertilization rate by 50 pounds per acre. The result was a $7,000 saving with no sacrifice in yield. His 1988 production was limited by dry weather, leaving unused nitrogen in the soil. In 1989, more than 6,000 producers and fertilizer dealers participated in this program.

Conservation tillage: Soil loss due to wind and water erosion continue to be above tolerance levels in much of Kansas. As defined by the Food Security Act of 1985, Kansas has 10.5 million acres of highly erodible cropland. The conservation tillage program development team has instituted numerous educational programs to help farmers retain surface residue, minimize erosion and reduce nutrient runoff through conservation tillage systems. The programs are often conducted in cooperation with SCS and soil conservation district personnel and farmers.

These cooperative efforts are making a significant impact on farming practices. For example, benchmark surveys indicate that 99 percent of Kansas producers have heard about conservation tillage and approximately 60 percent of Kansas farmers are using some form of conservation tillage on parts of their acreage. About 30 percent of the cropland in Kansas is farmed using a conservation tillage system. It is estimated that conservation tillage committees provided 3,700 hours of volunteer assistance in 22 counties and helped implement 122 demonstration plots, 223 drill demonstrations, 44 seminars/workshops and educational programs for 5,750 individuals in a single year.

Safe and proper use of herbicides and fertilizer is an integral part of conservation tillage educational programs.

Non-Point Source Pollution

The objective of non-point source pollution training programs is to provide county Extension agents and district conservationists with information to help them: (1) understand the production and environmental impact of agricultural chemicals, (2) conduct educational meetings, (3) evaluate the adequacy of water protection plans, and (4) encourage adoption of water quality protection plans by farmers and ranchers. Specifically, farmers subject to the conservation provisions of the 1985 Food and Security Act (60 percent of Kansas farmers) are encouraged to append water quality protection provisions to their farm plans. Others are encouraged to request the development of resource plans that will prevent point or non-point pollution.

Pesticide Applicator Training

Certification: To use restricted use pesticides, state and federal law requires that both private or commercial applicators be certified. The State Board of Agriculture administers the exam and pertinent regulations. Cooperative Extension publishes and provides, with help from industry and agency representatives, the technical expertise for all training materials and educational meetings. One objective is to provide 30,000 private and 4,500 commercial pesticide applicators with basic training in the safe use of pesticides. The training manuals incorporate the latest technology on pesticide storage, use, application, safety, groundwater contamination, endangered species protection, community right-to-know and waste disposal. Commercial applicators can renew certification by re-examination or by attending a 6-hour training class. Private applicators renew certification through a mail-out exam. More than 90 percent of all commercial applicators renew their certificates by attending KSU-organized training sessions. K-State specialists have developed 23 manuals to support the certification process.

Chemigation: A manual on chemigation also is being developed by K-State specialists working with appropriate state agencies. The manual addresses proper and safe use of pesticides and safety devices to protect both surface and groundwater.

Forestry Management

Riparian woodland management: Properly managed woodlands — particularly immediately adjacent to streams — have a positive effect on stream water quality. Riparian plantings and filter strips stabilize streambank erosion, trap sediment and reduce nutrient loads. Technical assistance is provided to landowners in the areas of water quality, erosion control, and wildlife habitat as well as timber production, recreation, and related areas.

Conservation plantings: Tree plantings can stabilize critical areas by reducing or trapping sediments, nutrients, and pesticides. Low-cost tree and shrub planting stock are provided to landowners for conservation purposes, including critical area and streambank stabilization, windbreaks, wildlife habitat and timber. Technical assistance is provided in developing conservation plans and for planting, maintenance, and management procedures.

Environmental coordination and review: Channel modification projects are reviewed for their potential impact on water quality and forest resources prior to the issuance of permits. State and Extension Forestry cooperates with the Division of Water Resources, State Board of Agriculture, in the review. Technical assistance is provided to permit holders for tree plantings and management.

Horticulture

Extension horticulture programs in water and environmental quality programs depend heavily on workshops, seminars, and publications to reinforce awareness of environmental hazards and the need to protect our soil and water resources. Demonstrations have proven very effective, and a few water and nutrient conservation demonstrations are listed below.

Intensive vegetable production: Based on research results, it was demonstrated that water applications could be reduced more that 50 percent (46,000 to 20,000 gallons per acre) using plastic mulch and drip irrigation systems. With drip irrigation, production often can be doubled using half as much water and fertilizer for a variety of vegetable crops.

Efficient nitrogen utilization: Producers are generally aware that large quantities of fertilizer elements can be lost by leaching in sandy soils. An effective demonstration series has been developed to show that a vigorous crop of seedling asparagus can be produced with only 7 pounds per acre of nitrogen when utilized in conjunction with drip or trickle irrigation.

Drip or trickle irrigation: When properly managed, the use of drip or trickle irrigation systems results in significant water savings. If neglected, water and nutrients may leach below the root zone and cause environmental degradation. To help alleviate this management problem, a series of water management demonstrations was instituted in commercial fields, vineyards and orchards in eastern and south central Kansas. The use of tensiometers in timing and controlling irrigation was an important part of the demonstration. Drip and trickle irrigation was demonstrated to commercial growers on two vegetable farms and at the Eastern Kansas Vegetable Research Farm at DeSoto. More than 130 growers participated.

Minimizing pesticide use: Excessive use of pesticides and subsequent run-off in orchards is a potential hazard where a spray schedule is used to prevent disease and insect problems. The following techniques were demonstrated to help producers achieve effective control while minimizing the use of pesticides.

- **Precision calibration of sprayers to prevent over- or under-application of pesticides.** For one grower, proper calibration plus shutting off two nozzles reduced pesticide use by 6 pounds per application and 48 pounds per season.

- **Use of pheromone traps and heat unit accumulation for timing treatments for coddling moth infestations.** Nine cooperators based their spray schedules on adult moths caught in sticky traps using codling moth lures. Using this method, insecticide applications were reduced from 1 to 3 applications per grower.

- **Landscape and turf:** Nearly 50 percent of the water used by households, businesses, and public grounds is for landscape plantings, particularly grass. Because of recent droughts and increased awareness of water availability, renewed emphasis has been placed on xeroscaping. Xeroscaping denotes the use of natural resources to create a quality living environment using limited amounts of water. Extension programs in turf are directed toward: (1) conserving water and resource inputs while maintaining quality turf through species selection and management, particularly water management, (2) use of run-off or water of non-drinking quality for irrigation on golf courses or large turf areas, and (3) use of turf as a filter strip to reduce surface water contamination.

Water Education for Teachers (WET)

Extension specialists in 4-H and youth and agricultural engineering cooperated to develop a Water Education for Teachers (WET) curriculum. It is designed for 4th through 8th grade teachers and for 4-H volunteers to use with elementary and middle school students, 4-H clubs, and others. The lessons are hands-on, experiential, and help youngsters gain new ideas and behavior patterns about water resources. The curriculum contains more than 60 lessons on the water cycle, water supply, water and waste water treatment, conservation and pollution.

Approximately 100 teachers received "hands-on" training with curriculum materials at the Kansas Teachers of Science and Kansas National Education Association meetings. In addition, 49 county agents and four area Extension specialists received specialized training. The WET curriculum has been requested by other states. It has gained national prominence and is scheduled for a national workshop for agents and specialists in March, 1990. A summer, 1990 workshop also will be held at the Kansas National Education Association Summer Leadership Conference.

Environmental Engineering

The following programs are supported with federal funding:

Hazardous waste technical assistance: In this program, administered by the Kansas Department of Health and Environment, EPA funds support a joint program at the University of Kansas and Kansas State University. The education objective is to minimize hazardous substance production by small quantity generators. The University of Kansas provides training in compliance requirements for state regulators and regulated industries. K-State's responsibility is technical assistance to small quantity generators through education and individual assistance. Target audiences include metal finishers, automotive equipment and heavy equipment repair, dry cleaners, analytical laboratories, etc.

Technology transfer: Kansas State University was recently named one of five national centers for hazardous substance research by the Environmental Protection Agency. KSU is responsible for EPA-supported research in ten states in EPA Regions 7 and 8. K-State is responsible for transferring new technology resulting from this research to other laboratories in the two regions as well as industries who are privately developing new hazardous substance management techniques. Technology transfer methods in use range from technical conferences to electronic data bases and specialized information repositories.

Radon measurement and mitigation: In cooperation with the Universities of Minnesota and Michigan, Engineering Extension at Kansas State University was recently named an EPA radon training center, one of only three in the country. The purpose of the center is to train contractors in proper methods of measuring and mitigating elevated radon levels in buildings. Educational conferences and certification testing will be conducted as part of this program. Extension engineers also provide technical assistance to small energy consumers throughout Kansas in a program administered through the Kansas Corporation Commission. This program focuses on energy conservation for the residential, business, institutional, and industrial sectors, and radon mitigation in homes. On a global scale, energy conservation programs help to minimize the "greenhouse effect" and slow the depletion of ozone through reduced use of chloroflurocarbons.

Water Quality Programs

Domestic water quality task force: The task force conducted ten day-long training sessions for county Extension agents and community health professionals. The training acquainted participants with known water quality problems in the state; probable, causes and remedial actions; water testing and certified water test laboratories; water sources and safe well construction; home water treatment devices and procedures; and simple water tests that can be performed by non-professionals.

A second effort concerned public awareness and included: (1) a water quality display at four metropolitan home and garden shows and six rural county health fairs (Extension specialists distributed literature and answered questions); (2) a monthly news column, "Questions and Answers About Water Quality"; and (3) ten 30-minute radio tapes for Kansas stations on topics including water quality and human health, nitrates and where they come from, safe wells and well plugging, water tests, and radon.

A handbook, "Household Water Quality," was developed prior to training sessions for agents and community health professionals as a comprehensive ready reference. Numerous fact sheets have been and are being developed on a variety of water quality problems. The subject matter is coordinated with the Kansas Department of Health and Environment, which helps with funding.

The domestic water quality task force also appointed subcommittees to address specific needs, including: impact of agriculture on water quality, household water quality, solid waste and hazardous waste, water planning and school enrichment. A one-week short course on private water systems is also developed and may be taken for credit.

Memorandums of understanding: Memorandums of understanding related to water quality protection and non-point pollution have been executed with the U.S. Soil Conservation Service and the Kansas Department of Health and Environment. It is expected that efforts related to water quality and non-point pollution will increase, especially in the areas of solid waste and hazardous waste. A number of cooperative programs are planned, particularly in non-point source pollution.

County Water Quality Programs

Several counties conducted programs to heighten awareness of the need to test private wells for drinking water quality. Two such programs are summarized below:

Harper County: Beginning in October, 1988, the Harper County Commission allocated $1,000 to assist in testing 200 water samples. This reduced the cost to residents by nearly half. Articles explaining the importance of water testing were published in county newspapers. KSU specialists were scheduled for a water quality program to

discuss the meaning of water quality test results for humans and livestock, as well as the effectiveness of shock chlorination for wells high in bacteria, the effectiveness of filtration devices and the utility of reverse osmosis in nitrate removal. Seventy people participated in the meeting.

A regular monthly testing schedule was established. Residents purchased test bottles, returned samples to the Extension office, and had them forwarded for testing. Test results were returned to the county office for distribution to cooperators. Residents were assisted in interpreting test results and mapping the location of high-nitrate wells. A total of 151 samples were processed in this manner. Subsequently, 21 residents obtained shipping tubes and ice packs for test bottles and sent the samples directly to the lab for testing. This speeded information return but limited the mapping of high-nitrate wells because test results were not returned to the county office. Based on water quality tests, 27 residents chlorinated their wells to alleviate bacteria problems.

Reno County: Development of an educational program on water quality was suggested by the economic development program development committee. The program was promoted and implemented through news stories, publications and individual consultation. A series of water quality and pesticide information meetings was presented to employees or public groups at Cargill Salt Company, Extension election mini-workshops, Haven Co-op meeting, nurses training seminar, and horticultural service personnel. About 260 people participated and 60 wells were tested. Thirty-six homeowners obtained individual assistance with water quality problems. As a result of this educational thrust, several Reno County residents have chlorinated and re-tested wells or plugged and then relocated wells.

Reno County Extension personnel also cooperated with the Soil Conservation District and a watershed board in planning programs that stress non-point source pollution. The county Extension director served on a committee to write a county sanitation code.

Extension Communications

Communication specialists, in cooperation with the water quality task force, prepare articles for use by county agents in newspapers and newsletters. Portions of this series have appeared in such widely distributed publications as "Kansas Country Living" magazine. The material alerts families to potential water contamination problems, urges use of certified water testing laboratories for testing their water supplies, and reminds them to seek guidance from unbiased sources, such as Extension agents or university specialists, before investing in costly and possibly unneeded household water treatment devices. County agents are also assisted with promotion materials for well testing, pollution abatement and other programs.