

Chapter 9

Extension Agricultural Engineering

Contents

Early Development	102	Organize Irrigation Districts—1950's.....	112
One-Person Department—1912.....	102	Educational Thrusts—1960's.....	112
Farm Architecture-Structures.....	103	Irrigation Program Objectives—1960	112
Building Construction—1920's-30's.....	103	Irrigated Crops—1960	113
Standard Plan Service—1921	103	Corn Plant Population—1960.....	113
Home Water and Sewage Systems—1923	104	Irrigation Educational Materials—1960	113
Builders Schools—1926	104	Irrigation Program—1950's & After.....	113
4-H Model Building—1935	104	State Irrigation Federation—1964	113
New Home Landscaping	104	SC Kansas Irrigation Program—1964	113
Painting Demonstration—1937	104	SC Kansas Program Objectives.....	114
War and Post War Years—1940's	104	SC Irrigation Teaching Center—1966.....	114
Septic Tank Demonstrations—1940's.....	104	Irrigation Tour—1966	114
Home Improvement Schools—1946	104	Feedlot Runoff Program—1965.....	114
Broaden Building Programs—1950's	104	Irrigation Education—1967	114
Purify Pond Water—1950's	105	Water Management—1960's.....	114
Rural Water Systems—1950's.....	105	Irrigation Demonstration Farms—1969-77	114
Building Training for Agents—1950's-60's.....	105	Runoff Water Use—1971	115
Housing Programs—1950's-60's.....	105	Irrigation Emphasis Changes—1971.....	115
Obsolete Building Practices—1960's	105	Groundwater District Act—1972	115
Community Buildings—1960's-70's.....	105	Irrigation Programs—1970's-80's	115
Rural Construction Services—1966	105	Irrigation Reports—1977	115
Materials Program Objectives—1966.....	105	KS Irrigation Workshop—1978.....	115
Confinement Housing—1968	106	Emphasis Shift—1970's	115
Livestock Housing Facilities—1970's	106	Public Policy on Water—1980's.....	115
Design Rural Farm Homes—1970's.....	106	Water Quality Emphasis—1980's.....	116
Homesite Selection—1970's	106	Current Programs—1980's.....	116
Farmstead Planning—1970's-80's	106	Soil and Water Conservation	116
Feed/Grain Systems—1971	107	Promote Terracing—1930's.....	117
Lose Architect Position—1979	107	Establish Soil Conservation Service—1935	117
Livestock Waste Programs.....	107	Organize Soil Conservation Districts—1937	117
Waste Management Objectives—1972	107	Terraced and Contoured Land—1940-61.....	117
Broad Based Program—1972	107	Stubble Mulch Tillage—50's and 60's.....	117
Animal Waste Program—1972	107	Waterway Interest—1960's.....	117
Confined Animal Waste—1977.....	107	Watershed Districts—1961.....	117
Solar Energy	108	4-H Conservation Project—1961.....	117
Solar Crop Drying—1981	108	Erosion Control—1964-88.....	117
Grain Storage 108		Improve Terrace Design	118
Energy Conservation—1970's.....	108	Cost Share Specifications—1968.....	118
Grain Storage Volume—1970's.....	109	Conservation Structures.....	118
Greater Storage Problems—1970's	109	Water Quality Eras—1970-71, 1977-78, 1985-88	118
Larger Grain Storage Bins--1980's.....	109	Water Education for Teachers—1970's	118
Grain Quality Task Force—1983	109	Drinking Water Quality—1986	118
Evaluate Grain Storage—1983-88	109	Non-Point Project—1925.....	118
Milo Problems—1986	110	Farm Power and Farm Machinery	118
Temporary Grain Storage—1987	110	Deep Tillage—1935.....	119
Grain Management Handbook—1988.....	110	Concrete Soil Packer—1936	119
Land Reclamation, Drainage, & Irrigation.....	110	Weeders/Lister Attachments—1937	120
Drainage Program—1951	111	District and County Events—1938	120
Drainage Districts—1960's	111	Contour Farming Demonstration—1939	120
Irrigation Wells—1922	111	Power/Fuel Exhibit—1939.....	120
Water Resources Division—1927.....	111	Home Silage Cutter—1940	120
Irrigation Expands—1940's	111	Machinery Adjustment—1940's.....	120
Sprinkler Irrigation Systems—1940.....	111	4-H Machinery Programs—1940's	120
Form Inter-Agency Committee—1949.....	111	Farm Power/Machinery—1950's	121
Memorandum on Irrigation--1950.....	111	Feed Handling—1960	121
Organize Irrigation Development Farms—1950.....	112	Mechanical Hay Equipment.....	121
Greatly Expand Irrigation—1950's.....	112	In-Depth Welding Schools—1966	121

Tractor Noise Level—1971	121	USDA State Defense Board—Early 1960's	127
Select Machinery—1973	121	Alternate Extension Headquarters—1962	127
Hay Handling—1975-78	121	Succession in an Emergency—1962	127
Energy Conservation Program—1977	122	Extension Civil Defense Program—1963	127
Continue Energy Conservation—1978	122	Civil Defense Training—1963	128
Study Rotary Combines—1978	122	Floods in Southwest Kansas—1965	128
Alcohol As Fuel—1980	122	County Civil Defense Training—1966	128
Feed-Lot Truck Driver Operations—1980	123	Emergency Preparedness Week—1978	128
Cut Harvesting Losses—1981	123	Safety Emphasis	129
Crop Oils for Fuel—1981	123	Livestock Safety Education—1978-1980	129
Fuel and Machinery Efficiency—1982	123	Safe Tractor Driving Training—1980	129
Tractor Efficiency—1983-87	123	High Accident Rate in Agriculture—1981	129
Rural Electrification, Power, & Processing	123	KSU Ag Safety and Health Center—1981	129
Farm and Home Electricity—1930's	123	Hazardous Occupations Training—1984-86	129
Rural Electrification Administration (REA)—1935	124	Society for a Safer Agriculture—1985	129
Tent Shows and Meetings—1939	124	Specialist Time Lost—1985	130
Rural Electrification—1949	124	All Terrain Vehicle Safety—1985	130
Rural Electricity—1950's and 60's	124	Teach Farm Safety—1986	130
Extension Electric Programs—1950's	124	Expand Hazardous Occupation Training—1987	130
4-H Electric Leader Training—1952-88	124	Pesticide Safety	130
4-H Electric Project—1955	124	Integrated Pest Management—1976	130
Work With Electrical Utilities—1957-88	125	Aerial Chemical Application—1978	130
Extension Electric Program—1960	125	Aerial Fly-In Program—1978	130
Specialist to Civil Defense—1960	125	Training Manual Grant—1979	131
Energy Conservation—1970's	125	Aerial Applications—1979-83	131
Household Equipment—1970's	125	Herbicide Demonstration Plots—1979-87	131
Meetings/Clinics/Workshops—1970's	125	Pest Management Plots—1980's	131
Great Plains Program	125	Insecticide Demonstration Plots—1980-83	131
Farm Stabilization Programs—1965	126	KSU/OSU Fly-In Clinics—1980	131
Establish Demonstration Farms—1960	126	Personnel in Ext. Ag Engineering	Ch. 6: 31-34
Great Plains Program Objectives—1961	126		
Train For Industries—1961	127		
Rural Civil Defense	127		
Action for Civil Defense—1960	127		

The information that follows focuses on some of the educational activities and programs of Extension Agricultural Engineering. It should not be viewed as a comprehensive review of the Department.

Early Development in Engineering

The Commission on Country Life was appointed by President Theodore Roosevelt in August, 1908 and released its reports in January, 1909. The Commission identified the most prominent deficiencies of rural life in America at that time and proposed remedies.

It identified education in rural areas as one of the two or three great issues of the time in rural life and suggested the establishment of a nation-wide Extension work. Its many significant proposals included rural mail delivery, a Federal aided highway system, and farm to market roads.

Establish One-Person Department—1912

Against this background the Department of Highway and Irrigation was established when the Division of Extension was created October 30, 1912. At that time W. S. Gearhart, who had been appointed Highway Engineer September 1, 1909, was the only member of the department.

On April 4, 1917, Gearhart was transferred to the position of State Highway Engineer for the newly

created State Highway Commission, Topeka. The early program of the Extension Highway Engineer has been credited with having been instrumental in the establishment of the State Highway Commission.

At that time the name of the Highway and Irrigation Department was changed to "Department of Drainage and Irrigation" with H. B. Walker in charge. On January 1, 1920, the department was changed to "Drainage, Irrigation and Farm Engineering." The name was changed again on July 1, 1921 to "Department of Rural Engineering." The staff at that time consisted of:

Mark Havenhill, Extension Engineer, in charge.

Walter G. Ward, Rural Architect.

Dorothy Heartburg, Secretary-Stenographer.

A few student draftsmen working part-time.

The projects in 1921 were: drainage districts, farm drainage, farm irrigation, farm buildings, farmstead planning, water supply and sewage disposal, farm machinery, and miscellaneous.

In 1941 the name of the department was changed to "Engineering Extension."

At that time the staff and their areas of work were:

Walter G. Ward, Architect, in charge, Farm Architecture - farm building plans, painting, home conveniences, and community buildings.

Land Reclamation - soil conservation.

Hal F. Eier, Extension Engineer, Land Reclamation - soil erosion control, drainage, irrigation.

Harold E. Stover, Extension Engineer on military leave.

Walter M. Carleton, Extension Engineer, Land Reclamation, Soil Erosion Control., Rural Electrification.

Eugene D. Warner, Extension Architect part-time. Farm Architecture - farmstead planning, farm building plans, model building, painting, home conveniences.

John M. Ferguson, Extension Engineer. Land Reclamation - soil erosion control. Farm Power and Farm Machinery

By 1961 the Department of Engineering Extension's program was organized into four subprojects:

24A Farm Architecture

24B Land Reclamation

24C Farm Power and Farm Machinery

24D Rural Electrification

The staff and the percentage of time devoted to each of the subprojects were :

Name and Title	24A	24B	24C	24D
John M. Ferguson, State Ld	10	40	40	10
Harold E. Stover, Ag Engineer	—	20	20	60
Walter E. Selby, Ag Engineer	—	85	15	—
Leo T. Wendling, Ag Engineer	100	—	—	—
Dale E. Schindler, Architect	100	—	—	—
Russell L. Herpich, Irrig. Engr.	—	100	—	—
Donald J. Brosz, Irrig. Engr.	—	100	—	—
Floyd N. Reece, Ag Engineer	—	20	60	20
Lyndell W. Fitzgerald, Area Engr.	20	40	20	20

Farm Architecture-Structures

Walter Ward was employed April 1, 1920, as Extension Rural Architect to carry on a program begun by J. D. Walters, Professor of Architecture, at Farmers' Institutes.

Ward's work included farmstead planning, farm building plans, water supply and sewage disposal, and community building plans.

Building Construction—1920's-30's

During the early 1920's, the economic situation was at a rather low level. Therefore, building construction was confined largely to structures that would give immediate economic return such as poultry and hog houses.

A bulletin on "Farm Buildings For Kansas" and another on "Poultry Houses for Kansas" were prepared by Walter Ward in 1925.

In 1929, a modern farm kitchen and a water supply system were displayed on the Wheat Train operated by the Union Pacific Railroad in cooperation with the College.

By 1930, the Extension Architect had developed cooperative working program plans with other Extension Specialists, particularly with those in poultry and home economics.

The depression years of the early 1930's witnessed a sharp decline in farm building construction but a continued demand for assistance in poultry housing and equipment was met by the Specialist in Extension Architecture. An open-front, deep, straw-loft laying house with a capacity for 300 hens was recommended.

Some time was diverted to assist the Agricultural Adjustment Administration. In 1935, a program for termite control was developed with the Extension Entomology Specialist.

Standard Plan Service—1921

One of Walter Ward's first activities (1921) was to establish a set of standard building plans. A set of blueprints was provided for each County Extension Agent's office. Farmers could order individual building plans as needed.

By 1930, the standard plan service was being used by 45 other states and Canada. The number of plans distributed in 1929 was 5,235, in 1930 it was 4,977.

During the decade 1950 to 1960, the farm building plan service was expanded to participate in the Midwest Plan Service, a cooperative program in which several Midwest states participated.

A total of 7,715 plans were distributed in 1960.

Home Water and Sewage Systems—1923

In 1923, Walter Ward stated that only five percent of the Kansas farm homes were supplied with water and only three percent were equipped with bathrooms.

In 1925, farm water supply and sewage disposal demonstration equipment was mounted on a truck and used extensively to implement a program in this area.

The Portland Cement Association provided a truck and equipment to be used by their representative and the Extension Specialist to encourage use of concrete as a permanent building material.

Builders Schools—1926

Builders Schools for lumber dealers, builders, interested farmers and County Extension Agents were initiated by Walter Ward in 1926 in 14 counties. The purpose of the builders schools was to acquaint builders and materials dealers with the Kansas State College recommendations and plan service.

Usually one or more commercial representatives assisted with the schools. In 1943, a mat service for farm structures was started. In 1945, the builders schools were modified to include house remodeling and other farm building problems.

4-H Model Building—1935

Eugene Warner, appointed Extension Specialist in Architecture February 15, 1935, started a program of model-building among 4-H Club members. The 4-H members were taught many principles of building design and construction.

New Home Landscaping

A cooperative program between the Extension Specialist in Architecture and the Extension Landscape Specialist was carried out to improve the appearance of newly constructed farm homes.

Painting Demonstration—1937

Painting demonstrations were started by Gene Warner in 1937. A Ford Model T engine was converted to an air compressor for paint spraying. The equipment, mounted on a small two-wheel trailer, created much attention and aided in creating interest in the need for paint and its use to preserve farm buildings. A commercial sprayer was used in 1940.

Painting work was incorporated into other architectural work when Warner was transferred to the Department of Information in 1944.

The Better Homes Train, in cooperation with the Santa Fe Railroad, toured its system in 1937.

War and Post War Years—1940's

The war years, 1942-1945, brought about a decline of activity in the water supply and sewage disposal program due to a shortage of plumbing materials and skilled labor.

In 1945 and 1946, the program was resumed with leader training and special interest demonstrations. Representatives of the Portland Cement Association and the Kansas State Board of Health cooperated with the Extension Specialists.

Reports for 1949 state that 2,322 septic tanks and 2,780 water systems were installed.

Septic Tank Demonstrations—1940's

The first demonstrations on construction of septic tanks were conducted in the early 1940's. Water supply and sewage disposal received much attention.

Forms for septic tanks were frequently made available on a rental basis (\$10.00 usually) by County Farm Bureaus and lumber dealers.

The 1940 census reported that only one of each six farms in Kansas had running water. Leader-training meetings were held by the Extension Specialists. The program was stimulated by the extension of rural electric lines.

Home Improvement Schools—1946

In 1946, two two-day housing institutes were organized by C. R. Jaccard, Land Use Planning Specialist, and held at Salina and Hutchinson. Home improvement schools developed from these institutes, and the builders schools lost their identity.

In 1947, 22 farmstead and home improvement schools were held, one in each five-county block, with 8,285 persons attending. Cooperating in the conduct of these schools were the Extension Architect, Extension Engineer, Extension Home Management Specialist, Extension Landscape Architect, State Board of Health, and Portland Cement Association.

Broaden Building Programs—1950's

By 1950 architectural work had broadened to include grain storage structures, dairy barns, milking parlors, milk-rooms, beef structures and equipment,

barnlot arrangement, poultry housing and equipment, and minimum standards for housing to be financed by the Farmers Home Administration.

Leo Wendling, Extension Agricultural Engineer employed November 3, 1947, was the leader in the development of this broad program. During this period hundreds of trench silos were constructed.

Wendling and a representative of the Portland Cement Association conducted many demonstrations on construction of concrete-lined trench silos.

Special assistance was also provided for the Balanced Farming and Family Living program initiated in 1945.

Purify Pond Water—1950's

Following the drought years in the early 1950's, a demand developed for assistance in purifying pond water for household use. Extension Engineers and the Engineering Experiment Station research staff developed a filtering system that proved to be very satisfactory.

In 1957, two publications were issued: Purifying Pond Water and How To Build a Water Treatment System.

Rural Water Systems—1950's

During these years a cooperative plan for rural water systems was developed. Credit for construction of such cooperative water systems was available from banks and the Farmers Home Administration.

Several such cooperatives were organized in eastern Kansas where the farm water supply was often inadequate and the water needs had been met in the past by hauling.

Building Training for Agents—1950's-60's

During the decade 1950 to 1960, much emphasis was placed on training County Extension Agents so they would be able to give assistance to cooperators without waiting for a county visit by the Extension Specialist.

Housing Programs—1950's-60's

Leo Wendling was the leader in farm structures work and Dale Schindler, appointed Extension Architect May 1, 1955, was responsible for the program in housing. Much housing work was done in cooperation with the Extension Home Management Specialists.

Assistance was given County Extension Agents in rearranging or preparing plans for construction of County Extension Office space.

The Extension Retail Marketing Specialist was given assistance in food market layouts for more efficient use.

The 4-H Club woodworking project had 3,107 members enrolled in 1955.

Following a tornado near Topeka on May 19, 1960, the Extension Architects, other Extension Engineering Specialists and Home Furnishing Specialists devoted much time to assisting Agents and families in their repair and reconstruction program. A total of 44 families were given special assistance.

Obsolete Building Practices—1960's

Past building practices revealed obsolete building practices, a decided absence of relatively new building materials, out-dated facilities and space requirements by the 1960's.

This was especially true in rural areas where construction firms were small, often one person, without access to trade journals, manufacturers mailings, or membership in trade organizations.

Community Buildings—1960's-70's

Plans for assistance to rural communities by Dale Schindler, Extension Architect, was also part of the in-office program. This included 34 fairgrounds and fair buildings and 13 rural churches. There were 82 miscellaneous projects completed, including many recreational facilities, and County Extension offices.

Rural Construction Service

In 1966, Leo Wendling conducted an educational program for firms and individuals responsible for providing building materials and construction service to the rural areas of Kansas.

Materials Program Objectives—1966

The major objects of the program on building materials and construction were to provide technical information and planning that would:

- 1) Enable a builder to improve the quality and flexibility of a building without increasing the cost to the owner by using improved techniques and materials.
- 2) Enable a builder to reduce the cost of a building to the consumer without decreasing the quality of the building.

- 3) Prepare the builder to assist with the planning process and insure a standard of quality and space as determined by current research.
- 4) Encourage the inclusion of Emergency Preparedness shelters and related facilities for humans and livestock in the planning of homes and farm buildings.
- 5) Ultimately up-grade the quality and livability of homes and farm buildings in rural Kansas.

Confinement Housing—1968

Many field days were conducted on building pole barns and septic tanks.

In 1968, research indicated that buildings with a controlled environment had economic merit for poultry and swine producers in the northern part of the U.S.

The use of confined housing had real appeal to Kansas growers because of labor costs and the state's waste disposal law.

For these reasons, Extension Engineers were engaged in educational efforts for confined housing, use of slatted floors with manure pits underneath, ventilation, and supplemental heating and cooling.

Requests for advice were mostly from swine growers with farrowing houses and small pigs, since confinement housing was not proven entirely satisfactory for feeder pig operations. Interest in confinement housing of swine and chickens continued through the 70's and 80's.

Livestock Housing Program—1970's

In the 1970's, Kansas livestock producers built many new livestock facilities. In 1971, through educational activities in the farm building program, Extension Specialists had direct contact with approximately 725 swine producers, 450 beef producers, 30 dairymen, and 25 poultry and sheep producers, plus 125 agribusinesses serving the farm building construction and building materials industry in Kansas.

In addition, County Extension Agents throughout the state were working with approximately 2,500 livestock producers on building problems.

Through these contacts, farm producers were informed of recommended building designs, construction practices, the operational management of buildings, and farmstead layout improvements. In addition, 2,740 building plans were distributed and an unknown number of producers were provided

educational materials through various mass media channels.

It is estimated that the 1970-71 Extension educational program significantly influenced and improved the development of 200 swine production units, 125 beef production units, 20 dairy production units and 125 farmsteads.

Design Rural Farm Homes—1970's

Design of rural homes by Dale Schlinder was also a part of farmstead planning. In the ten years, from 1970-1980, the Extension Engineering office completed 576 individual projects, which included 89 new homes and 173 remodeled homes. A conservative value of the buildings was about \$2,645,000.

The consultation provided certainly was not the same as on-site work, but approximately 90 percent of this effort was directed to persons of low or moderate income who would otherwise have been unable to obtain architectural or engineering advice.

Homesite Selection—1970's

Lack of sufficient quantity and quality of affordable housing was a major problem in many Kansas communities. It was important that proper site selection was considered while trying to meet community housing needs.

Homesite selection information included a discussion of natural site conditions, soil limitations, regulatory considerations, and availability of facilities and services.

A publication entitled "Choosing a Homesite" was produced in July 1977. It contained a checklist of items to consider in selecting a homesite. Assistance was given to individuals attempting to develop land for residential tracts, on request.

Suggestions were offered relating to general site design, regulations which affected decisions, and efficient approaches to development.

Farmstead Plans—1970's-80's

Farmsteads of the past were built to produce a small volume of many different farm products. As farms became more specialized, productive farmstead arrangements were required that would be efficient for a specific need.

Throughout the 1970's and 1980's, an Extension farmstead educational program was developed to assist rural residents to plan and develop new or improved farmsteads that were efficient, economical and attractive business centers.

The goal of the program was to alert rural residents to the factors of feed and animal facilities, pollution abatement, building location, weather protection, future planning access, topography, and odor control so that the producers could obtain the maximum benefit from their farmsteads.

Feed /Grain Systems—1971

The development and construction of improved feed and grain storage, treatment, processing and handling systems was the main emphasis at eight public meetings with 360 people present.

Mass media was used with three statewide news

releases, two radio programs, and one television program.

It was estimated that over 100 producers made improvements using ideas and information from the Extension Service.

Lose Architect Position —1979

The unfortunate early retirement (1979) of the Extension Architect, Dale Schindler, with an accompanying hiring freeze, reduced the ability of Extension Engineering to adequately serve and service clientele who had a need for home planning, home remodeling, or to make problems solving farm visits or office conferences.

Livestock Waste Programs

In 1972, Leo Wendling and Pat Murphy, were delivering livestock waste educational programs as a result of a state livestock pollution law passed in 1966.

From a production viewpoint, improper waste management contributed to animal disease and health problems. Handling animal waste was a labor and cost item, and the wastes caused odor, fly, and dust problems.

Waste Management Objectives—1972

The objectives and goals of the Extension waste management education program were:

- 1) Keep the livestock producers informed regarding their responsibility to the public.
- 2) Provide information about needed non-pollution animal waste handling and disposal systems.
- 3) Inform the public about facts regarding animal waste pollution and actions being taken by producers.
- 4) Consult with, and assist through educational means, all governmental and regulatory agencies.
- 5) Encourage research.

Broad Based Program—1972

To accomplish these goals, Extension Engineers in the farm structures, irrigation, and electrification fields conducted a broad based program of educational activities and events.

Animal Waste Program—1972

On a county basis, in cooperation with County Agricultural Extension Agents, systems of animal waste management that were recommended and approved by Extension Engineering Specialists were installed in approximately 75 Kansas counties in 1972.

Extension Engineering Specialists provided plans and served as consultants to the livestock producers in the establishment of these demonstrations.

A 1972 livestock waste seminar, attended by 250 livestock feeders, included presentations on Swine Waste Handling Systems, a progress report on KSU livestock Waste Management Research, Cattle Feedlot Waste Management Systems in the Region, and the Rural Environmental Assistance Program (REAP) Animal Waste Management Program.

Confined Animal Waste—1977

A continued increase in the number of animals confined within an enclosed structure brought about new animal waste management problems.

Animal waste, when improperly handled inside a building, can create a hazard to both man and animal. Gases such as ammonia, carbon di-oxide, hydrogen sulfide and methane are produced from manure undergoing decomposition.

In 1977, working with County Agricultural Extension Agents, Extension Livestock Specialists, and Extension Veterinarians, public meetings and

workshops on animal Waste Management were conducted in 32 counties.

Extension Engineering Specialists presented animal waste management system design and operation information to 1,500 producers.

Animal waste management demonstrations were established in 15 counties. A new problem area that emerged in animal waste management was air pollution or odor control.

Solar Energy

Through joint efforts with the Washington County Extension Agent, Garry Keeler, a solar energy demonstration project coordinated by James (Pat) Murphy and Charles Spillman, compared the energy consumption of a conventional 36-sow farrowing house with a solar heated 36-sow farrowing house.

Electrical and propane usage were monitored periodically on both buildings. The solar unit also had the capability to use its heat storage to cool the building during extreme hot summer temperatures.

Results indicated a fuel savings of 60 per cent with the solar unit. This fuel savings amounted to 1,400 gallons of propane per winter.

The economic return of the unit approached a break even point with 1988 propane prices. Experiences gained with construction materials and electrical systems were used to further improve the design of later units.

Nine solar heating demonstration projects were constructed and used for heating during the winter of 1980. Data were gathered on each of the collectors to ascertain the amount of heat that the collectors delivered throughout the winter.

Solar Crop Drying—1981

The Extension Agricultural Engineering Department, through the efforts of John Anschutz, received a USDA-SEA (Science and Education Administration) sponsored grant to demonstrate the economic and technological feasibility of using solar energy for crop drying in 1981.

Ten grain producers throughout the State were selected to participate in the demonstration project. All demonstration sites utilized multiple use collectors to improve economic viability.

An energy efficient, drip cooling method to cool lactating sows was developed by KSU Extension Engineer James (Pat) Murphy. The equipment was demonstrated at the 1986 KSU Swine Day to 700 producers. The drip cooling method was also installed at 21 on-farm demonstrations.

Weight maintained by the sow, plus additional weight gained by the litter, was worth \$35 per farrowing sow. The drip cooling method also reduced electrical consumption required for conventional evaporative coolers and exhaust fans by \$20 per crate.

Surveys indicated that 10,000 Kansas swine producers had adopted the drip cooling method.

Grain Storage

During the 1950's and 60's, programs in the grain post harvest area focused on using electricity for grain drying and handling. These programs stressed effective use of electricity and the importance of selecting the proper equipment.

Mechanical grain handling equipment was introduced to the farm, and grain drying programs were developed as engineers better understood the relationships between grain losses and moisture content.

Typically, wheat is not dried on the farm, so attention was given to maintaining a quality product through proper aeration during storage.

Energy Conservation—1970's

Energy conservation as applied to grain drying became the focus of post harvest programs in the 1970's. Grain drying energy conservation programs developed by Elywn Holmes and Dennis Kuhlman focused on natural air and low temperature drying.

Low temperature drying reduced the energy requirements 40 percent as compared to conventional high temperature dryers. Two sites were developed to demonstrate the use of solar collectors to provide the necessary heat energy for low temperature drying.

Holmes conducted many workshops on natural air drying, stressing the advantages, but cautioning producers about the management requirements with this drying technique.

Kuhlman developed programs and publications on aeration and temperature monitoring equipment.

Grain Storage Volume—1970's

In the 1970's, on-farm grain storage in Kansas was increasing, stimulated by grain supplies, prices, and agricultural policies. Many grain producers who were developing sizable grain storage systems had only limited experience with large volume and long-term grain storage.

To minimize grain losses in storage and to insure the development of efficient on-farm grain storage systems, an expanded educational program stressing the planning, design and in-storage management of farm-stored grain was initiated by Extension engineers, grain science, entomology, and economics Specialists.

Extension engineers in 1978 presented information on grain storage system development and management at field days, public and special interest meetings, and workshops in 41 counties during the year.

Approximately 2,000 grain producers attended these meetings. In addition, approximately 500 producers received consulting service on grain storage systems or grain storage problems via farm visits, correspondence, and phone calls with Extension Specialists.

Publications covering grain handling, grain drying, aeration of grain in storage, and energy conservation in grain storage were prepared, up-dated and distributed statewide through the county Extension offices.

Mass media, the press, radio, and television were used to make producers aware of possible problems and head off possible storage losses.

In the late 1970's, producers placed more grain in on-farm storage. Department of Agriculture loan programs provided a potential for increasing the lengths of the storage period.

Greater Storage Problems—1970's

There was a trend toward earlier harvesting of grains which lead to placing grain into storage at higher moisture contents. Producers had limited

experience with storing wet grain and longer grain storage time.

The potential for excessive in-storage grain losses prompted the planning and delivery of an expanded grain storage educational program thrust in 1979.

Grain quality became the focus of the post harvest programs in the 1980's. There were 913 million bushels of grain stored off-farm and 400 million bushels stored on farm.

Larger Grain Storage Bins—1980's

Producer interest in constructing and managing farm storage continued. New bins held 5,000 to 10,000 bushels and were larger than old facilities which held less than 3000 bushels.

Producers realized storage management in large bins was different than in small bins and flat storage. Large volumes of grain in the metal bins created moisture migration problems, which in turn encouraged more problems with spoilage and insect infestation. These factors led the Extension Engineering Specialist to give emphasis to aeration system design and best management practices.

Surveys showed most producers lost five cents per bushel during storage due to insect, mold or other storage losses. These data showed Kansas farmers were losing 20 million dollars per year during the storage of grains.

Grain Quality Task Force—1983

Buyers of Kansas grain products were concerned about the quality of grain leaving Kansas. A KSU Extension Grain Quality Task Force was developed in 1983. This group was composed of representatives from Agricultural Engineering, Entomology, Agricultural Economics, Administration, Plant Pathology, Grain Science and Industry, and the USDA Grain Marketing Research Laboratory.

The Grain Quality Task force was chaired by Hyde Jacobs from 1983 to 1987 and then co-chaired by Randall Higgins and Joe Harner.

Evaluate Grain Storage—1983-88

From 1983 to the present, over 75 extension meetings were held related to grain storage. These meetings were attended by over 1000 producers.

During some of the meetings a survey was distributed and its results found producers felt they profited by 7 cents per bushel of stored grain from

more effective aeration, usage of chemicals, and prevention of storage losses.

These were jointly conducted by Agricultural Engineering, Entomology, Grain Science and Industry, and the local county extension office.

Sprouted Milo Problems —1986

Sprouted milo at harvest in 1986 sent producers in eastern Kansas scrambling for information. Agricultural Extension Engineers provided information on natural air, low temperature, and in-bin drying and cleaning of milo.

Temporary Grain Storage —1987

In 1987 a bumper fall grain harvest resulted in Agricultural Extension Engineers being busy designing temporary storage structures. Two publications were developed, and five special meetings were conducted, to warn farmers about the loads created on shop walls if grain was piled against the sidewall.

Over a 30 day period, Joe Harner and Pat Murphy handled over 100 calls related to converting an existing building to temporary storage.

Grain Management Handbook—1988

A 200 page handbook, "Stored Grain Management," was developed and released in 1988 for County Extension Offices and ASCS offices. This handbook included information on marketing, aeration, insects, molds, safety, and sampling.

Approximately 15 additional extension publications were developed related to grain drying and handling by members of the task force. Engineering information related to drying and storing of soybeans, corn, grain sorghum, wheat, sunflowers, and canola was developed for various interdisciplinary publications.

Land Reclamation/Drainage/Irrigation

The first drainage work was done by W. S. Gearhart, Extension Highway Engineer, as drainage was a factor in the construction and maintenance of highways.

Later H. B. Walker, Extension Drainage and Irrigation Engineer, continued drainage work, which consisted of only a few projects brought to his attention through contacts at Farmers' Institutes and by County Extension Agents.

The cost of tile was high and farmers' finances were low; therefore much of the drainage work was by the open-ditch method. In 1922, Mark Havenhill, Extension Engineer, reported that drainage plans were being prepared for 18 projects involving about 3,000 acres. County Extension Agents reported about 800 acres actually drained.

Drainage Program—1951

Following the first drainage work by Extension Engineers, no extensive program was undertaken until the high rainfall and flood year of 1951. In the Kaw River Valley, particularly, much crop land was covered with a layer of sand following a July flood.

Approximately 500 acres of such sand covered land was "deep plowed" to incorporate the sand with the good loam soil. During the following year approximately 33,270 acres of valley land was leveled to make it suitable for cultivation and 8,500 acres were deep plowed.

Interest in drainage by open ditches increased and 65,460 acres were so handled in 1953.

Drainage Districts—1960's

Organization of drainage districts also commanded the attention of the Extension Engineers. In the 1960 report the Extension Specialist stated:

Kansas has no large areas in need of drainage for reclamation. However, some drainage work is needed in many areas to make it possible to accomplish timely seedbed preparation, seeding, cultivating, and harvesting in normal or wet years.

Drainage problems are encountered in areas being developed into irrigation projects.

Irrigation Wells—1922

In 1922, Havenhill stated that irrigation work was largely in the central part of the state with Harry Baird, County Extension Agent in Ford County, showing the greatest activity.

Water from wells was the primary source of irrigation water. Seventeen projects were given assistance, six of these in Ford County. County Extension Agents reported about 300 additional acres were placed under irrigation during the year.

From 1923 to 1935 only a small amount of work was done on drainage and irrigation. A few demonstrations continued to show the value of both drainage and irrigation.

In Geary County in 1926, irrigated alfalfa produced 3 3/4 tons per acre while unirrigated yields were only 3/4 tons.

In 1927, in Leavenworth County, a drainage project paid for itself with the crop saved during the wet season.

In 1935, after a series of dry years, some interest in irrigation for gardens developed in the western part of the state.

In 1936, County Extension Agents reported that 310 farms had installed irrigation systems for 6,725 acres, a substantial increase over the previous year. There was interest wherever water was available for irrigation.

In the Garden City area, irrigation gradually grew because of the production of sugar beets under the supervision of the beet company.

Extension Engineers and County Extension Agents established six irrigation demonstrations. They also assisted with 11 irrigation meetings with 264 farmers attending, and 16 leader-training meetings for 422 leaders.

Drainage work was confined to areas along rivers subject to overflow. One small drainage district was recommended in 1937. The amount of interest depended on the season.

Water Resources Division—1927

The Division of Water Resources in the State Board of Agriculture was established in 1927. The State Board assigned an Irrigation Engineer at Garden City to observe and record underground water levels as well as the water supply from the Arkansas River. He also provided technical assistance to farmers.

Irrigation Expands—1940's

By 1940, the irrigated acreage in the state was reported at 178,000 acres. Extension Engineers, under the leadership of Hal Eier, had developed a strong educational program for farmers interested in irrigation.

Seventy-four meetings with an attendance of 2,336 were held during 1940. Discussions centered around the underground water supplies, suitability of water for irrigation, land leveling, and application of water.

During the decade, 1940 to 1950, irrigation continued to grow steadily. Concrete lined ditches, underground concrete pipe, siphon tubes, gated pipe, and sprinklers for rough or sandy land came into more general use.

Hal Eier resigned June 16, 1942. He was succeeded by Robert White who served from July 10, 1942 to September 10, 1944. Walter Selby was appointed October 29, 1944 as Extension Agricultural Engineer. Selby devoted a portion of his time to drainage and irrigation.

Interest and work in drainage remained at a rather constant level, varying with the seasons, wet or dry. The Federal program for development of the Missouri River basin had progressed so that it was evident that water from reservoirs constructed, or to be constructed, would be available for irrigation on northern Kansas farms.

Sprinkler Irrigation Systems—1940

The first sprinkler systems were being used in Kansas in 1940. Additional land placed under drainage systems totaled 23,263 acres on 470 farms.

Form Inter-Agency Committee—1949

In 1949, an Inter-Agency committee was formed to study the means by which an educational program for the efficient use of irrigation water might be most effectively carried to the farmers of northern Kansas who would use water from the reservoirs for irrigation.

It was agreed that the committee's goals could be accomplished effectively by sponsoring and establishing irrigation development farms in appropriate areas.

Memorandum on Irrigation—1950

A Memorandum of Understanding was developed between the Bureau of Reclamation, the Soil Conservation Service and Kansas State University.

A Technical Committee was to be created to develop a practical farm agreement and promote an appropriate research and Extension educational program.

Billy Bryan was employed as Extension Irrigation Engineer on February 15, 1951, to work with the Technical Committee.

Irrigation Development Farms—1950

The first irrigation development farm was established in 1950 in the Smoky Hill River valley below the Kanopolis Reservoir on a farm three miles northeast of Lindsborg, owned and operated by H. A. Malm and son.

The farm was organized, and the cropping system developed, to support 60 head of cattle. A small amount of research was done on a field scale and

included response to variety and plant population, a desirable length-of-run for furrow irrigation, and a desirable width and length-of-run for border application of water. Carefully kept records included precipitation, amount of water applied and the yields of the various crops.

Early in 1952, a second development farm was established with Raymond Kutina of Ellis, located below the Cedar Bluffs Reservoir. A third development farm was started in the spring of 1952 on a farm operated by Dean Hanson of Jamestown.

This is just south of the area to be included in the Bostwick Irrigation District which was scheduled to receive water from the Harlan County Reservoir in Nebraska but it served as a demonstration farm until a farm was selected within the Bostwick district.

Early in 1954, the fourth irrigation development farm was started on land owned by Mrs. Henry Kaser and operated by her son, Wayne Kaser, on the South Fork of the Solomon River three miles east of Osborne and below the Kirwin Reservoir.

Early in 1955, the fifth irrigation development farm was started on land operated by Calvin Hobson, six miles west of Republic. This farm was within the Bostwick Irrigation district and received water from the Harlan County Reservoir.

This farm had 265 acres of irrigatable land on which crop and beef production programs prevailed. Water from the reservoir became available August 4, 1955.

In 1956, the sixth irrigation development farm was that of Bernard Vohs, seven miles downstream from the Kirwin Reservoir.

A seventh irrigation demonstration farm was organized in 1962 on the Jerome Shaffer farm, Simpson, in the Glen Elder Project Area.

Greatly Expand Irrigation—1950's

Irrigation districts were organized in each area represented by the irrigation development farms, and in addition the Almena District which was to have water available from a reservoir to be constructed on Prairie Dog Creek in Norton County.

By 1955, the irrigated acreage in Kansas had greatly increased, to 548,683 acres. The development of irrigation practices included sprinkler application, use of gated surface pipe, underground irrigated pipe lines, a new type head control structure,

inclusion of horticultural crops in irrigation programs, emphasis on safety around pumping machinery, and training schools for Extension and other agency personnel.

Newly irrigated land was located in many portions of the state other than around the irrigation development farms; Wichita County, the southwest counties and Kaw Valley being the leaders. In 1957, 101 counties reported some irrigation.

Specialty crops such as cantaloupes, strawberries, onions, tomatoes, root and leaf crops, grass seed and hybrid sorghum seed, were grown in the western sections of the state.

By 1960, irrigated acreage had increased to 1,007,724 acres. All but seven counties of Kansas reported some irrigated acreage. Some of the acreage was "in and out" for irrigation depending upon the season, availability of labor or other situations.

Organize Irrigation Districts—1950's

Five irrigation districts were organized, namely: Kansas-Bostwick, Kirwin, Webster, Cedar Bluffs, and Almena. The Kanopolis District was in the process of organization and was to be completed by mid-1961.

Educational Thrusts—1960's

Three major educational thrusts were utilized; the use of flow measuring equipment, installation of underground pipe for water conveyance and use of grated pipe.

It was estimated that 2.5 million feet of underground pipe existed and one quarter of all irrigation water was in gated pipe.

Ten irrigators were known to use flow meters.

Irrigation Program Objectives—1960

The 1960 objectives of the Extension irrigation program included:

- 1) Proper land development.
- 2) Choosing crops to fit the land.
- 3) Planting at the proper rate.
- 4) Using adequate amounts of needed fertilizer.
- 5) Applying water timely and in sufficient quantities.

These practices produced outstanding yields for that time, such as these on the Webster farm: 34 tons of corn silage per acre, 155 bushels of corn and seven tons of alfalfa hay.

Irrigated Crops—1960

The use of irrigated land by crop was: 33 percent for grain sorghum; 23 percent for wheat; 17 percent for corn; 11 percent for forage sorghums; 7 percent for alfalfa; one percent for vegetables; and 7 percent for all other irrigated crops which included sugar beets, pasture grasses, grass seed, fruits, potatoes and miscellaneous.

Corn Plant Population—1960

The KSU research program developed the "geometric pattern" of planting corn. Studies showed that one corn plant on each 20 by 12 inch rectangle produced the highest yields in 1960. (Plants at 12 inch intervals in 20 inch rows.)

Irrigation Educational Materials—1960

Educational materials prepared by the irrigation Engineers included a bulletin "Irrigation Farming for Profit," a circular "Water Control Structures," a leaflet "Irrigate When Corn Needs It Most," a slide rule "Planting Guide for Corn and Sorghums," feature stories for leading magazines and newspapers, news stories for local newspapers, radio talks, and television programs.

Donald Brosz was appointed Extension Irrigation Engineer, an additional position, on August 1, 1960. He resigned November 30, 1962 to join the Wyoming Extension Service.

Donald Miles was appointed to succeed Brosz on January 7, 1963. Miles resigned August 14, 1965 to join the Colorado Extension Service.

Irrigation Program—1950's & After

Russell Herpich began his career on July 9, 1951 as an Extension Engineer, a position he held until his death on March 16, 1974. He briefly interrupted his service from September 1, 1952 to July 20, 1953 to finish graduate studies at KSU.

Herpich was instrumental in organizing extension educational programs and promoting irrigation development. Irrigation demonstration farms were a key component of this effort.

Frederick Bergsrud served as Area Extension Irrigation Engineer from June 15, 1964 to February 28, 1969, then left to join the Minnesota Agricultural Extension Service.

Lynn Shuyler was also an Extension Irrigation Engineer during this time, September 27, 1965 to August 17, 1971. He was employed by the Environmental Protection Agency in Oklahoma.

David Pope, Sept. 8, 1971 to June 17, 1976; and DeLynn Hay, Oct. 4, 1971 to June 30, 1981; along

with Russell Herpich, served as Extension Irrigation Engineers.

Hay was the first area based Extension Irrigation Engineer and was located at Colby, Kansas.

Pope, originally stationed in Manhattan, transferred to the Garden City area office on August 1, 1973.

DeLynn Hay replaced Herpich as Extension Irrigation Engineer in 1974.

Elmer Zerr became the Northwest Area Extension Irrigation Engineer on July 1, 1975. He left to become a consulting engineer on April 19, 1977.

For over two decades, an intensive educational program by KSU extension irrigation engineers was conducted to attain the full development, wise use and responsible management of land and water for irrigated farming, irrigation demonstration farms, irrigation field days, irrigation tours, on-farm schools and educational meetings.

Extension Irrigation Engineers were extensively involved with various surface and groundwater irrigation organizations.

State Irrigation Federation—1964

By 1964 over one million acres were irrigated in Kansas and 24 locally organized irrigation associations or irrigation districts had been formed.

Representatives from these organizations felt a need to organize a state federation to serve the interests of all Kansas irrigators. In April of 1964, such an association was formally organized.

Additional goals were to assist the Kansas Cooperative Extension Service with educational programs and to sponsor other programs and tours.

Promotion of irrigation development continued to be emphasized, but educational efforts to promote irrigation efficiency increased.

SC Kansas Irrigation Program—1964

Early in 1964, an Irrigation Development Program was established in South Central Kansas. It came as a result of requests from a locally-organized Irrigation Development Committee.

Members were aware of the irrigation potential in the area, and were interested in capturing economic and social benefits for the total area.

The program was designed to provide the educational leadership essential for developing public knowledge about the total benefits from irrigation farming in Reno, Stafford, Pratt, Kiowa, Barton, Rice, Pawnee, and Edwards counties.

SC Kansas Program Objectives

The specific objectives of the program were to:

- 1) Fully develop 500,000 acres of irrigation farming in the area.
- 2) Train a community of irrigation farmers to understand the technical phases of irrigation, and to apply the best known, most successful irrigation farming practices.
- 3) Develop appreciation and understanding among citizens of the necessity for responsible management of the water resources.

SC Irrigation Teaching Center—1966

Since experience had been gained with educational programs for irrigation development in North Central Kansas through the Kansas Irrigation Development Farm Program, the methods found successful in that program were incorporated into the general outline of the program for Irrigation Development in South Central Kansas.

The Richard Spencer farm in Stafford County served very effectively as a teaching and demonstration center for the area. Annual tours were held on the farm for interested irrigators.

In 1966, 350 people visited the farm to observe the irrigation program. Both gravity and sprinkler irrigation were demonstrated, as well as proper use of land grading and underground pipelines, solid set sprinkler irrigation, and a highly successful double-cropping program.

Irrigation Tour—1966

In September, 1966, a ten farm irrigation tour was held in which successful irrigation farming practices were shown. Nearly 300 interested irrigators in the area attended this tour.

Feedlot Runoff Program—1965

Legislation relating to the collection and partial management of runoff from feedlots in Kansas created a need for the development of systems for collecting and disposing of feedlot runoffs.

A demonstration project was designed and carried out in cooperation with the Pratt Feedlot Company.

Irrigation Education—1967

The continued expansion of irrigation farming in Kansas created a need for intensive education programs designed to contribute to the full development, wise use and responsible management of the water resources available for irrigation within the state.

In 1967, the Extension Irrigation Education Pro-

gram focused upon four projects:

- 1) Irrigation water measurement.
- 2) Tailwater recovery systems.
- 3) Groundwater management districts.
- 4) Management of feedlot run-off.

Water Management—Late 60's

Three areas of the state had withdrawal of groundwater in excess of the normal recharge to the aquifer by the late 1960's. Responsible management of the resource for the long-time economic life of the agricultural industry in the area became more of a concern.

Education to maximize economic and social benefits from water were undertaken in two areas:

- 1) Development of legislation permitting local regulation and management of water.
- 2) Broadening public knowledge of the value of the economic benefits from using water and the nature, extent, magnitude, and characteristics of the resource.

As a result of educational meetings and discussions, proposed legislation was presented to the 1968 session of the Kansas Legislature

Irrigation Demonstration Farms—1969-77

An irrigation demonstration farm program was initiated in Harvey County with two cooperating farm operators - one, Clinton Holderman, using a sprinkler system, and the other, Eugene Wolf, a gravity system.

By 1970, over 1.8 million acres in Kansas were under irrigation and rapid increases were still underway. In northwest Kansas, efforts were underway to organize an irrigation demonstration farm for the area underlain by the Ogallah formation.

The LeRoy Everett farm near Goodland, Kansas was selected as the demonstration site. Irrigation demonstration farms at Goodland in Sherman County, two in Harvey county, plus ten others that are no longer formal cooperative efforts served as focal points of educational events.

During the 1970 crop year nearly 3,000 persons attended demonstrations held at these farms.

Runoff Water Use for Irrigation—1971

Traditional irrigation programs were organized in irrigation districts. Water was supplied from reservoir storage or groundwater areas.

This was changed in 1971 when Southeast Kansas became a focus of educational programs.

Annual runoff in the Southeast region was high. Therefore runoff could be stored for irrigation during summer drought periods.

A water management demonstration farm near McClure was established to show procedures and methods for managing land and water resources.

Irrigation Emphasis Change—1971

However, the overall emphasis was beginning to change from mostly promotion and development to management and consumption. Several surface water districts experienced water shortages. Water tables were declining in highly developed groundwater areas.

Groundwater Management Dist. Act—1972

The Kansas Groundwater Management District Act was passed by the 1972 legislature. Extension Irrigation Engineers were actively involved in an educational meeting to explain the Act, the purpose of a Groundwater Management District (GMD), and the formation procedures.

By 1976, five GMD's were organized covering the major irrigated areas in Kansas.

Irrigation Programs—1970-80's

Wise and efficient irrigation water use became the emphasis of Extension educational programs.

Rising energy costs required programs for maintaining pumping plant efficiency and comparing irrigation fuel alternatives. Cooperative educational programs and demonstrations with newly formed Groundwater Management Districts (GMD) were common.

Pope left Extension to assume the position of Manager of GMD No.3.

James Thomas became Southwest Area Extension Irrigation Engineer on August 18, 1976 until February 21, 1983, when he joined the Mississippi Extension Service.

Thomas conducted an Extension demonstration program in six counties of southwest Kansas and also cooperated with Groundwater Management Dist. No. 1 in a concentrated irrigation management area emphasizing water measurement and soil moisture monitoring, both components of an irrigation scheduling program.

Irrigated acreage now exceeded 3 million acres, but declining water levels in some areas required reductions in irrigated acres and crop changes.

Irrigation Reports—1977

Danny Rogers became Northwest Extension Irrigation Engineer on June 1, 1977.

In a cooperative program with Groundwater Management Dist. No. 4 and northwest area farmer volunteers, over thirty irrigated fields were monitored for up to four growing seasons with water measurement and soil water monitoring devices. Annual reports of irrigation water use, production information, and yields were prepared.

The program provided basic information about the ranges of practices being employed, and demonstrated the importance of the measurement devices.

Statewide pumping plant efficiency programs were being conducted at this time. Rogers prepared an Evapotranspiration Report (ET) for Northwest Kansas irrigators.

Kansas Irrigation Workshop—1978

In 1978, DeLynn Hay organized a state wide irrigation school, known as the Kansas Irrigation Workshop.

Water Plan—Late 1970's

Radio broadcasts and newspaper reports presented crop water use information to farmers for scheduling irrigation.

A shift from the developmental phase of the irrigation industry in Kansas to a maintenance and conservation phase also shifted the emphasis of extension educational programs. Water use and supply issues for all classes of users - municipal, industrial, power generation, etc. - were becoming more apparent.

Extension Irrigation Engineers became more involved with water resources management, not just irrigation water, water quality and water policy programs.

Richard Black became Extension Irrigation Engineer on June 18, 1982. Water resources were a major political topic at the time.

Public Policy on Water—1980's

Public policy meetings were conducted throughout the state, with Black, Thomas, and Rogers joining with other Extension personnel in agricultural economics to present the issues and prepare the bulletin, Who Will Control Our Water Supply.

Water Quality Emphasis—1980's

By the mid 80's, Black shifted the emphasis of his educational programs to water quality issues.

Rogers, after returning from sabbatical leave in 1988, was transferred to Manhattan. He and Black continued to provide Extension educational programs

for irrigators in irrigation water use efficiency, system design and energy use.

Current Programs—1980's

Sprinkler package options, surge flow irrigation and drip irrigation for commercial grain production

as well as for horticulture crops were irrigation topics in 1988.

Water quality concerns were high priorities, with household water quality and non-point source pollution concerns receiving special emphasis.

Soil and Water Conservation

In the 1922 Extension report Mark Havenhill, Extension Engineer in charge of the Department of Rural Engineering, said:

Terracing - This is one of the new lines of work undertaken. There is plenty of need to work. One set of terraces was laid out in Leavenworth County but the farmer refused to carry out the program when he found that it would necessitate plowing up some of his crops.

The Extension Engineer cooperated with Mr. Ira L. Plank, teacher of vocational agriculture in the Winfield High School in surveying about 40 acres of the Dr. Kelley farm for terraces. A start was made on their construction but work was discontinued on account of rain. The high school boys expect to complete the work, however, as soon as possible.

On January 20, 1925, Claude Shedd, Extension Engineer, was employed to succeed Mark Havenhill who had resigned August 31, 1924. Claude Shedd added much emphasis to soil erosion control by the use of terraces and soil saving dams, thus pioneering this program.

In 1925, 24 terrace demonstrations involving about 400 acres were established in 11 counties. County Extension Agents reported terracing and soil saving dams on 43 farms, protecting 913 acres from erosion.

In the 1927 report, Claude Shedd related the experience of H. W. Miller of Brown County who terraced some land that was so badly eroded it was not profitable for cultivated crops. Two weeks after terracing a three-inch rain caused no erosion of the field. A 20-bushel wheat crop was produced the following year.

Instruction was given five farmers in Jewell County after they purchased a farm level for use to determine where terraces should be located. Another farmer in Jackson County and two County Extension Agents were trained to locate terraces.

A bulletin on "Terracing Farm Lands in Kansas" was prepared by Extension Specialist Shedd in 1927.

Terrace construction demonstrations were used to emphasize the need for broad base terraces high enough to give proper protection against erosion caused by heavy rains.

John Glass was employed as Extension Engineer October 1, 1928 to succeed Claude Shedd who resigned September 30, 1928 to accept a position with the University of Missouri. Glass enthusiastically promoted soil erosion control work, and in 1929 reported that 100 demonstrations had been in operation long enough to be of value as a teaching method.

Earle Cole in Doniphan County, an engineer-farmer, worked with the Extension Specialist in laying out terraces and assisted others with this work on a commercial basis.

Promote Terracing—1930's

The John Deere Plow Company, the International Harvester Company, and vocational agriculture teachers cooperated freely in conducting terrace construction demonstrations. The Corsicana Grader Company of Corsicana, Texas, loaned one of their terracing machines for demonstration purposes.

In 1930, John Glass reported that 279 farmers had been trained for terrace survey work, and these leaders assisted 483 other farmers to terrace 11,976 acres with the aid of County Extension Agents in 18 counties.

A program of soil erosion control needed no campaigning in counties where successful demonstrations had been established, according to Glass. Succeeding years brought continued success.

A summary report in 1936 gave a total of 136,987 acres terraced by individual Kansas farmers. Only 23,305 acres of the land protected by terraces was farmed on the contour. On the other hand, 66,663 acres were farmed on the contour without the added protection of terraces.

Establish Soil Conservation Service—1935

The Soil Conservation Service created by an act of Congress in 1935, established demonstration areas in Allen, Franklin, Jewell and Seward Counties. As soon as these demonstration areas were in operation they were used extensively for tours and field demonstrations by Extension Specialists, County Extension Agricultural Agents and personnel of the Soil Conservation Service.

Organize Soil Conservation Districts—1937

The Kansas legislature provided for the organization of Soil Conservation Districts under the direction of a state committee in 1937. The organization of Soil Conservation Districts proceeded rapidly under the supervision of L. E. Willoughby, Extension Agronomist, and the Engineering Specialists.

The State Conservation Committee desired that each County be a District. Concurrently with the organization of Soil Conservation Districts, a strong educational program was continued to train farmers in terrace layout, terrace construction and maintenance, and the value and place of contour farming.

Terraced and Contoured Land—1940-61

By 1940, 446,248 acres of cropland had been terraced in Kansas with 199,315 of these acres also being farmed on the contour. Another 487,924 acres were farmed on the contour but not terraced. Terrace demonstrations were conducted in 46 counties and contouring demonstrations in 10 counties in 1940, with a total attendance of 2,470 persons. Leader training schools were continued in 70 counties with 1,495 men attending.

By 1961, 5,768,051 acres had been terraced and 3,924,401 acres farmed on the contour. Soil Conservation Districts were active in all 105 counties.

Stubble Mulch Tillage—1950's- 60's

Extension Engineers worked closely with Extension Agronomists and other disciplines to develop a coordinated educational program for stubble mulch farming during the 1950's and 60's and conservation tillage for a broader range of crops in the late 1970's and throughout the 1980's.

The primary areas of engineering input included improved water management, erosion control and equipment selection, adjustment, and use.

Waterways—1960's

There was a need for adequately protected wa-

terways to increase the establishment of diversions, terraces, contour farming and strip cropping in many counties.

Watershed Districts—1961

Interest in Watershed Districts as a means of securing more effective water conservation, erosion control and flood abatement had developed. Five pilot and 117 voluntary watersheds were in operation, and a total of 45 watersheds had been organized under the provisions of the Kansas watershed district law. Ten watershed districts were organized during 1961 and 14 were pending.

Dirt-moving contractors became established in many counties and Extension Engineers worked with the contractors' association to promote construction standards.

4-H Conservation Project—1961

Seventy-one counties had 302 4-H Club members enrolled in the 4-H soil and water conservation project; 55 counties selected county champions. Wilfred Lehman, of Leroy, was selected as the State Winner in the project in 1961.

Erosion Control—1964-88

Water and wind erosion continued to be a serious problem in some portions of Kansas. Extension Engineering expertise was used to address this problem through various efforts for more than 60 years.

Giant strides were made in getting landowners to implement practices to control erosion through the cooperative efforts of Soil Conservation Districts, the USDA Soil Conservation Service, the USDA Agricultural Stabilization and Conservation Service and County Extension Offices.

Agricultural Extension Engineers in the KSU Cooperative Extension Service were closely involved in education, training, and promotion of conservation practices to control wind and water erosion throughout the 25 year history, 1964-1988.

Activities included conservation tillage, water quality, improved conservation system design and windbreaks for wind and water erosion control.

Improve Terrace Design

Extension Engineers provided educational leadership to develop improved terrace design, including parallel terraces, underground pipe outlet systems, water and sediment control basins, and parallel terrace systems.

Field demonstrations of parallel terraces, underground pipe outlet systems, and water and sediment control basins were conducted in cooperation with the USDA Soil Conservation Service, the Kansas Land Improvement Contractors Association, and landowners.

Publications described these improved terrace design components. Radio programs, TV programs, tours, and field days were also used to further the adoption of these practices. Extension engineers recommended and promoted terrace system designs which maximized the efficiency for farming terraced land throughout this period.

Cost Share Specifications—1968

By 1968, cost share program specifications had been adopted for parallel terraces and flat channel terraces by the USDA Agricultural Stabilization and Conservation Service.

Conservation Structures

Maintenance was essential for conservation structures to continue to perform their intended function. Extension Engineers provided educational leadership for numerous field days where maintenance of conservation structures was demonstrated.

Other educational methods used to promote maintenance of conservation structures included publications, newspapers, and radio media.

Water Quality, Three Eras—1970-85

Water quality was an area of program emphasis three periods of time, beginning in 1970.

First, was emphasis on sediment control and reduction in 1970-71. Second, were statewide 208 water quality plans (non-point source) completed by the Kansas Department of Health and Environment, in 1977-78.

In these two efforts, Extension Engineers provided technical input about water quality and its control for

publications, slide/tape sets, and other media.

The third, and by far the most comprehensive water quality thrust, began about 1985 and continued to build in response to national and local water quality issues. Extension Engineers gave leadership to the Extension Water Quality Task Force and Non-Point Source Committees in cooperation with other departments.

Water quality became a major topic for discussion and educational programming. Extension Engineers assumed leadership roles in the development of publications, the planning and conducting of educational meetings, and educational programs through newspapers, radio, and television media.

Water Education for Teachers—1970's

Extension engineers prepared a set of water reference materials which were compiled into a notebook for teachers, with primary focus on grades 3-8. This Water Education for Teachers, (WET) was a school enrichment program through 4-H.

Drinking Water Quality—1986

Water quality emphasis for 1986-88 was on drinking water quality, with considerable interest and response to county water quality clinics.

However, non-point source water quality problems continued to be addressed, as influenced by agriculture and other contributors.

County Extension Agent training, publications, newspapers, radio, and television were used to complete the drinking water quality educational program.

Training of USDA Soil Conservation Service personnel and County Extension Agents was the primary initial thrust of the non-point source program.

Farm Power and Farm Machinery

The farm machinery subproject was inaugurated in 1925. Claude Shedd, Extension Engineer, was the leader of this subproject and also of Land Reclamation. The following statement from the 1925 report gave the basis for this new program:

The purchase and maintenance of tractors and farm implements are large items of expense

on Kansas farms. The farmer has a well established reputation for extravagance in quickly wearing out and discarding machinery. It is not unusual for farm machinery to be scrapped after ten years during which it has been used only a week or ten days each year, a total length of service of 80 or 100 days.

Farmers who have become educated to the advantages of adequate repair shop equipment

have reduced their upkeep expenses on machinery by 50 percent. The farm shop and tractor schools are for the purpose of reducing the waste of farm implements. The ultimate goal in this work is to reduce the economic waste resulting from poor selection, inefficient operation and lack of housing and repair of farm machinery and equipment.

In 1925, four tractor repair schools were conducted with 26 three-hour sessions and a total attendance of 288. The participants overhauled their own or their neighbor's tractors. In most cases they accomplished a good class of repair work.

Two farm shop schools of 14 three-hour sessions each were conducted with 132 attending. Instruction provided practice on tool sharpening, woodwork, forging, soldering, rope splicing, rope knots and implement repair.

Two field demonstrations were held on proper hitching and adjustment of plows in Sedgwick County.

In 1926, 13 gas engine and tractor schools involving 67 sessions with 1068 people attending were held. There were 74 farm shop practice sessions with 870 participants. Farm shop instruction included seven sessions with 68 people present. One plow adjustment demonstration was attended by 20 men.

The same pattern of schools was followed in 1927 with 10 three-day schools on gas engine, tractor and farm shop instruction and practice, for 1,051 people.

The Extension Specialist also assisted with schools conducted by the Caterpillar Company and the Advance Rumley Company at Wichita. Claude Shedd resigned September 30, 1928 and no report on this subproject was made for that year.

The 1929 report prepared by John Glass, Extension Engineer employed October 1, 1928, stated:

The advent of the combine, the general purpose tractor and more adequate corn harvesting machinery has naturally developed an unusual demand for the work presented under this project.

The year 1930 marks the beginning of a five-year farm machinery program in connection with the Wheat Belt Program, and with the cooperation of the Kansas Implement Dealers Association, this project will be developed as rapidly as time will permit.

In 1930, three Tractor and Gas Engine Schools were attended by 491 people. Six district farm machinery schools were held. These were at Iola, Holton, Colby, Dodge City, Newton, and Salina.

District Implement Dealers Clubs were organized at Fredonia and Colby. County Extension Agents reported 2,786 new general purpose tractors purchased during the year and 813 corn picker-harvesters in use. The Extension Engineering Specialist's time available for this program was quite limited.

In 1931, ten small District Farm Implement and Tillage Schools were held by John Glass, Extension Engineer, A. L. Clapp, Extension Crops Specialist, and E. G. Kelly, Extension Entomologist. The schools were held in Saline, Rice, Barton, Reno, Harper, Clark, Ford, Finney, Thomas and Rawlins Counties, with 433 persons attending. Implement dealers prepared special exhibits of implements for the schools.

In the years 1932, 1933 and 1934, only a small amount of Extension Specialist's time was devoted to this subproject. Work was primarily on recommendations about use of equipment and methods for preparing summer fallow to reduce wind erosion of the soil.

Selection, care and operation of machines for terrace construction were also emphasized. Professor F. J. Zink of the Agricultural Engineering Department prepared literature for use by County Extension Agents and vocational agriculture instructors.

Deep Tillage—1935

In 1935, assistance was given in "deep tillage" demonstrations as an aid in control of wind erosion. Reports indicated that 3,360,245 acres were deep tilled during the year.

Concrete Soil Packer—1936

The advent of the concrete soil packer came about in 1936. The idea was conceived by Leonard F. Neff, County Extension Agent in Washington County, in the spring of 1932.

Cast iron forms were made, into which was packed dry concrete to make wheels four inches thick and 15 inches in diameter. Eight or 10 wheels were assembled on a shaft to make a very satisfactory packer that saved the farmer from \$50-75.

In 1936, H. T. Willis, farm fieldman for the Portland Cement Association, worked out a set of forms

consisting of two gold miner's pans that made wheels five inches thick and 16 inches in diameter.

Demonstrations on construction of concrete packer wheels were conducted in 11 counties with 164 people attending. Later several commercial concrete products companies made the concrete packer wheels.

Weeders/Lister Attachments—1937

Rod weeders and damming attachments for listers were new implements introduced to farmers at 15 meetings attended by 3,827 people in the western counties in 1937. The leader of this subproject was Hal Eier, appointed Extension Engineer on February 1, 1934.

District/County Events—1938

Due to the inability of the Extension Specialist to meet all of the requests from counties for assistance in farm machinery work during 1938, two large district meetings were conducted, one at Dodge City and one at Hutchinson.

Forty-one counties were represented at the events by 1,750 farmers and businessmen. One or two blocks of street were devoted to machinery exhibits.

Implements receiving attention were damming listers, duckfoot cultivators, spring-tooth harrows, rod weeders and press-wheel drills. Twelve large machinery manufacturers assisted with these machinery shows and schools.

In 1939, two district and 23 county machinery meetings and shows were conducted similar to the district meetings of 1938. Conservation of both soil and farm machinery was stressed.

Extension Specialists taught that the expense for farm machinery could be reduced by proper selection, adjustment, repair, and care. Farmers were discouraged from buying machinery that was not needed.

All of the major implement and rubber tire companies assisted with the program and displays. In 15 central and eastern counties schools were conducted on selection, care, repair and adjustment of the more common farm implements.

Contour Farming Demonstration—1939

Another new educational feature in 1939 was a contour farming demonstration. Contour lines were laid out on a cooperator's farm in the forenoon. In

the afternoon machinery dealers demonstrated their equipment by using tillage tools on the contour. Five such field days attracted 1,663 persons.

Power/Fuel Exhibit—1939

An exhibit on Kansas Power and Fuel was prepared for showing at the national corn husking contest at Lawrence with approximately 75,000 persons attending.

Home Silage Cutter—1940

A homemade ensilage cutter was introduced in 1940. Several machines of this nature were constructed in western counties from old combines on which were mounted commercial cutting heads. Up to 100 tons of silage per day was harvested with one of these machines.

Machinery Adjustment—1940's

Machinery adjustment schools and demonstrations also commanded much interest. County Extension Home Demonstration Agents and leaders were given training in cleaning and adjusting sewing machines.

4-H Machinery Programs—1940's

Early in the 1940's a program of tractor maintenance was started among 4-H Club members. The Standard Oil Company sponsored this program by furnishing personnel, excellent literature, and awards. A general safety program was also conducted among 4-H Club members.

The 4-H Tractor Maintenance activity was changed to a 4-H Project in 1960 with 913 enrolled. In 1954, and the years following, a tractor driver contest was held at the State Fair for 4-H members enrolled in the 4-H Tractor project. Contestants from 24 counties participated in 1960.

A 4-H Automotive project was started in 1957 on a pilot basis in five counties and was extended to all counties in 1959. There were 749 members enrolled from 86 counties.

Farm safety programs continued with 4-H members, home demonstration unit members, and other groups of adults. Emphasis was on tractor safety. A representative of the Kansas Farm Bureau assisted with that program.

Farm Power and Machinery—1950's

Extension Specialists who devoted a portion of their time to farm power and machinery included John Ferguson, Harold Stover, Walter Selby, and Harold Ramsour.

By 1950, a number of new activities had been

inaugurated. Emphasis shifted from "repair" to "maintenance" of machinery. County Extension Agents were given special training since most were not agricultural engineers by training.

Tillage demonstrations were popular with many commercial companies assisting in the training program.

From 1950 to 1960, Kansas farmers increased the number of their tractors by 26 percent. Continued emphasis was placed on tractor maintenance through 1960. This program was taken to farmers, dealers and servicemen.

The use of L-P (liquid petroleum) gas in tractors was becoming common. A special state-wide school on L-P gas use was attended by 75 gas servicemen.

Feed Handling—1960

Extension Engineering Specialists initiated training schools in mechanical feed handling for Agents during 1960. The state-wide Agricultural Engineering Day held at Kansas State University in April was devoted to exhibits and discussions on feed handling machinery and installations.

Mechanical Hay Equipment

The use of mechanical hay conditioning equipment was a new phase of the farm machinery program. Demonstrations were held with the cooperation of equipment manufacturers and the research staff of the Department of Agricultural Engineering, Kansas State University.

In-Depth Welding Schools—1966

Many farmers and ranchers realized that time of operation was one of the valuable assets at their disposal. They could do advance equipment repair and operational checks but could not predict when something would break and need welding.

Along with being able to save time, operational costs of equipment could be lowered if the farmer could weld the piece in place.

Realizing this problem, Harold Stover and John True, Extension Engineers, offered in-depth welding schools in the 1966 planning program. These schools were conducted in Elk and Greenwood Counties in 1967 with one school per week for three weeks.

The participant was shown the capabilities and limitations of gas and electric welding equipment. He was then given an opportunity to weld metal pieces normally found on the farm. During the first session, he was given only easy to weld metals and allowed to gain confidence with these.

In the following two sessions, he was given pointers on metal recognition and shown how to weld, braze and hard solder metals that were capable of being handled in the respective manner. In each case, he was allowed to practice the technique.

Tractor Noise Level—1971

In 1971, a demonstration was conducted by Rodney Horn in Edwards County to check the noise level of farm tractors and explain to their operators the dangers involved.

Sixteen tractors were checked with approximately 70 interested participants. The program was highly successful, with reports of many of the people in attendance purchasing protective hearing equipment within the following week.

Select Machinery —1973

Educational programs were conducted to teach farmers methods of selecting proper size and types of machinery for their farms.

As a result of a 1973 effort by Mark Schrock, several agricultural machinery dealers expressed an interest in obtaining more detailed information on machinery selection so they could better assist farmers in making machinery management decisions.

Hay Handling—1975-78

In south central and southwest Kansas, alfalfa hay production was definitely on the increase in 1973-1978, with several counties reporting up to 25,000 acres of alfalfa. This increased interest in raising alfalfa was associated with a good demand for quality hay from large commercial feedlots.

One limiting factor in this development was a lack of automated hay handling equipment and inadequate storage facilities for the hay in the area.

To inform producers of some of the newer developments in hay handling equipment and storage as well as the most current hay production practices, County Extension Agents, Extension Agronomists and Extension Engineers, including Mark Schrock and Elwyn Holmes, teamed up to conduct special hay production clinics and demonstrations in four counties in 1975-78.

Over 500 producers or potential producers attended these events. As a result of these meetings, it was estimated that ten individuals, or groups of producers, in the area began using new automated hay handling systems and a number erected hay storage facilities.

Energy Conservation Program—1977

In 1977, energy became a major focus of the Kansas farmer. Extension Engineer, Mark Schrock, worked closely with the department of agricultural engineering staff to conduct the Kansas-Nebraska Energy Conservation Project funded by the Federal Energy Administration (FEA).

This 18-month project involved several educational events and activities in addition to collecting data on energy use from approximately 200 farms in the two states, involved several educational events and activities.

A total of eight field days were conducted statewide by engineers Mark Schrock, Dennis Kuhlman, John Kramer, Maynard Herron, and Richard Koelsch, to demonstrate energy conserving possibilities for farm power units.

An exhibit at the Kansas State Fair was viewed by approximately 20,000 people. Numerous fact sheets covering energy conserving practices related to machinery adjustment, irrigation, and grain drying were prepared, published, and distributed.

Continue Energy Conservation—1978

Efforts continued in 1978 in the area of agricultural energy. Proper weight and tire selection for farm tractors was of specific emphasis in the field demonstrations.

For meeting and booth display work, several other conservation technologies were promoted such as proper fuel storage, solar livestock housing, and irrigation water measurement. Conservation came from the application of a number of small energy saving techniques. Their application could save about 10 percent of a typical farmer's annual fuel bill. Statewide, such techniques may have saved over 20 million gallons of fuel per year.

There were some encouraging changes taking place in 1978 in the attitudes of farmers toward machinery and energy. In general, agricultural producers demonstrated an increased interest in energy conservation, particularly in regard to machinery selection.

Farmers were becoming more aware of the fact that the purchasing decision when buying a large tractor could easily make \$8,000 - \$10,000 difference in fuel costs over the life span of that tractor. As a result, they more carefully examined the Nebraska

Tractor Test results and other information supplied by Mark Schrock through the Extension Service.

Study Rotary Combines—1978

In 1978, Mark Schrock, Extension Agricultural Engineer, and Gustave Fairbanks, KSU Agricultural Engineer, conducted a field study to determine the effectiveness of newly marketed rotary style combines. The rotary combine was compared to conventional machines at three different locations in Kansas to determine if advantages in loss, capacity, or grain damage existed.

The results of these field studies indicated that when operated by typical farmers the rotary combine was capable of delivering more net grain in the bin.

The impact of one additional bushel of wheat per acre in the state of Kansas was over \$36 million. Results of the study were made available and publicized through mass media and Extension meetings in 1979.

Alcohol As a Fuel—1980

Increased farm energy costs, low grain prices, the desire of farm producers to become more energy sufficient and less dependent on foreign oil imports, and popular press publicity, stimulated an avalanche of interest in fuel-alcohol in 1980.

In response, Extension Agricultural Engineer, Mark Schrock, took a leadership role in planning and conducting a fuel-alcohol educational program with the cooperation and support of the Departments of Agricultural Economics and Animal Science.

The educational thrust was directed toward providing research based information on the technology of fuel-alcohol production and its use in farm power units, the economics of alcohol fuels, and the utilization of distillation by-products.

Feed-Lot Truck Driver Operations—1980

A special 1980 program for feed-lot truck drivers was well received by the participants. This was a cooperative meeting involving Extension Specialists in Veterinary Medicine and Mark Schrock, Extension Agricultural Engineer.

Information was presented on machinery operation and maintenance, along with animal nutrition and medication, directly to feed-truck drivers of the Kansas feedlots. This program was continued by David Pacey from 1980 through 1988.

Cut Harvesting Losses—1981

Several studies showed that harvesting losses for grains could usually be lowered significantly with proper machine adjustment and operation. Also, the type of combine and crop gathering unit could have a significant impact on losses and grain quality.

Public meetings, news releases, and a farm show booth were used by David Pacey in 1981 to disseminate information on harvesting losses.

The main thrust was to present the method for checking field losses and then recommend machine adjustments to reduce losses. Several programs covered the operational differences between the rotary and conventional combines.

Crop Oils for Fuel—1981

To demonstrate the possibility and potential of using crop oils as diesel engine fuel alternatives, Research and Extension Engineers, Mark Schrock and David Pacey, assembled a trailer-mounted diesel motor with dynamometer and fuel options of 100 per cent crop oil.

This 1981 demonstration unit was exhibited and operated at the Agronomy Field Day, the State Fair, and two County Energy Exposition Shows. It was estimated that 12,000 people viewed the demonstration and received information regarding the potential use of crop oils as a fuel alternative.

Fuel and Machinery Efficiency—1982

Efficient use of fuel and machinery continued to be of vital interest to Kansas Farmers in 1982. Both fuel and money could be saved by proper machinery selection and operation.

Public meetings, radio programs, and publications were used by David Pacey to disseminate information on selecting tractors based on the Nebraska Tractor

Test Data, machinery sizing and selection, proper tractor tires and ballast weight, and use of gear-up, throttle-down practices.

Tractor Efficiency—1983-87

KSU Cooperative Extension publications "Tractor Test Data" and "Getting the Most from Your Tractor" were revised and updated.

Items relating to efficient tractor operation were demonstrated in 1983-1987 to producers throughout Kansas by David Pacey and other Extension Agricultural Engineers with cooperation from County Extension Agents and Experiment Station and Field professionals in research.

Controlling tire slippage, use of gear-up and throttle-down for light loads, radial tires, and front wheel drive assists were demonstrated at seven research fields or branch experiment station field days across the state. An exhibit was also prepared for the Kansas State Fair.

Producers learned the relationships between weight and pull, and between slippage and tractive efficiency. They were shown how to gear-up and throttle-down with light load operation and typically save 25 per cent on fuel compared to full speed operation.

Advantages and differences with radial tires and front wheel drive assists were discussed.

A Nebraska survey indicated that farmers who participated in an energy conservation program reduced fuel use by 7 per cent over a three year period while other farmers had a 4 per cent savings. A 3 per cent additional fuel savings by 2,400 Kansas farmers represented a savings of over \$200,000.

The Energy Extension Service directed by Richard Hayter, provided \$10,000 to this program to provide a tractor efficiency demonstration.

Rural Electrification, Electrical Power & Processing

The Kansas Committee on the Relation of Electricity to Agriculture was organized in February, 1924. The committee was composed of representatives from the Kansas Public Service Association, Public Utilities, and the Kansas Farm Bureau.

In 1936, the Department of Rural Engineering organized a subproject in Rural Electrification and employed Harold Stover to take the leadership in that area of work.

Farm and Home Electricity—1930's

Much work was done in the 1930's in the field of electricity, cooperating with the Kansas Committee on the Relation of Electricity to Agriculture. Electrical equipment for the home was featured in an exhibit displayed at the Topeka Fair and at the State Fair in Hutchinson.

In 1936, an electrically equipped model kitchen was prepared in cooperation with the Extension

Home Economics staff for display at a farm power and equipment show held at Wichita, February 25-28, 1936. This display was brought up to date each year and displayed at Wichita until the machinery show was discontinued.

Rural Electrification Admin. (REA)—1935

Creation of the Rural Electrification Administration in May 1935, caused interest in rural electrification to expand greatly.

By 1937, eight cooperative rural electrification projects had been approved to include 1,247 miles of line for 3,870 potential users. Public utilities had extended lines to 854 additional users. Harold Stover assisted with 59 meetings attended by 2,123 people.

By 1938, one additional project was approved. More than 1,000 users were connected to the new REA lines, and utility companies connected 2,000 new users. Approximately 11 percent of Kansas farms had central electric power service.

The Extension Specialist conducted 50 meetings attended by 1,836 people who were interested in methods of organizing cooperative electric projects, adequate wiring, utilization of electricity, lighting, and selection of electric equipment. The western part of Kansas was still interested in home electric plants.

Tent Shows/Meetings—1939

In 1939, a series of six two-day tent shows were conducted throughout the eastern two-thirds of the state. Discussions and demonstrations were devoted to all of the problems common to new users of electricity from power lines.

The Extension Specialist participated in 137 meetings with an attendance of 16,148 people. Approximately 15 percent of Kansas farms had central electric power service.

Rural Electrification—1949

In 1949, the home improvement schools were enlarged to include rural electrification. These were held in 68 counties with 6,408 persons attending.

Rural Electricity—1950's-60's

With the introduction of electricity to the rural areas, Extension Agricultural Engineers in the electrical power and processing position spent most of their time introducing electricity to the rural areas in the 1950's and 60's.

Programs were conducted showing the benefits of electricity on the farm and in the house. Extension

Engineering Specialists worked with Rural Electric Cooperatives and Extension Home Economists to develop special programs on uses for electricity.

Helping producers make the right decisions on proper sizing of electrical conductors, motors, equipment, and household appliances was the primary focus of the programs. Besides public meetings, many extension publications were developed.

The application of electricity to pumps for watering livestock and for irrigation also played an important role in developing the agricultural industry in rural Kansas.

Extension Electric Programs—1950's

By 1950, 63 per cent of the farms of Kansas were connected to central power sources. Thirty five electric cooperatives were operating to provide electric service to the membership. Thirteen private utility companies also served rural users.

The interests of new users expanded to include selection and care of the larger electric appliances such as electric motors for income producing purposes, washers, dryers, ranges, dishwashers and improved lighting. Cooperatives had reached the western portions of the state, eliminating requests for information concerning home electric plants.

4-H Electric Leader Training—1952-88

KFEC sponsored the 4-H electric leaders clinic each year. The 36th consecutive electric leaders clinic was held in 1988. The utility industry worked through the years with Extension Agricultural Engineers, Elwyn Holmes, Pat Murphy, and Joe Harner, to provide financial and personnel support.

4-H Electric Project—1955

The 4-H Electric Project started in Shawnee County on a pilot basis in 1955. The project became state-wide next year.

The first state-wide leader training school was held in the 4-H Encampment Building at Hutchinson in the fall of 1952. The training program brought about much additional interest in the project and by 1961, 1,812 4-H club members were enrolled. Over 100 leaders from 102 counties attended the training school in 1961.

Work With Electrical Utilities—1957-88

Extension Agricultural Engineers developed a long tradition of working with the electric utility industry in

Kansas. The Extension Agricultural Specialists were involved with the Kansas Farm Electrification Council (KFEC) from 1957 to 1987. The organization then merged with the Kansas Committee on the Relation of Electricity to Agriculture.

Extension Electric Program—1960

In 1960, power line electric service was used by 96 per cent of the farmers of Kansas. Most of the remaining farmers had electricity available but had chosen not to use it.

Harold Stover and his engineering associates gave some assistance to 13,535 people by meetings and demonstrations on the use of electricity for income producing purposes, especially for grain and hay drying and feed handling systems.

County Extension Agents reported 2,129 grain drying installations and 95 hay drying units. Agents were given special training in grain drying, hay drying, and mechanical feed handling systems.

Specialist to Civil Defense—1960

In 1960, Harold Stover, Extension Specialist in Engineering with primary responsibility for the Rural Electrification subproject, was appointed Assistant to the Director of Extension for the organization and execution of a Rural Civil Defense program in Kansas.

Approximately 15 percent of Harold Stover's time was devoted to Rural Civil Defense.

Energy Conservation—1970's

The energy crisis of the early 1970's caused programs to shift from the introduction of electricity to the farm to energy conservation on the farm.

Elwyn Holmes developed programs on insulation, earth housing and utilization of solar energy

for agricultural applications. These programs were conducted in the late 1970's and continued through 1988, the end of this history, under the direction of the Energy Extension Service.

Household Equipment—1970's

Selection, care and maintenance of household equipment and appliances was one way to stretch a limited budget and improve living and working conditions for many housewives.

To teach homemakers how to select and care for their appliances, Extension Engineering Specialists and Extension Home Economics Agents worked together to develop clinics.

Meetings/Clinics /Workshops—1970's

Instruction included adequate wiring, the electrical code, and safety. Clinics were offered advertising what's new, since homemakers were interested in new appliances and the best techniques for use and repair.

The schools consisted of approximately a two-hour lecture demonstration followed by a two-hour workshop on appliance trouble shooting and repair. Special emphasis was placed on the electrical load potential of new appliances and their effect on house wiring.

In the workshop, men and women were divided into small work groups by type of equipment. With advice from Extension Specialists each participant worked on his or her own appliance, learned more about the appliance and, hopefully, how to make future repairs.

The number of participants in each workshop had to be restricted to 20 people because of differences in appliances and a limit on instructor's time.

During 1972 these clinics were held in 12 counties with an average attendance of 30 people.

Great Plains Program

Following the drought years of the early 1950's, the United States Department of Agriculture provided money to the Extension Service for a program to reduce farmer's losses in the Great Plains area as a result of a reduction in livestock numbers and a recurrence of soil erosion by wind.

On August 7, 1956, the President of the United States approved Public Law 1021 which authorized

an appropriation to support a Great Plains stabilization program. Appropriations were made in subsequent years, and from those funds two Extension Specialist positions were established.

On September 1, 1955, Leroy Nelson was appointed Area Extension Engineer and Dale Edelblute, Area Extension Agriculturalist. They were located at the Branch Experiment Station at Garden City.

Farm Stabilization Programs—1956

In his 1956 report, Leroy Nelson stated:

The land reclamation phase of the Great Plains program is concerned with stabilization and utilization of soil areas so that the hazards of wind and water erosion will be greatly reduced, and also with the development of sound and profitable irrigation projects on the farms of the area.

The program was in its initial year of operation and the activities were confined to the accumulation of data, ideas, and opinions for use in the formulation of a policy that might lead to solutions of the problems of the 31-county area. A total of 77 meetings were conducted with 1,127 persons participating. Leroy Nelson resigned October 22, 1956.

George Armantrout was appointed Area Extension Engineer on January 1, 1957. In 1957, residue management, popularly called "Stubble Mulch Tillage," was encouraged as a supplement to terraces, contour farming and improved tillage practices to help get water into the soil and reduce soil losses to water and wind erosion.

George Armantrout resigned December 31, 1958.

Lyndell Fitzgerald was appointed Area Extension Engineer February 1, 1959. Agricultural stability was the number one problem in the Great Plains. Severe droughts had exerted a strong influence on the type of agriculture that existed in the area. Prosperity depended upon favorable weather and markets.

The long instability was caused by a complex aggregation of factors including :

- 1) Recurring periods of below normal rainfall.
- 2) Use of cropping and livestock programs which were not adapted to the resources available.
- 3) Lack of good marketing programs.
- 4) Inadequate credit facilities.
- 5) Poor management practices.

In his 1960 report, Lyndell Fitzgerald stated:

The major problem facing agricultural producers in the Great Plains is one of adjustment — adjustment in production, adjustment in resource use, and adjustment of actual operational and management techniques.

These adjustments are not only of vital concern to the producer but also to the agribusiness group, which includes the dealers of farm machinery, seed, fertilizers, fuel, chemicals and the

businessmen involved in processing and marketing agricultural products.

Stubble mulch demonstrations were conducted in Norton and Rooks Counties. Tillage techniques and recommended use of machinery were demonstrated.

Demonstration Farms—1960

By 1960, two demonstration farms were established, one in Lane County and one in Pawnee County, to demonstrate recommended practices contributing to a stable agriculture. Field days were held at these farms in August 1961.

A third irrigation demonstration farm was established in Edwards County, and a fourth farm for dry-land demonstrations in Decatur County, to begin operations in 1962.

Great Plains Program Objectives—1961

By 1961, after five years of study and observation, working with farmers and professional people of the Great Plains area in Kansas, these objectives had been established after considering the problems of the area:

- 1) To demonstrate and encourage the adoption of cropping and livestock programs on individual farms that will make the best use of all available resources.
- 2) To demonstrate the use of sound conservation and land use practices that can be made a part of a working program of everyday farming operations.
- 3) To investigate and assist in the development of new crops and new production programs.
- 4) To give engineering assistance in the development of new agricultural industries in rural areas.
- 5) To develop an understanding and appreciation of the economic forces present in the economy, and the engineering, agronomic, marketing and management problems which occur at the farm level which so greatly affect the efficiencies and net return from agricultural products.

Train for Industries—1961

Two training schools devoted to new agricultural industries were conducted for County Extension Agents and business leaders in 1961.

Discussions dealt with market positions, growth potentials, design and selection of equipment, layout, and operation. Personal assistance was given a few small industries that were being established or expanded.

Rural Civil Defense

In 1960, the Kansas Extension Service began a Rural Civil Defense program based on an agreement between the Federal Civil Defense Mobilization Administration and the Federal Extension Service.

Action for Civil Defense—1960

Harold Jones, Director of Extension, assigned responsibility for the program to Harold Stover, Extension Engineer. The program was conducted and coordinated with the Regional Civil Defense Office of Defense Mobilization in Denver, Colorado.

The initial promotional and educational activities included:

January - A letter to each County Extension Office explaining the purpose of the Rural Civil Defense program and the need for cooperation with the County Civil Defense Director. Two instructional kits followed the letter to each county.

April - Joint district meetings held at Salina, Wichita, Norton and Dodge City to give instruction to County Civil Defense Directors and County Agricultural Extension Agents. A recommended procedure was presented and discussed.

July - District summer program planning conferences attended by most Extension personnel used to explain progress in Rural Civil Defense (RCD) and advise on how the program could be further developed.

Each county was directed to hold four training meetings for RCD leaders. By the end of the year all but 14 counties had completed the educational program, and 1,238 leaders had participated in those meetings.

November - A research project was organized and approved by the Engineering Experiment Station at Kansas State University to study various types of radioactive fallout shelters.

In 1961, 33,354 people attended 1,097 meetings in Kansas on the Rural Civil Defense program.

Five models of fallout shelters were constructed and used at the Extension conferences, fairs, and other places where civil defense was discussed. Fallout shelters were planned for 365 families.

USDA State Defense Board—1960's

The Director of Extension was very active as a

member of the USDA State Defense Board, a successor to the former USDA State Emergency Planning Committee.

The State Director of Defense at Topeka was most cooperative by providing printed materials, attending training meetings, and showing enthusiastic support for the Extension Service.

Alternate Extension Headquarters—1962

An alternate headquarters for the Extension Service was planned in Hays, Kansas at the Branch Experiment Station.

All necessary equipment was procured, emergency personnel designated, and plans made for duplicate personnel and financial records to be deposited in the files at the emergency headquarters.

Succession In An Emergency—1962

In 1962, the State Defense Board assigned a succession of officials in case of an emergency. Extension Director Harold E. Jones was designated to assume Chairmanship of the Board.

Harold Stover was to be the Attack Analysis Committee Chairman; Sykes Trieb, Extension Specialist in Retail Food Marketing, was to become Chairman of the Food Requirements and Supply Information Committee; and Oscar Norby, State Leader of County Field Operations, was designated as the Non-Food Requisites Committee Chairman.

Personnel from seven other Federal Agencies were assigned to emergency responsibilities.

Extension Civil Defense Program—1963

On January 1, 1963, Richard Jepsen, a former County Agricultural Extension Agent with military training in Civil Defense, was appointed Extension Specialist in Rural Civil Defense. In his 1963 report he stated:

- 1) Twenty-eight training meetings were held by the Extension Rural Civil Defense Specialist with local leaders, with a total attendance of 301.

There were 676 people attending sixteen public meetings. Thirty-six staff training meetings had an attendance of 696.

- 2) With the present apparent relaxed international conditions it is difficult to get the general public interested in a civil defense program.

Agents have been encouraged to get leaders and instructors trained now in order that there will be sufficient trained personnel available if and when the next crisis arises.

Each county should have trained instructors in monitoring, shelter management, medical self-help, communications, organization and other pertinent areas.

Many Agents are assisting in this type of program. Most notable achievements have been in the areas of medical self-help and monitoring.

- 3) The Extension Rural Civil Defense Specialist visited 23 county USDA Defense Boards in an attempt to encourage the County Extension Agent, the Civil Defense Director, members of the USDA Board and others interested in Civil Defense, to form an educational committee for their county civil defense educational program.

Authority for the USDA Board to operate in this capacity came from Paragraph 30d, USDA County Defense Operations Handbook.

This committee has not been asked to do the training in technical subjects, but to assist in planning an educational program and to assist in finding instructors.

Civil Defense Training—1963

County Extension Agents were trained in what to look for in shelter space on farms and how to improve such space if need be.

Monthly newsletters kept interested persons up to date. Eight television programs, two radio programs, and many news releases were prepared by the Extension Specialist in Civil Defense.

In 1963, the Extension Department of Continuing Education signed a contract with the Department of Defense to employ personnel to do technical training in civil defense. That work is recorded in the Continuing Education section of this history.

Floods in Southwest Kansas—1965

The University's educational role in a disaster when serious flooding occurred in sections of Kansas during 1965.

Heavy rains and cloudbursts in Colorado caused the Arkansas river to rise to its highest recorded levels in many southwest Kansas counties.

With advance action by Richard Jepsen, Extension Engineering Specialist in Civil Defense, and the Extension Information Department, the USDA Agricultural Handbook, First Aid for Flooded Homes, was sent to the areas that could be affected by high water.

News items on what to do were prepared and distributed. USDA disaster committees were informed of their responsibilities and the actions they should take.

During the actual flood, County Extension Agents assisted where they could. The recovery phase required most of the effort of the Agents.

Tape recordings, TV shows, news releases and mimeographed material were prepared and distributed by various members of the state and county staff.

County Civil Defense Training—1966

During 1966, agricultural leaders in the counties developed a Civil Defense training program. Each county proposed a training kit to be used by the local leaders to train people.

This kit included a film, instructor study guide, and lesson plans, plus participant work materials. It was designed to increase the knowledge and understanding of rural people in order to stimulate them to take proper action for emergency preparedness.

Emergency Preparedness Week—1978

Kansas Emergency Preparedness Week was conducted during the week of April 3-7, 1978. Governor Bennett issued a proclamation encouraging citizens to participate in this public education program.

A packet of information material was made available to County Extension Agents and a special packet was sent to the news media. The National Weather Service also provided publications.

Safety Emphasis

During the 1970's, the objectives of the Farm Safety Program were to continue to identify farm accident areas, keep people aware of state and federal health and safety regulations, provide subject

matter on safety programs to selected key leaders and Agents.

The program also provide safety material and programs to counties as requested by Agents, and

provide pertinent safety information through various media.

Livestock Safety Program 1970's

Although a large number of animals were used in Kansas for both recreational and farming purposes, very little information concerning safety was available for people working with livestock.

A livestock safety education program was developed and presented to Kansas State University Experiment Station personnel and County Extension Agents.

The program identified how livestock accidents occurred and how the accidents could be reduced in number and severity.

A livestock safety demonstration was presented in the Farm Bureau arena at the Kansas State Fair on September 20, 1980.

Approximately 200 farmers, farm wives and farm youth witnessed this demonstration.

Safe Tractor Driving Training—1980

Twenty-three farm youth participated in a safety tractor driving program at the Kansas State Fair on September 17, 1980.

Approximately 200 parents and other youth observed the activities.

The program consisted of a written exam, a practical test, pulling and backing a two-wheel trailer, and pulling and backing a four-wheel trailer. A tractor safety examination was conducted during all driving events, including the practice driving.

High Accident Rate in Agriculture—1981

Safety was an Extension education thrust that permeated many crop, livestock, and agri-business related educational efforts.

The accident rate for workers in the production agriculture industry was the highest of all industries.

The accident rate in Kansas for workers in the agricultural industries had risen during the past three years, 1978-1980.

The Kansas State University Agricultural Safety and Health Center was created to address safety problems for both production agriculture and agri-business concerns.

KSU Ag Safety and Health Center—1981

The KSU Agricultural Safety and Health Center was established to develop programs to help solve these problems.

The Center had a Project Director, Richard Jepsen, and two Extension Specialists, Robert Welty and Stan Ward, to develop and present safety and health education programs to Kansas workers in production agriculture and in agri-industries.

Production agriculture ranked as one of the top two most hazardous industries in the U.S. and in Kansas. Tractors and machinery caused the most serious accidents. Small ag-related industries had accident rates above the national average.

Most of these industries had insufficient resources to employ a full time safety specialist or to develop a safety resource center. The number of fatal farm accidents reported to the Agricultural Safety and Health Center from 1976 to 1980 averaged 42 per year.

A series of agricultural accident and rescue procedure programs were presented across the state to farm employers, farm wives, farm youth and emergency medical technicians.

A program was established to encourage small agricultural industries with higher than average accident rates to establish safety programs.

Hazardous Occupations Training—1984-86

Hazardous Occupation Training for youth was given priority status. Twenty-seven counties reported conducting a 10-hour Hazardous Occupation Training Program for 327 youth enabling them to be safer and more competitive for jobs.

In the period 1984-1986, 2,414 Kansas youth received a 10-hour Hazardous Occupation Training program.

Society for a Safer Agriculture—1985

The Society for a Safer Agriculture was organized and held its first annual meeting in January, 1985. A fund drive raised about \$2,000.

Thirty-nine workshops, meetings and safety speeches were presented to an audience of 650 people. A farm accident survey was initiated.

Technical assistance was provided to employers, employees, safety specialists, educators, attorneys, farm organizations and others.

Ninety counties conducted a 10-hour Hazardous Occupation Training Program for 1,100 youth. Over 200 4-H leaders provided guidance in 105 counties for youth in the 4-H safety project.

Specialist Time Lost—1985

Richard Jepsen, Safety Extension Specialist, retired December 31, 1985. Due to lack of funds for a full-time position, a 0.5 FTE Safety Extension As-

sistant, John Kramer, was employed May 1, 1986.

All Terrain Vehicle Safety—1985

A new safety program on All Terrain Vehicles (ATV's) was started in 1985. The National Electronic Injury Surveillance Systems (NEISS) estimated the number of ATV-related injuries treated in hospital emergency rooms.

The number jumped from 8,600 in 1982 to 26,900 in 1983; 63,900 in 1984; and 63,900 in 1985. Kansas reported three ATV-related deaths from 1983 to 1985.

Eighteen hundred Kansas farm family members were trained in the safety and practical use of ATV's. Through ATV training, at least 35 per cent of the deaths and a similar percentage of the injuries would have been prevented if the recommendations of the ATV training were adopted.

Farm Safety—1986

In 1986, approximately 800 farmers received

farm safety information at demonstrations and county level meetings throughout the state. In 1986, 11 farm safety news articles were released. Expand Hazardous Training —1987

In 1987, the Hazardous Occupation Training program was promoted to audiences not required to take the training; specifically, youths who worked only on their family's farm, those ages 16-21, and farm wives wanting to become more knowledgeable about agricultural hazards.

Consequently, 1,078 student manuals were sent out in 1987, while an estimated 518 youths, 14-15 years old, received certification.

Prior to 1977, educational efforts related to Pesticide Application were previously the responsibility of Extension Engineering Specialists in Power and Machinery.

Programs in this area were conducted by John A. True (1962-67), Elwyn S. Holmes (1967-1970 and 1971-1973), Rodney S. Horn (1970-1971) and Mark D. Schrock (1973-1977).

Pesticide Safety

Integrated Pest Management—1976

In 1976-1977, the Kansas State legislature created a new Extension Specialist position in Agricultural Engineering, along with an educational research package for Integrated Pest Management at Kansas State University.

The new position was titled "Extension Agricultural Engineer, Pesticide Application" and was filled by Dennis Kuhlman in September 1977.

Aerial Chemical Application—1978

In 1978, the majority of agricultural chemicals were applied using aerial methods. With the exception of the EPA certification requirements, little had been done to provide educational material for aerial application.

A major program was initiated by Dennis Kuhlman to provide beneficial educational material concerning equipment, calibration procedures, and application methods.

Aerial Fly-In Program—1978

A major aerial pesticide application problem was pattern distribution as determined by a series of contacts with individual aerial applicators. An Aerial Fly-In was organized to give aerial applicators an opportunity to determine their discharge distribution.

The Fly-In resulted in the checking and adjustment of twelve aircraft to obtain maximum distribution efficiency.

A total of 35 pilots witnessed the tests and learned a method of checking their aircraft's spray pattern distribution.

Those attending also witnessed a demonstration of some of the newest equipment.

The Fly-In's impact was evaluated based on the following assumptions:

- 1) Each pilot covered 15,000 acres per season.
- 2) Ninety percent of the pilots found improvement in distribution patterns possible.
- 3) Based on the aircraft tested, a three per cent improvement in pesticide use efficiency was anticipated.

The economic value of the Fly-In was estimated at \$60,244.00, or \$1,721.00 per applicator.

The overall effect of the Fly-In was beneficial in terms of economic, environmental, and educational benefits.

This method of education for aerial applicators was continued on an annual basis, with the incorporation of information on new procedures and the latest equipment.

Training Manual Grant—1979

A grant was received in 1979 from USDA-SEA (Science and Education Administration) to develop an aerial application training manual.

Donald Cress, Extension Pesticide Coordinator and Dennis Kuhlman, Extension Agricultural Engineer, were responsible for the development of a training manual in two parts: one for the pilot/operator, and a second for the grower/farmer.

The grant was 18 months in duration and included input from pilots, farmers, Cooperative Extension Service, industry and industry-related organizations.

Aerial Applications—1979-83

The educational needs of a growing agricultural aviation industry from 1979 to 1983 were approached by:

- 1) Annual fly-in for checking distribution systems deposition patterns,
- 2) Discussing aerial application methods and techniques at the annual applicators convention, and
- 3) Preparation and distribution of an aerial calibration bulletin.

Support and demand for these educational thrusts continued to grow.

Herbicide Demonstration Plots—1979-87

Herbicide demonstration plots generally involved the effects of herbicide selection, gallonage rate, and application technology on weed control.

These plots were treated using aerial and ground methods, and combinations of both methods. The results were used in winter crops schools to help demonstrate the need for proper pesticide application techniques.

Calibration demonstrations were conducted at field days to show the importance of proper calibration.

The demonstrations dramatically illustrated that proper pesticide application lead to increased efficacy, and reduced environmental and safety hazards.

Pest Management Plots—1980's

Demonstration plots were a very effective way of

communicating the effects of application practices in pest control in the 1980's.

The Integrated Pest Management (IPM) demonstration plots dealt primarily with the use of the proper equipment and calibration of pesticide application equipment.

Insecticide Demonstration Plots—1980-83

Insecticide plots involved the proper use of synthetic pyrethroids for control of southwestern corn borer in corn. Sets of plots were established using a KSU Calibrated Aircraft on half of the plots and commercial applicators on the other. Three gallonage rates were used on each set of plots.

The most significant result was that the aircraft that was evaluated and calibrated by the University was able to get substantially better spray control at all gallonage rates.

This increase in control was due primarily to the superior distribution pattern and droplet size adjustments, and demonstrated the need for proper system adjustments to meet application requirements.

KSU/OSU Fly-In Clinics—1980

In 1980, Extension Agricultural Engineering at Kansas State University and the Department of Agricultural Engineering at Oklahoma State University jointly held six fly-in clinics, three in each state, to assist aerial applicators in properly equipping their aircraft for optimum pesticide application performance.

Personnel involved in these Fly-Ins included Dennis Kuhlman, Mark Schrock, and David Pacey from Kansas State University, along with Richard Whitney, Lawrence Roth, and Thomas Underwood from Oklahoma State University.

These activities resulted in an estimated economic benefit of \$113,400 with a benefit/cost ratio of 16.2 to 1.

No attempt was made to evaluate other benefits in terms of reduced environmental damage; reduced enforcement actions by the State Board of Agriculture; or improved safety.

Contributing Author. The primary contributing author to material for this chapter on Agricultural Engineering for the period from 1965 through 1988, was James P. Murphy, Extension State Leader, Agricultural Engineering Program.

Complete information about personnel in Extension Agricultural Engineer is included in Chapter 6, Extension Personnel, pp. 31-34.