Approved February 25, 1992
Date

MINUTES OF THE Senate COMMITTEE ON Economic Development.

The meeting was called to order by Senator Dave Kerr at
Chairperson

8:00 a.m./p.m. on February 21, 1992 in room 123-S of the Capitol.

All members were present except:

Senator Bill Brady, Senator Paul Feleciano, Senator Alicia Salisbury
(Excused) (Excused)

Committee staff present:

Lynne Holt, Legislative Research Department
Bill Edds, Revisor of Statutes' Office
LaVonne Mumert, Committee Secretary

Conferees appearing before the committee:

Dr. Walt Woods, Kansas State University
Dr. Rollie Sears, Kansas State University
Steve Curran, Kansas State University
Dr. William Spurgeon, Kansas State University
Dr. Robert Cochran, Kansas State University
Dr. Curtis Kastner, Kansas State University

Dr. Walt Woods led off the presentation on the impact of agricultural research on the state and its economy (Attachment 1). Dr. Woods said that agricultural production amounts to $6 to $7 billion annually in sales at the farm gate. Through value added activities, this figure increases to about $18 to $21 billion. Dr. Woods talked about the contribution made by the Agricultural Experiment Station (AES) research to agriculture and associated processing industries. He described efforts to ensure that the research conducted meets the needs of agriculture. Dr. Woods advised that during FY 91 the AES received over $12 million in extramural research support.

Dr. Rollie Sears discussed plant breeding and described the impact of the newest wheat release, Karl. Dr. Sears talked about the continuing need for developing wheat with improved disease and insect resistance.

Steve Curran told the Committee about the development of the short flow grain mill. He described the positive features of the mill: simplicity, low space requirements, easy shipping and erection, low power requirement, low cost and versatility. Mr. Curran advised that the interest level from around the world in the mill has been phenomenal. Kice Industries, Wichita, is the sole licensee of the unit and manufactures the entire unit, except for a sifter.

Dr. William Spurgeon talked about research designed to improve irrigation efficiency. He described the primary irrigation systems: furrow, sprinkler, drip and LEPA (Low Energy Precision Application). Research efforts assist farmers in properly managing their systems as well as producing optimum yields with the least water. Dr. Spurgeon said that not only does increased efficiency extend the life of the Ogallala aquifer but also results in lowered fuel costs for farmers.

Dr. Phillip Stahlman focused on weed control research. He discussed the impact weeds have on production and profitability. Dr. Stahlman described research efforts with native, nonengineered soil bacteria to control winter annual grass weeds.

Dr. Robert Cochran described the value of cattle in Kansas and their heavy dependence on native range for sustenance. He discussed range research efforts with relation to both range management and the nutritional management of livestock grazing on rangelands.

Dr. Curtis Kastner spoke about the AES work with regard to value-added and food safety research, particularly beef and beef products. He explained the

impact additional in-state processing could have on Kansas' economy.

Senator McClure moved that the minutes of the February 20, 1992 meeting be approved. Senator Francisco seconded the motion, and the motion carried.

The meeting adjourned at 9:00. The next meeting of the Committee will be Tuesday, February 25, 1992.

Date 2/21/92

SENATE ECONOMIC DEVELOPMENT
VISITOR SHEET

(Please sign) Name/Company	Name/Company
Curtis Kastor	Kansas State Univ
Bob Cochran	Kansas State University
Bill Spurgeon	KSU - SWREC Garden City
Ruth Jirdon	Kansas State University
Walter R Woods	Kansas State University
STEVE CURRAN	KSU. GRAIN SCIENCE
Phil Stahlman	KSU - Ft Hays Exp. Sta. - Hays
Rollie Sears	KSU Agronomy Dep.
Richard Hahn	Kansas Value Added Center
Terry Denker	Ks. Bd. of Ag.

AGRICULTURAL EXPERIMENT STATION RESEARCH PROGRAMS

and

THEIR IMPACT UPON ECONOMIC DEVELOPMENT ACTIVITIES

Presented to

Senate Economic Development Committee

February 21, 1992

Agricultural Experiment Station
Kansas State University

Attachment 1
2/21/92
Sen. Eco. Dev.

Table of Contents

2/21/92
1-2

Overview

Walter Woods

Dean of Agriculture and
Director, Kansas Agricultural Experiment Station

A competitive and profitable production agriculture is the foundation for the value-added processing industries in Kansas that have contributed to economic development in the state. The production of raw agricultural commodities and associated end products has been improved immensely by the research programs of the Kansas Agricultural Experiment Station (AES). Agricultural production in Kansas amounts to $6-7 billion annually in sales at the farm gate. This figure increases to about $18-21 billion through the value added by meat packing, food processing, and other value-added activities. To be at the leading edge of technology and competitive, the food chain depends heavily on agricultural research which is provided by AES. Research based information from AES has helped shape and build agriculture and the associated processing industries to their present level in Kansas. The significant contributions of the AES have come from programs in support of production efficiency and profitability of crop and livestock production. These contributions provided agricultural products that are more amenable to value-added processing, and the research on utilization of agricultural products has enhanced the value of crops and livestock grown in Kansas. Research continues a certain path of inquiry and leads over time to additional conclusions. This knowledge base lays the groundwork for continued progress in crop and livestock production, processing and utilization of agricultural products on a long-term basis. In order to have a viable source of raw commodities for further processing, research must continue to seek new improvements in crop and livestock efficiency. Wheat varieties with better milling and baking qualities and cattle with leaner beef lend themselves to greater value-added opportunities than low quality wheat or fat beef.

We are often asked the question whether or not we are conducting the kinds of research that are needed to meet the needs of a rapidly changing agriculture in a global economy. I believe the Kansas AES is right on target within the resources available. We have kept the program current through the following important steps:

1. A major citizen-based task force held a series of public hearings to identify the research needs to keep Kansas competitive in the year 2000. These hearings helped formulate the publication "Agriculture 2000 - The Kansas Plan."

2/21/92
1-3

2. Major reviews of each research unit is conducted every five (5) years by a national external peer group mandated and selected by USDA because of federal funds we receive from them.

3. From continuing interaction with commodity, general farm and industry groups, we learn their needs. These activities are augmented by annual meetings with several advisory groups.

4. We are in a continuous planning process and we have a major effort underway now to update the AES Strategic Plan. This effort builds upon two previous efforts during the last six years.

5. Federal priorities are well known and they are important to the future of Kansas. Our faculty has competed well for competitive funding on many national research initiatives.

6. We believe we are on target to research priority areas in support of Kansas agriculture. During the last several years we have increased research emphasis on value-added processing of agricultural products, food safety, water quality and use efficiency, forage-based livestock systems (range), dryland agriculture (conversion from irrigated to rain-fed agriculture), wheat genetics and alternative crops. In order to be successful, a continuing long-term effort is required. Based upon several studies of public investment in U.S. agricultural research, an annual rate of return of 20-50% has occurred based upon public funded AES programs nationally.

A number of Agricultural Experiment Station projects are targeted to enhance the value of Kansas products and time does not permit me to discuss them, so they are listed in Attachment A. Each project has specific objectives to address one or more of the following: food safety and stability, enhance quality and/or nutritional value, new uses, improved shelf life, improved efficiency in processing plants, agricultural commodities more suitable for value added processing, or provide greater convenience to meet consumer preferences. Processing and adding value offers increased economic activity and the potential of new markets for raw agricultural commodities produced in Kansas.

During FY 91, the 27 departments in five colleges, two branch stations, and two research-extension centers which comprise the AES, received $12,007,000 in extramural research support. This extramural funding is equivalent to twelve companies with an annual budget of $1 million each. The payroll of each of these companies would be about $800,000. The Fort Hays Branch

2/21/92
1-4

Experiment Station has extramural research funding of $155,000. To the Hays community, this represents support for 5 to 6 families plus 3 to 4 college students during the summer. It is important to emphasize that our extramural research program is successful because of the high quality faculty and the on-going support provided by the base funding supplied by the State of Kansas and the federal government. The economic benefit of these extramural funds to Kansas is very significant in the short run while we are conducting research that will have long-term economic benefits to the Kansas economy. These funds were used to support specific targeted research areas and could not be used for other research objectives. Attachment B lists extramural funded research that has specific objectives to address one or more of the following initiatives: enhanced quality and nutritional value, new uses, improved nutritional value, improved shelf life, improved efficiency in processing, and plants more suitable for value added processing and/or convenience to meet consumer needs. We strongly encourage our faculty to seek extramural funds to support the AES priorities and the faculty has been very successful.

In this session today, we would like to outline some of the economic development impact of research sponsored by the Agricultural Experiment Station at Kansas State University. Six (6) AES faculty member have been asked to present research findings today. I would like to introduce them to you in the order they will present their information.

Dr. Rollie Sears	Faculty member, Department of Agronomy
Mr. Steve Curran	Faculty member, Department of Grain Science and Industry
Dr. William Spurgeon	Faculty member, SWREC
Dr. Phillip Stahlman	Faculty member, FHBES
Dr. Robert Cochran	Faculty member, Department of Animal Sciences and Industry
Dr. Curtis Kastner	Faculty member, Department of Animal Sciences and Industry

In closing, in addition to the concrete examples you have seen today of economic development type activities from the Agricultural Experiment Station, we are working on other new potential economic development activities. One project deals with canola production and the ability to determine whether nor not canola can capture a significant share of the U.S. oilseeds market which depends on whether or not the crop can be produced profitably enough in Kansas to compete with other crops. Increased production of canola in Kansas would reduce our dependance on imports, provide farmers with an alternative crop, and provide an opportunity for adding value to a Kansas-produced crop. These activities fit closely with the mission of the Great Plains Canola Council and their activities to develop a processing plant for oilseeds including canola. Another project

7/21/92
1-5

deals with triticale variety development in Kansas. Triticale's adaption closely resembles wheat, it is resistant to wheat streak mosaic virus and Russian Wheat Aphid, and it has superior tolerance to both heat and drought stress. These valuable traits of triticale can potentially make a valuable contribution to feed grain and forage production in Kansas. Kansas annually feeds 3.2 million head of cattle in feedlots, mainly in western Kansas. This industry must be supported by the production of a dependable supply of feedgrains.

These activities you heard about today are some of the AES activities that contribute to enhancing the economic value of agricultural commodities produced in Kansas. These activities contribute greatly to the Kansas economy. Thank you for the opportunity to discuss the importance of AES research from economic growth and food system viability in Kansas.

ATTACHMENT A

Specific Projects Whose Objectives Enhance Industrial Development in Kansas

These 49 projects out of a total of 348 AES projects are funded by state and federal base funds. The majority of the remaining projects are to enhance crop and livestock productivity, address environmental issues, protect crops and livestock from disease and insects, and provide enhanced state competitiveness as well as address family and community issues.

Project title:

1. Domestic and International Marketing Strategies for U.S. Beef.
2. Impact of Agricultural Policy on Producer, Consumers, and Taxpayers.
3. Economic Analysis of the Impact of USDA Farm Programs on Cropping Systems and Rural Income in Kansas.
4. Changing Patterns of Food Demand and Consumption Behavior.
5. Enhancing Export Opportunities for Processed Kansas Wheat and Meat Products.
6. Pricing and Marketing in the Livestock Sector Under Structural Change.
7. Improvement of Hard Winter Wheats and other Small Cereal Grains.
8. Development of Premium Quality Hard White Winter Wheat Varieties.
9. Advanced Technologies for the Genetic Improvement of Poultry.
10. Functions, Nutritive Composition, quality, Stability, and Efficient Production of Pork Products.
11. Development of New processes and Technologies for the Processing of Poultry Products.
12. The Genetics of Body Composition in Beef cattle.

2/21/92
1-6

13. Analysis of Animal Feeds and Products by Near-Infrared Reflectance Spectroscopy.
14. Non-Enzymatic Browning Products as Antioxidant in Restructured Beef.
15. Cause and Control of Flavor Deterioration During Aseptic Storage of Ultra-High Temperature Sterilized
16. Measuring Changes In Body Composition and Meat Quality in Growing Holstein Steers.
17. Rapid Assessment of the Potential Cheese Quality During Manufacturing and Ripening.
18. International Livestock Program-International Trade Development.
19. Animal Science Food Safety Consortium.
20. Marketing and Delivery of Quality Cereals and Oilseeds.
21. Functional Properties of Certain Components From Cereals in Baked Products.
22. Effect of Kernel Hardness of Wheat Millability.
23. Market Quality of Hard Wheat for Domestic and International Foods.
24. Processing and Alternate Uses of Hard Red and Hard White Winter Wheats.
25. Improvement of Bread Quality: Role of Fats in Bread Staling.
26. Influence of Wheat Type, Flour Extraction and Formulation on Quality of Leavened flat Bread.
27. Effects of Processing on the Nutritional Impact of Dietary Fiber.
28. Wheat Utilization: Non-food and Non-feed Uses.
29. New and Nutritionally Improved Food Products From Wheat and Other Cereal Grains.
30. Factors Affecting the Baking Quality of Whole Wheat Bread
31. Single Kernel Physical Properties and Wheat Millability Hardness
32. End Use Objective Quality Determination in Grain Processing
33. Utilization of Cereal Co-Products in Animal Feed Processing
34. Micro-Environment Modification for Field/Greenhouse Vegetable Production
35. Plastic Mulch and Drip Irrigation in Nursery Production
36. Grapevine Management and Value-Added Potential of Grapes and Brambles
37. Woody Biomass Energy Plantations: Seedling Productions, Establishment and Growth
38. Improvement of Pearl Millet and Sunflower
39. Microbial Control of Winter Annual Grass Weeds in Winter Wheat
40. Parasite Manipulation to Control Flies in Confined Livestock Operations
41. Crayfish Culture in Kansas
42. A Kansas Agricultural Transportation Policy Analysis Model
43. Impact of Transportation Changes on Agricultural Marketing and Local Communities
44. Gasification of Short-rotation Intensive Culture Woody Biomass
45. Modern Systems Techniques for Value-Added Processes of Grain and Grain Products

46. Reducing Pesticide Exposure of Applicators Through Improved Clothing Design and Care
47. Non-Food Uses of Soybean Protein and Oil in Textile
48. Improvement of Thermal Processes for Foods
49. Food Quality Changes and Energy Consumption Associated with Thermal Processing in Food Service Systems

ATTACHMENT B

Specific Grant Supported Projects Whose Objectives Enhance Industrial Development in Kansas

These 59 projects out a total of 507 projects are funded from extramural sources. The majority of the remaining projects are designed to enhance livestock and crop productivity, address water quality and use efficiency, protect livestock and crops from insects and diseases, and enhance a better understanding of biology of plants and animals to provide as foundation for further improvement.

Project Titles:

1. High Erucic Acid Development Effort-Crambe and Rapeseed.
2. Evaluation of Canola Varieties and Germplasm in Kansas.
3. Premium Color and Quality Wheats for Kansas Agriculture.
4. Breeding White Corn For Milling Use.
5. Utilization of Wild Relatives of Sorghum bicolor for Genetic Improvement of Adapted Germplasm.
6. Genetic Improvement of Winter wheat for Kansas.
7. Breeding Sorghum for Improved Digestibility and Feed Efficiency.
8. Improvement of Market Quality of Kansas Wheats by Breeding.
9. Development of Hard White Winter Wheat for Kansas.
10. Development of the Hard White Winter Wheat Industry in Kansas.
11. Improvement of Market Quality of Kansas Wheats by Breeding.
12. Improvement of Hard Winter Wheat
13. Development of Hard White Wheat for Kansas
14. Improvement of Market Quality of Kansas Wheat by Breeding
15. International Livestock Program - International Trade Development
16. A Study to Determine the Efficacy of Hydrolyzed Spray Dried Plasma Protein as a Replacement for Milk Protein in Calf Milk Replacers
17. Appearance Characteristics of Fresh Beef as Affected by Display
18. Animal Science Food Safety Consortium
19. Use of Loin and Connective Tissue From Desinewed Beef Shanks in Low Fat Ground Beef
20. Evaluation of Beef Plasma Protein Compared to Porcine Plasma Protein in Starter Pig Diets
21. Effects of Alternative Processing Techniques on the Nutritional Value of Soybeans
22. Large Scale Milling and Baking Trials of New Wheat Varieties
23. Factors Controlling the Viscosity of Batter Systems

2/21/92
1-8

24. The Use of L-Ascorbate 2-Phosphate In Foods
25. Computer Interface to the Mixograph
26. Variations in Cake Flour Quality
27. Effect of Particle Size and Other Factors on Cake Flour Quality
28. Evaluation of End-Use Properties of Hard Winter Wheat Breeder's Progenies
29. Effect of Fatty Materials on Swelling of Starch
30. Isolation and Characterization of A Baking Factor From Rye
31. Support for a Research Extrusion Position
32. Extrusion Technology for Food Applications of Soybeans
33. Utilization of By-Product Gums From the Wheat Starch/Gluten Washing Industry
34. Factors Affecting the Firming of Bread
35. Single Kernel Physical Properties and Wheat Millability Hardness
36. Predicting Wheat Mixing Properties and Sprout Damage by Near Infrared
37. Optimization of Technical Parameters for Milling of Debranned Wheat
38. Optimization of Hard Red and White Winter Wheat Flours for the Production of Frozen Bakery Foods
39. Utilization of Corn, Grain Sorghum, and Wheat in the Production of Plastic Goods
40. High Erucic Acid Development Effort - Crambe and Rapeseed
41. Determination of Factors Controlling Crumb Grain of Bread
42. Thermal and Mechanical Properties of Dough Based Foods
43. Removal of Bran From Wheat Flour
44. Kansas Hard Red and White Winter Wheat Flours in Frozen Dough Production (1) Comparison to Hard Red Spring Wheat Flour and (2) Increased Versatility by Air Classification
45. Pilot Plant Milling of Heavy Bran From Hard White Wheat
46. Chlorine Replacement of Cake Flour
47. Utilization of Honey in Ready-to-Eat (RTE) Breakfast Cereals
48. Utilization of By-Product Gums from the Wheat Starch/Gluten Washing Industry
49. Wet Processing of Wheat and Other Kansas Grains
50. Database of Funded Research on Corn Quality and Utilization
51. Winter Rape Testing Project
52. Genetic Development of Higher Disease Resistance and Grain Protein in New Wheat Varieties
53. Pearl Millet Breeding KS-101 Old Number 5-20350
54. State Short Line Railroads and the Rural Economy
55. Effect of Single Kernel Physical Properties of Wheat on Milling and Energy Requirements
56. Use of Soybean Derivatives in Textiles Processing
57. Starch Gels in Food Products
58. Functionality and Utilization of Wheat Germ Protein Flour in Model Systems and in Meat Products
59. Develop a Sugarless/Low Calories Caramel Corn Formulate to be Marketed by the Twin Valley Workshop in Greenleaf, Kansas

Wheat Improvement

Rollin G. Sears
Department of Agronomy

Plant breeding is one of the most cost-effective and environmentally sound methods for enhancing our ability to produce food. New varieties use fertilizer and water more efficiently, do not require fungicides or insecticides to protect against disease or insect pests and represent improvements in milling and baking quality. The most recent KAES wheat release Karl, for example, carries resistance or tolerance to 9 of the 11 serious wheat diseases affecting wheat in Kansas most years. Karl's performance in Kansas has been extremely good as well. Due to its yield advantage over varieties it has replaced, it will add as much as $12-15 million to the state's economy this year. Because of its improved milling and baking quality, Karl will provide an added income of some $4 million to the Kansas milling industry. Karl is genetically higher in protein than other varieties. This allows farmers to produce more protein/unit of fertilizer nitrogen applied. Also, it also allows Kansas millers to buy local high protein wheats instead of purchasing more expensive high protein spring wheats. Karl also has higher flour yields than most varieties, which makes the flour millers more efficient in their operation. For the first time, Kansas mills are offering a premium of 5¢ per bushel of Karl.

Karl was released in 1988 and its rapid acceptance has and will have very positive economic impacts in Kansas. Roughly 1.5 million acres of Karl are planted in Kansas. The economic returns from this one variety over the varieties it replaced in 1992 will offset the about half the cost of Plant Science Phase II (Throckmorton Hall) on the KSU campus. The research and extension programs coming from that enhanced facility will serve agriculture in Kansas for perhaps the next 100 years. Newton wheat developed at KSU and released in 1977 increased the value of the Kansas wheat crop by $200 million during the period 1980 to 1987.

This year the KAES is increasing two (2) potential new wheat varieties with intent to release; one is a hard red and the other is a hard white wheat. Both have improved disease resistance, better yield and equal or superior milling and baking qualities compared to Karl. These new wheats will make positive economic contributions to both the farming and milling industries. The white wheat research has been enhanced directly because of support from the Kansas Technology Enterprise Corporation (KTEC) and the Kansas Wheat Commission. By developing wheat with improved disease and insect resistance, we improve yields and make our wheat crop more dependable from year to year. By improving milling and baking quality we enhance the value of the

2/21/92
1-10

crop because it stays in Kansas for domestic milling and utilization by the baking industry. We must continue to improve the protein, and milling and baking quality of Kansas wheat to be competitive in a global economy.

Each year our wheat crop is attacked by both disease and insect pests that reduce yield about 20%. It is easier and more cost efficient to increase yields of our wheat crop in Kansas by improving both disease and insect resistance than by trying to improve yield per-se. In the Great Plains for example leaf rust causes an estimated $200 million in lost yields. Hessian fly reduces yield by an estimated $8 million every year. In the past two years the Wheat Genetic Resource Center at Kansas State has released seven new germplasm lines resistant to both these important pests. The WGRC directly benefits Kansas farmers by finding and utilizing new genes for many traits; it directly benefits the wheat industry throughout the entire United States. For example, the germplasm that has been released most recently is being utilized by wheat breeders throughout the United States.

Wheat varieties in the future will look much the same as their predecessors of previous years. They will be different in their improved ability to protect against disease and insect pressure and heat or drought stress. They will have increased milling and baking quality. In part, the successful applications of sustainable agriculture practices will depend upon the continual development of varieties with genetic resistance to pests with improved fertilizer and water use efficiency. I'm confident that the wheat research team at Kansas State University can continue to successfully meet the demands of our expanding and increasingly competitive wheat industry.

2/21/92
1-11

Short Flow Grain Mill

Steve Curran
Department of Grain Science

THE INVENTION

A new grain processing flow design was recently developed within the College of Agriculture at Kansas State University. The new technology allows white flour to be produced with a minimum amount of equipment, facilities, power, skilled labor, and capital expenditure.

IMPACT

Direct benefits to the state of Kansas are difficult to predict at this early stage of development. In the few months since its introduction, one unit has been sold and is currently in operation and two others have been ordered, all sold to companies within the United States. In this short time, there has been significant interest from countries throughout the world. A conservative estimate of five units sold in a year would mean an added revenue of over $4 million to Kice Industries. Kice Industries currently employs approximately 200 people and predicts hiring an additional 15 to 25 more employees to help meet the extra demand.

An added benefit with the development of the short flow, is the potential for the development of new cereal-based food products in cooperation with other Kansas companies. For instance, Wenger Manufacturing, of Sabetha, is currently studying extruded new foods made from products manufactured on the short flow.

The versatility of the mill allows for the milling of small lots of grain with minimum clean-out and product loss. This could add substantially to the potential for identity-preserved or specially grown grains where cross-contamination in large milling units is a problem. A single short flow unit operating only 260 days per year, 8 hours per day, could utilize 73,000 bushels of grain.

The major impact for the state of Kansas that may be generated from the short flow mill <u>is</u> <u>not</u> an economic one. The mill design has the potential to provide a staple food for starving people with the added benefit of giving them the dignity of manufacturing and providing that food for themselves.

BACKGROUND

The impetus for the new design was a desire to solve some unique problems of developing countries; to feed people in

2/21/92
1-12

towns and villages by letting them process grains themselves rather than relying on large manufacturing units in cities and poor transportation systems.

Kice Industries, of Wichita, recently contracted with Kansas State University to be the sole licensee of the short flow mill. Except for a gyratory sifter made by Great Western Manufacturing, Leavenworth, Kice Industries is manufacturing the entire unit.

FEATURES

* SIMPLICITY

The milling unit is so simple to operate that one person, with minimum training could grind up to 280 bushels of wheat in 8 hours.

* LOW SPACE REQUIREMENTS

The unit requires only a single-level building approximately 36 feet long, by 15 feet wide, by 15.5 feet high, rather than the five or more stories required by conventional mills.

* EASY SHIPPING AND ERECTION

The unit is designed in a modular form that allows it to be shipped in a relatively small container. It can be erected and fully operable in five to ten days.

* LOW POWER REQUIREMENT

Minimal power is required to operate the mill. The use of on-site generators would be feasible, if necessary.

* LOW COST

The unit is relatively inexpensive to purchase. If on-site buildings are available, nearly ten of the short flow units could be purchased for the current price of one conventional mill.

* VERSATILITY

The short flow is also adaptable to cereal grains other than wheat. Acceptable flour products have been milled from barley, oat groats, sorghum, millet, triticale, and corn.

Economic Impact of Research on Efficient Water Use

William E. Spurgeon
Southwest Research-Extension Center, Garden City

The Ogallala aquifer is the largest freshwater source of groundwater in the world and covers the western third of Kansas. Irrigation for crop production is the major user of this water source; helps reduce the risk of crop failure; increases the farmers' profitability; and minimizes the fluctuation of grain supplies. When irrigation was first developed in southwest Kansas little concern was given to conservation because water was plentiful and fuel prices were low. However, in recent years, political and economic pressures have been applied to agriculture to reduce water use and assure that the remaining supply is clean.

There are about 1.7 million acres of irrigated land in Southwest Kansas. That is roughly distributed as 1/3 in wheat; 1/4 in corn; 1/4 in grain sorghum; and the remaining 1/6 in alfalfa and soybeans. Current trends show increasing acreage for irrigated corn and wheat and decreasing acreage for irrigated grain sorghum. Traditionally, furrow irrigation was the predominant method used to irrigate crops because it required little investment and operating costs. However, as water becomes more scarce or is regulated and as fuel prices increase, it becomes cost effective for farmers to invest in a more efficient method of delivering the water to the crop.

Irrigation system efficiencies vary widely by system type and management. Generally, furrow, sprinkler and drip efficiencies are estimated at 60%, 85% and 99%, respectively. Almost all new sprinkler systems being purchased are installed with narrow spaced outlets and drops that place sprinkler heads either near the top of the crop or 1 to 2 feet above the ground surface. That could raise sprinkler efficiencies to 90 or 95% but also increases management problems such as water runoff.

Past research has been heavily oriented toward furrow irrigation because that was the predominant method used to irrigate crops in southwest Kansas. Recently, many farmers have begun to convert those fields to sprinkler systems. Drip irrigation has emerged as an additional option. Currently, only a few farmers use subsurface drip irrigation for corn. Those drip systems deliver water very efficiently and uniformly but do so at a high investment cost. Center pivot sprinklers cost about $300/acre to install whereas a subsurface drip system might cost $500/acre. Irrigation efficiencies depend on weather and soil conditions. Furrow irrigation is affected to the greatest extent by these conditions while drip irrigation is affected the least.

Current KSU research with sprinkler systems is conducted to help farmers properly manage their systems while showing them how to produce optimum yields with the least water. Research shows that

2/21/92
1-14

improper nozzle selection could cause water runoff resulting in corn yield reductions of over 20%. Drip irrigation research has been designed to identify and solve management problems and develop methods to reduce the installation cost. Research has shown that the irrigation requirement for corn for southwest Kansas under drip may be as low as 15 inches as opposed to 18 inches with sprinklers or 24 inches with furrow.

Each crop requires a different amount of water to produce optimum yields. One way to evaluate the benefit of irrigation water is to determine the added value of crop production from irrigation. Research has shown that corn, sorghum and wheat yield responses to each inch of irrigation water are 7 bu/ac, 5 bu/ac and 2 bu/ac respectively. That translates into a gross return of $15.00/ac for each inch of irrigation water for corn, $10.00/ac for sorghum and $7.50/ac for wheat. Therefore, we chose corn as the corp on which we studied highly efficient irrigation systems.

Our analysis of the economic impact of improving irrigation efficiency is based on the assumption that we will raise overall irrigation efficiencies in southwest Kansas from 70% to 90%. Those efficiency improvements would save southwest Kansas producers over $7 million/yr just from pumping less water. We estimate that those improvements would also extend the aquifer life by 25%.

An important economic consideration which we will not address is the impact of grain produced for use in the growing cattle industry in southwest Kansas. Currently 70 percent of Kansas' cattle on feed are located in southwest Kansas. Those numbers stand at 1.25 million and are increasing at a rate of 28,000 head/year. The success of these feedlots depends upon an adequate, stable supply of grain and roughage.

If the aquifer were depleted and all the irrigated corn acres converted to dryland what; irrigated wheat to dryland wheat; and irrigated sorghum to dryland sorghum; the economic impact would be a loss of $265 million annually in gross revenue for southwest Kansas. For example, delaying this impact for just 10 years adds $2.65 billion in income for farmers in southwest Kansas. The cost of raising the overall efficiency from 70% to 90% would be about $282 million for Groundwater Management District #3 alone. Additionally, dryland production of feed grains would only provide about 30-40 million bushels of sorghum.

KSU has invested three years in research on highly efficient irrigation systems such as drip and LEPA (Low Energy Precision Application). Those projects have depended upon cooperation among Agricultural Engineering, Agronomy, the Northwest Research-Extension Center and the Southwest Research-Extension Center and have been supplemented by funds from USDA, Kansas State Board of Agriculture, local groundwater districts, and industry.

2/21/92
1-15

Relevance of Weed Control Research in the Kansas Agricultural Experiment Station to the Kansas Economy

Phillip W. Stahlman
Fort Hays Branch Experiment Station, Hays

Weeds are the major pest affecting man and the production of Food and fiber worldwide. Losses in both yield and quality of crops, plus costs of controlling weeds, exceed $15 billion annually in the U.S. In Kansas, the value of lost production of corn, soybeans, grain sorghum, and winter wheat from weed interference ranges from $350 to $450 million annually. This does not include the costs of controlling weeds, losses incurred in other crops and rangeland, or the incalculable costs of additional land, labor, livestock, equipment, fuel, and other pesticides and fertilizer that may be required to maintain economical commodity production when weeds are present. In addition, allergic reactions to weeds affect the health and well-being of many persons in urban and rural populations alike.

The profitability of farming in the U.S. has become precariously low. Commodity prices have not kept up with dramatically increased production costs. Also, mandated federal programs have necessitated changes in production practices which have resulted in increased pest problems, especially weeds. To survive, farmers have had to increasingly depend on agrichemical inputs to increase the efficiency of their operations and to reduce soil erosion potential. Pesticides and fertilizers now constitute about 50% of the variable costs and 25% of total production costs incurred by U.S. farmers.

Weeds influence farmers production decisions more than any other agricultural pest. They spend more than $3 billion annually for herbicides and their application with herbicides accounting for more than two-thirds of total pesticide sales. Each $1 spent on herbicides historically returns $3 to $6 in increased gross output. Kansas farmers apply herbicides to 85 to 90% of the corn, sorghum and soybean acreage and about 30% of the winter wheat acreage. In comparison, less than 50% of the corn and less than 5% of the sorghum, soybeans, and winter wheat are treated with insecticides, and less than 1% of cropland acreage is treated with fungicides.

Increased public concern and debate on public health and environmental risks associated with the use of synthetic chemicals have stimulated interest in and investigation of alternative weed management systems. The following illustration is an example of our activity in this area and its potential effect on the Kansas economy.

Microbiological Control of Grass Weeds in Winter Wheat
Farmers are adopting conservation tillage production practices in

2/21/92
1-16

an attempt to reduce soil erosion. The adoption of these systems and low-competitive, high-yielding semi-dwarf winter wheat cultivars have been accompanied by a dramatic increase and dispersal of winter annual bromes (cheat, downy brome, Japanese brome) and jointed goatgrass. Winter annual bromes and jointed goatgrass infest an estimated 6 million acres of dryland winter wheat in the western U.S. and nearly 1 million acres in Kans, and their spread is continuing. These winter annual grasses reduce winter wheat yields by an estimated 15% to 20%. Based on current prices, this equates to annual losses of $300 to $400 million nationally and $50 to $65 million in Kansas.

Selective chemical control of winter annual grass weeds in wheat is either inadequate or cost prohibitive, depending on the herbicide. Biological weed control agents are perceived as safer than synthetic chemical controls. They have the potential of reducing the need for both chemicals and tillage and may lower crop production costs while enhancing environmental quality and alleviating public health concerns.

In 1988 we received a grant from the Kansas Agricultural Experiment Station to assess the potential of using native, nonengineered soil bacteria to selectively control winter annual grass weeds in winter wheat. This is a unique and promising new approach to weed management. USDA personnel at Washington State University and the University of Missouri have the only other known public research programs investigating the use of bacteria for selective weed control in crops. We have developed a strong cooperative relationship with the USDA personnel at Washington State University that enables both programs to access and benefit from each others research.

Currently, we have isolated more than 150 bacterial isolates which inhibit the root development of one or more annual bromes and jointed goatgrass without affecting wheat in laboratory studies. Several isolates continue to demonstrate weed suppressive activity in nonsterile soil where they must compete with natural microbial populations. In a preliminary field study in 1990, one of our isolates increased wheat yields by 13%. Effects of several isolates currently are being evaluated in field studies on several weed species and winter wheat.

These naturally-occurring bacteria proliferate at moderate to low temperatures (late-fall and early-spring) and suppress plant growth by selectively colonizing the root surface and producing a short-lived toxin. If this occurs during the seedling stage, the crop gains a competitive growth advantage, and may further suppress weed growth at later stages of growth. The bacteria function as a direct delivery system for the natural plant-suppressive compounds they produce. Their populations diminish to natural levels as soil temperatures increase during late-spring and summer months.

2/21/92
1-17

We are participating in a five-state USDA Pilot Project to field test a promising bacterial isolate which in a field test in Washington reduced aboveground growth of downy brome by 50% and increased winter wheat yields by 31%. Preliminary data suggest this isolate may not survive and proliferate as well in Kansas as in Washington.

Potential benefits of this new technology include improved crop production efficiency, more rapid adoption of production practices which reduce soil erosion, reduced reliance on synthetic chemical herbicides, and reduced environmental and health risks associated with chemical pesticides. Although we currently are emphasizing weed control in winter wheat, this technology has application in other crops also. It is essential that alternative, environmentally-friendly weed management strategies be developed to maintain efficient crop production and restore public trust in agriculture.

This novel approach to weed control has attracted national attention and has stimulated considerable interest from both public and private sectors. We received notification that we are to receive significant federal and industry support to continue our research.

It is essential that the Kansas Agricultural Experiment Station continue to have the resources to fund novel research projects that address environmental quality and agricultural sustainability.

2/21/92
1-18

Impact of Selected Range Research on the Kansas Economy

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In Kansas, between 17.3 and 18.6 million acres (approximately 35% of the land area) are classified in land-use categories that would fall within the general rangeland classification. Kansas' rangelands are among the most productive in the nation. This is particularly true of the tallgrass prairie region (approximately 5 million acres). On January 1, 1991, the total number of cattle and calves in Kansas was estimated to be 5.7 million. This included 1.35 million beef cows whose diets are primarily dependent on rangeland and/or harvested forage. In addition, an estimated 1.5-1.8 million growing steers and heifers (stockers) are entirely dependent on native range during particular intervals each year. Given the value of these animals and their heavy dependance on native range for sustenance, a considerable potential exists for impacting the Kansas economy via influencing management practices employed by Kansas' range livestock producers.

Range research at Kansas State University has addressed both classical range (pasture) management and the nutritional management of livestock grazing native rangelands. Within the range management area, research regarding grazing management and burning demonstrate the potential for economic impact. Although numerous approaches to grazing management have been proposed, KSU research pioneered grazing management which promoted rangeland vigor while maintaining individual animal performance. The resultant system, known as intensive early stocking (IES), is becoming accepted by "stocker" operations in Kansas and has potential for considerable expansion. This system involves grazing at doubled stocking rates for only half of the normal grazing season. In order to calculate the potential economic impact that would result from applying this system, the following assumptions were used:

Length of grazing season: Normal=150 days, IES=75 days
Typical stocking rate: Normal=4 acres/head, IES=2 acres/head
Expected gains: Normal=1.8 lbs/head/day, IES=2.3 lbs/head/day
Pounds beef/acre: Normal=67.5 lbs/acre, IES=86.25 lbs/acre

If half of the tallgrass prairie region was devoted to "stocker" systems (approximately 2.5 million acres), then adoption of IES compared with the traditional grazing approach would represent a potential benefit of $35 million annually (assuming feeder cattle at $75.00/cwt). Recent KSU research indicates that stocking rates can be further elevated under IES without depressing animal performance. Under such conditions, elevating the stocking rate

2/21/92
1-19

to 1.5 acres/head would increase pounds of beef per acre to 115 and the potential annual benefit to approximately $89 million. In addition, preliminary research indicates that cattle from IES systems are more efficient in feedlot performance which would result in economic benefits to the feedlot segment of the beef cattle industry.

A second area of research in the range management area which deserves consideration is the impact of burning. While burning has been practiced in the tallgrass prairie region for over 100 years, KSU research has maximized the impact of that practice by defining the proper time to burn for maximum livestock response and effective weed and brush control. A recent summarization of a long-term burning project indicated that for "stockers" grazing the entire season, gain would be increased an average of 30 pounds. For "stockers" maintained under a season-long grazing program, this would translate into an increase of 7.5 pounds of beef per acre. If half of the tallgrass prairie region (2.5 million acres) was involved with raising "stockers" and practiced annual burning, the potential economic advantage would be approximately $14 million annually (assuming feeder cattle at $75.00/cwt). An additional benefit of burning is the effect on weed and brush control. Brush control effects are evident even with intermittent burning and are expected to cost approximately $20/acre every ten years or $2.00/acre annually. Thus, the economic dividend resulting from effects on weed and brush control on the 2.5 million acres would be approximately $5 million. The combined impact would be on the order of $19 million annually.

With regard to the nutritional management of range livestock, an important area of KSU research during the past several years has been is the optimization of beef cattle supplementation programs. Research at Kansas State has provided strong supporting information regarding the validity of emphasizing protein supplementation for cattle consuming poor-quality range or other poor-quality forages. It is common to observe differences in conception rate of 5 to 6 percentage units between low and high protein supplements. If such improvements were applied across half of the beef cows in Kansas (approximately 675,000 cows), the potential value of the additional calf crop would be about $16 to $19 million annually (assuming weaning weight of 500 lbs and value of $95.00/cwt). Supplementation research with "stockers" has emphasized the use of energy supplements to complement the high-quality forage consumed by livestock managed under IES. In addition, the use of supplements in conjunction with federally approved growth promotants (for example, ionophores) has been evaluated. Results from a 4-year trial completed during 1991 indicated that supplementation of steers managed within an IES system with 4 pounds of sorghum grain plus an ionophore would increase gain by .5 to .6 lbs/head/day (assumes .1 to .2 lbs/head/day gain from an ionophore administered at 200

2/21/92
I-20

mg/head/day). If feeder cattle were valued at $75.00/cwt, then the increased value at the end of the IES period would be approximately $31.00. Assuming sorghum grain to be $75.00/ton, estimated cost of grain plus labor would be slightly more than half the value of the additional gain. This would translate into a potential increase in net profit of $12.00 to 14.00/head. If this approach to supplementation was applied in conjunction with IES on half the land area in the tallgrass prairie region, the increase in economic impact (above IES alone) would be approximately $16 million.

Finally, although the estimated economic impact of range research is quite significant, it also is important to recognize the contribution of such research to the long-term sustainability of rangeland ecosystems in Kansas. The goal of the range management and range livestock nutrition research programs at Kansas State University is to pursue management schemes which optimize the efficiency of range livestock operations while ensuring the maintenance of a vigorous range-plant community. While maintenance of our range resource in an excellent state may not be easily quantifiable from an economic standpoint, it ensures that future generations of farmers and ranchers in Kansas will be able to continue to participate in this unique, and economically viable, sector of Kansas agriculture.

2/21/92
1-21

Economic Development Committee Presentation
Value Added Food Products and Food Safety

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The efforts within the Kansas Agricultural Experiment Station cover a wide variety of food products relative to value-added and food safety research. Because our time is limited, I have selected one facet of this total effort that integrates value-added processing and food safety.

Adding value to beef and beef products that are produced and initially processed in Kansas is a central focus of our research. One research area is designed to maximize the value of beef by restructuring portions of the carcass, that would normally go to ground beef, into higher value steak- and roast-like items. The restructuring technology which allows the development of those kinds of products has been and will continue to be one of our major research thrusts and is most logically performed at or near the point of initial processing. This research is designed to encourage a significant portion of the 4.0 billion pounds of the carcass beef processed in Kansas to be further processed within the state, thus adding value before shipment. Conservatively assuming that the 4.0 billion pounds of carcass beef yields 1.0 billion pounds of ground beef raw material of which 20% could be upgraded from ground beef prices to add an additional $.50/pound due to restructuring, this would mean $100 million in added value in Kansas. Additionally, to add that value would require additional labor and capital investment that would contribute to the economic base in Kansas. Restructured products are being demanded by consumers because they offer a high quality, economical alternative to traditional steak and roast items. That variety of choice and resulting enhanced demand is critical to the future of the Kansas beef industry.

The products discussed above require careful handling and monitoring during formulation, packaging, shipping, and marketing. To meet consumer demands for quality, safety needs to be assured before shipment from Kansas-based processors to domestic and international markets. Also, shelf life of the product must be enhanced to withstand processing at a central facility and subsequent shipping and marketing. This is particularly critical to U.S. competitiveness in international markets.

To support this effort our safety research is designed to rapidly detect disease causing bacteria. This allows for microbial quality of the product to be determined before shipment which minimizes product recall and the incidence of food borne disease. This enhances consumer confidence in and demand for meat. Current research has led to developments that allow detection of

2/21/92
1-22

Listeria, a potentially pathogenic bacteria, in 24 hours versus 9 to 14 days. We are also determining the most critical control points during processing to apply naturally occurring meat constituents, such as lactic acid, to enhance product safety and shelf life.

This is just one example of how we are integrating value-added and food safety research to meet the needs of Kansas, the goals of the Kansas Agricultural Experiment Station, and the objectives Food Safety Consortium special grant funding by the USDA Cooperative State Research Service.