

PLAN OF WORK

Oklahoma State University

**Division of Agricultural Sciences and Natural
Resources**

Oklahoma Agricultural Experiment Station

Federal Fiscal Years 2000-2004

July 15, 1999

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Introduction

The Division of Agricultural Sciences and Natural Resources (DASNR) of Oklahoma State University, located in Stillwater, Oklahoma, includes the Oklahoma Agricultural Experiment Station (OAES), the College of Agricultural Sciences and Natural Resources (CASNR), and the Oklahoma Cooperative Extension Service (OCES) and is a separately administered entity.

This Plan of Work (POW) summarizes the overall research goals and objectives, as well as the individual programs, established within DASNR to address the needs of our users, consumers and patrons for the next five years. Components of the POW are based on the OSU DASNR Strategic Plan, which is being evaluated, revised and updated in 1999. A draft copy of the DASNR Strategic Plan is appended. Priority areas 2-6 of the Strategic Plan are virtually identical to the five national goals of the Agricultural Research, Extension and Education Reform Act of 1998 (AREERA).

The Plan, which was designed to coordinate with the POW of the OCES, includes the elements required by AREERA and the USDA's Guidelines for Land Grant Institution Plans of Work.

Contact Person

All correspondence regarding this plan should be directed to:

Dr. D.C. Coston
Associate Director, Oklahoma Agricultural Experiment Station
139 Agriculture Hall
Oklahoma State University
Stillwater, OK 74078

Voice: 405-744-5398
FAX: 405-744-5339
E-mail: dcoston@okstate.edu

Adoptions by Reference

Planned Programs

AREERA National Goals 1–5, as presented in the *Federal Register: April 19, 1999*, are addressed by Oklahoma Agricultural Experiment Station research efforts in National Goals 1–5, respectively. These programs are described below, and an estimate of the allocated resources (financial and scientist year support) for each program is provided. Many individual projects, of course, involve faculty teams from multiple departments and disciplines and contain research components that cross program lines. Such projects were assigned to the one program area best representing the largest component of that project. A small number of projects address particular regional or local issues and are not specifically included within one of the five POW National Goals.

CSREES National Goal 1: An agricultural system that is highly competitive in the global economy.

Issues

Oklahoma agriculture competes in a marketplace that is both national and global. International markets have long been important for the state's grain crops, and exports of the state's beef, pork, and poultry products are growing. Applied and fundamental research programs in plant and animal agriculture and natural resources, including an emphasis on value-added industry, will remain cornerstones of DASNR's work. The Division's programs will be comprehensive, spanning fundamental inquiry, production, management, processing, marketing and policy.

Performance Goals

Increase knowledge of plant, animal and soil systems and their interactions; increase the production efficiency of major and alternative agricultural enterprises; improve farm, ranch and agribusiness management practices; and enhance national and international market opportunities for Oklahoma's commodities and value-added products.

Output Indicators

1. New production practices and improved products and/or services that are more efficient, improve net returns, and/or are environmentally more favorable or sustainable.
2. New market opportunities and value-added products for Oklahoma commodities.
3. Results of research for development of selected products and new agricultural practices.

Outcome Indicators

1. Enhanced domestic and international markets and trade opportunities for Oklahoma agricultural products.
2. Increased efficiency and yields, improved quality, and greater returns and market share from agricultural products to Oklahoma producers.

Key Program Component(s)

- Fundamental Inquiry

In the Department of Animal Science, efforts concentrate on the molecular mechanisms that control functions of animal cells and organs. Examples include the evaluation of proteins produced by embryos to improve embryonic survival and the development of techniques to modify the genetic makeup of bacteria to produce new dairy products.

In the Department of Biochemistry and Molecular Biology, key investigations focus on plant metabolism and biotic stress, plant genomics and bioinformatics relating to plant stress responses. Following exciting recent discoveries on the crystallization and X-ray analysis of the structure of the cytochrome b/c1 complex, researchers are identifying molecular mechanisms of energy transduction in electron transport and photosynthesis. Strong research programs also exist in enzymology and protein physical chemistry, and in the molecular biology of animal nutrition and plant and animal disease mechanisms. A recent expansion of the genomics area includes the molecular genetics of arthropods, particularly ticks.

Fundamental research within the Department of Entomology and Plant Pathology include strong programs on the mechanisms of host plant resistance to insects (both pests and predators used as biocontrol agents) and the physiology, biochemistry and immunology of tick-pathogen interactions. Key plant pathology-related basic investigations deal with the nature of plant virus cell-to-cell movement and host plant resistance mechanisms that control virus movement, the molecular basis for insect transmission of phytopathogenic prokaryotes, and the roles and molecular regulation of toxins and the extracellular polysaccharide virulence factor, alginate, by plant pathogenic bacteria.

Basic investigation within the Forestry Department includes emphases on root hydraulic properties and genetic and environmental control of rooting density, gene transfer and genetic improvement of trees, and ecophysiology projects directed toward improved understanding of the effects of environmental stresses and silvicultural practices on tree and forest stand productivity, and the extent of genetic variation in stress resistance within selected tree species.

Fundamental research in the Department of Horticulture and Landscape Architecture includes investigation of the roles of cell wall components in fruit and vegetable texture and ripening, as well as in response to injury and biotic stresses.

In the Department of Plant and Soil Sciences, major inquiry foci include the evaluation of genetic resources for general adaptation of plant species to Oklahoma as well as for specific desirable traits, the characterization of mechanisms conferring water-use efficiency to crops, the chemistry and bioavailability of waste constituents in soils, and the induction of plant resistance genes by pathogens or biotic stress.

- **Beef-Wheat Pasture Management**

Cultural practices relative to planting date and depth for maximizing profitability of dual-purpose wheat are being refined. A self-limited monensin-containing energy supplement and a supplement for hand feeding every other day to wheat pasture stocker cattle is being developed. The supplementation program is expected to consistently increase daily weight gain of growing cattle on wheat pasture by about .5 lb and increase profits by \$15 to \$31 per animal, depending on feed cost and profit potential of the cattle. At a technology adoption rate of 30%, total profit from wheat pasture stocker cattle in Oklahoma could be increased by **11.35 million dollars per year**. In addition, use of the supplement will help in management of bloat and should decrease death losses of cattle from bloat.

Grazing trials are conducted with six hard red winter wheat varieties at four stocking densities. This research has been identified as a high-priority for the wheat stocker/feeder cattle enterprises of the region since the early 1960s. The magnitude of the differences in live weight gains of cattle, grain yields, net returns (\$/acre) from cattle, grain, and cattle plus grain, due to the combined effects of variety and stocking density, will be huge from both biological and economic perspectives. Differences in net return from cattle plus grain should be as large as **\$61/acre**. Stocking density is being studied as to greater and more consistent effect on growth performance of stocker cattle than wheat variety.

The potential of this project for improving the economies of many rural communities in Oklahoma and southern Great Plains is enormous. Annual income in Oklahoma could be increased by \$131 million by improving the technical efficiency of production of the 1.5 million head of stocker cattle that are grown to heavier weights on wheat pasture in Oklahoma prior to being finished in feedlots. This research has similar potential impacts on the 5.5 million head of wheat pasture stocker cattle in the states of Texas, Kansas, New Mexico and Colorado. These studies involve a team of scientists in the Departments of Animal Science, Agricultural Economics, and Plant and Soil Sciences.

- **Wheat Improvement**

Wheat improvement research encompasses several scientific disciplines in the OAES, where research initiatives are identified and implemented by a team of 10 scientists known as the Wheat Improvement Team (WIT). Their mission is to develop and ensure adoption of winter wheat cultivars with marketable grain quality and superior adaptation to the unique production practices of Oklahoma. The team approach provides a natural fit to a research area that requires expertise beyond what the wheat breeder uses in hybridization and selection of superior progeny. It is absolutely critical to developing a comprehensive but targeted breeding strategy for producing cultivars better adapted to dual-purpose (forage and grain) management systems, which are more common in the southern Great Plains than anywhere in the world.

Working closely together are plant geneticists, agronomists, plant pathologists, an entomologist, a physiologist, a cereal chemist, and an extension specialist. Breeding goals are established and continuously modified by the team; the supportive research in germplasm introgression, genomics, pest resistance, stress tolerance, and end-use quality is then conducted in concert with those breeding goals. Each team member participates in the development and evaluation of breeding lines and the subsequent decision to recommend release of a new cultivar. Approximately 70% of the effort is with hard red winter wheat, with the remainder of the program investigating the potential for hard white wheats in Oklahoma.

- **Animal Health**

The College of Veterinary Medicine (CVM) and College of Agricultural Sciences and Natural Resources are heavily involved in collaborative OAES-sponsored research in two major cattle diseases and in cattle and swine reproduction: Transmission of and immunity to *Anaplasma marginale*, Female reproductive biology, and Pathogenesis, diagnosis, and immunity of shipping fever.

Anaplasmosis is a severe tick-borne disease of cattle. OSU has been a leader in anaplasmosis research for many years, and scientists in the CVM and Department of Entomology and Plant Pathology have determined the life cycle of the organism, mechanism of transmission, and important aspects of immunity. There is currently no vaccine available for anaplasmosis; the previous one that was derived from infected bovine blood could induce untoward side effects. One of the main thrusts of our anaplasmosis research is in vaccine development using *A. marginale* that CVM scientists have successfully adapted to replicate in tick cell cultures. This vaccine should stimulate immunity. During the next years, studies will be conducted to determine optimization of cell culture procedures and appropriate dose, immunization procedures, duration of immunity, safety and efficacy of a cell culture-derived vaccine.

Shipping fever is the main cause of death loss, illness and economic losses in the beef cattle industry. Scientists from the CVM and Department of Animal Science have

studied basic and applied aspects of this disease ranging from molecular biology, pathogenesis and immunity related to the viruses and bacteria associated with the disease to nutritional management and treatment of shipping fever. Studies are ongoing to apply basic science principles for disease control, diagnosis and prognostication using the Willard Sparks Beef Cattle Research Center. These studies are designed to determine endogenous factors such as persistent infection with Bovine Viral Diarrhea Virus, bronchoalveolar lymphocyte subsets, acute-phase protein responses, and bronchoalveolar cytokine production that influence whether cattle:

- Resist developing respiratory disease after stress
- Develop respiratory disease and to what extent after stress
- Respond to treatment for respiratory disease.

In addition scientists will evaluate the influence of antibiotic treatment on *Pasteurella haemolytica* isolates with respect to development of multiple drug resistance.

Faculty in the CVM and Department of Animal Science are investigating roles of proteins and other factors produced by the porcine uterus and peri-implantation embryo during the process of placental attachment and establishment of pregnancy. The possibility that similar proteins and processes occur in cattle, which also display non-invasive placental attachment, is also being investigated. In addition, in collaboration with a scientist at OSU-Tulsa, patterns of gene expression in the early embryo in both cattle and swine are being studied with the goal of developing the capability to characterize and modify genetic potential at the pre-implantation stage. Finally, OSU scientists are studying gene expression in the pituitary of nutritionally-anestrous cows in response to exogenous steroid treatment as well as the effects of steroid concentration on uterine expression of the estrogen receptor gene in cows with the goal of understanding the temporal and spatial patterns of the estrogen receptor during the estrous cycle and early pregnancy.

- **Turfgrass Improvement and Management**

Turfgrass research at Oklahoma State University is primarily focused on bermudagrass. Commercial interest in turfgrass in Oklahoma is not only on lawns and golf courses, but also on holding soil in right of ways, city parks, and developing more dependable, higher-quality varieties of greenbelt areas. Since the state is entirely within a transition zone between warm and cool-season turfgrass species, “tougher” varieties are being developed that can withstand not only Oklahoma’s hot summers, but also the effect of Great Plains cold spells that settle into the state. OSU researchers in several departments are testing the ability of these grasses to withstand cold and attacks of spring dead spot (SDS), which is particularly devastating to bermudagrass managed under turf conditions. Researchers are screening other cultivars for resistance to this disease via an effective method of inoculation using infested oats. Cultural methods for control of SDS are also under study. The mechanism responsible for increased necrotic patch size with increased cutting height will be the focus of future studies.

Studies to date at OSU will result in better vegetation selection for low-maintenance areas on roadsides, establishment, Best Management Practices, and Integrated Pest Management. Cooperative studies planned include looking at the effect of runoff from bermudagrass areas. Fewer pesticides applied in the right places at the right times in the correct amounts will result in economic savings and a safer environment. The effectiveness of buffer strips and other management practices to reduce pesticide and nutrient runoff will be studied in the near future.

Variable rate technology (VRT) is a dynamic program involving several departments, disciplines and programs on crops at OSU. Turfgrass is an ideal place to utilize findings from other areas. Tests are now underway in several departments to determine the effectiveness and economic efficiency involved in using VRT on bermuda turfgrasses.

- **Forage Production**

Despite evidence that progress has been made toward improved profitability of alfalfa hay production, much remains to be done to maximize returns from this commodity. The following list of needs for future research programs includes those items that can reasonably be addressed over the next 5 years.

- Assistance to farmers in setting production goals for alfalfa stands, i.e., high-quality dairy hay with short harvest intervals and potentially reduced stand life vs. lower-quality hay with dry matter yields maximized by longer harvest intervals and longer stand life.
- Development of crop life tables/working budgets for alfalfa stands to include varied levels of inputs (seeding costs, fertility, pest control, harvest costs,) and potential returns annually and over stand life. Include management options to maximize forage quality or to maximize stand longevity.
- Communicate/implement much more effectively the keys for increased stand life including: soil testing for optimal fertility and pH; improved seedbed preparation; use of high-yielding, multiple-pest resistant varieties; inoculation of seed; well-timed and effective insect pest and weed controls; selection of appropriate harvest intervals for desired production goals, i.e., dairy hay vs. on-farm use. Continued evaluation of newly released, multiple-pest resistant varieties to identify those best suited for production in the southern plains. Provide names of recommended varieties to farmers with data to illustrate potential for increased profitability over production with Oklahoma common.
- Continue to refine integrated control programs for insect pests and weeds.
- Investigate means of increasing profitability of the final 1-2 years on declining stands through overseeding with cool-season grasses and spring grazing.

- Conduct additional research/implementation of varied options for packaging and utilization of alfalfa forage, i.e., hay dried and baled vs. green hay baled and wrapped for ensilage.

Identify the most appropriate criteria for establishing fair market value of alfalfa hay and develop/implement more consistent pricing criteria to reflect the value of hay.

- **Decision Support System Development**

A decision-support microcomputer model for analyzing the profitability of grain only, dual-purpose (i.e., cattle and grain), and grazing only enterprises is being developed for use by producers. This program will also contain links to many other sources of information that should be useful to producers in making production decisions.

The Alfalfa Calendar on the world-wide-web will be refined to improve its utility and the range of information provided to users. The utility of decision-making software such as 'Alfweev' for alfalfa weevil control will be enhanced by linking with the calendar.

Using the Oklahoma Mesonet system of 107 weather-monitoring sites located across the state, agricultural engineers are working to develop coefficients for row crops at specific times of the year in order to make accurate irrigation predictions. When complete, a software package will be available for use in on-farm personal computers. The researchers also are adapting this technology to develop an evapotranspiration model for cool and warm-season lawns. Once it is in the Extension phase, OSU personnel can use it as a decision tool to keep their lawns alive without overwatering.

Internal and External Linkages

Partnerships, coalitions, and consortia will be continued and enhanced within the Experiment Station and between it and Extension, other universities, federal agencies, research foundations and private enterprises, as appropriate to the goal. Focus will be concentrated on shared responsibilities and joint research and extension objectives to enhance knowledge and to facilitate technology transfer when appropriate. For example, faculty from several different OAES departments have joined to form cooperative research Teams for enhanced communication and synergism in the Program 1 areas of Wheat Improvement, Turfgrasses, and Beef Cattle Stress. International linkages, such as several long-standing cooperative projects with CIMMYT, will continue to strengthen OSU's agronomic and plant breeding research.

Target Audiences

Focus will be devoted to commodity producers, processors, and consumers of food and agriculture products, including small and mid-sized operations and disadvantaged individuals.

Program Duration

Five-year program life for approximately 140 projects pertaining to this program area will continue as deemed necessary.

Allocated Resources

(\$'s x 1000)
(SY = Scientist Year)

Current (1998)		FFY 2000		FFY 2001		FFY 2002		FFY 2003		FFY 2004	
\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's
25,662	72.6	25,919	72.6	26,178	72.6	26,440	73.0	26,704	73.0	26,971	73.0

CSREES National Goal 2: A safe and secure food and fiber system.

Issues

The OAES is actively involved in research designed to improve the quality of food and agricultural products, to provide technical support for the evaluation of the safety of Oklahoma food products, and to develop new processes and genetically improved plants, animals, and microorganisms. The establishment of the new OSU Food and Agricultural Products Research and Technology Center (FAPC), in which a team of new research faculty affiliated with various home departments throughout the Division are housed together to optimize interdisciplinary research efforts, is evidence of the importance of this Program within the Division.

Performance Goals

Improve quality of food and agricultural products; improve microbial food safety; enhance use of Oklahoma commodities; and enhance development of value-added process industries in rural communities.

Output Indicators

1. Improved methods for detecting and control of food-borne pathogens.
2. Improved processes to enhance food quality.
3. Improved quality and shelf life of foods.
4. Increased use of Oklahoma commodities.
5. Development of value-added processing in rural Oklahoma

Outcome Indicators

1. Better quality and safer foods.
2. Increased shelf life to permit better marketing of foods.
3. Increased demand for Oklahoma commodities.

Key Program Component(s)

- Food Safety

ogist in OSU's FAPC has areas of specialty dealing with specific pathogens. The pathogens E. Coli, listeria, salmonella, and campylobacter are the primary focus of many studies. In each case, FAPC scientists are working directly with industry to solve a specific challenge in addition to addressing the effect that pathogen may have on society as a whole. Probiotics, compounds derived from lactic acid to control the growth of pathogens, also is under study. FAPC scientists are drawn together from several disciplines, and though housed at the FAPC building, are members of various departments in the OSU Division of Agricultural Sciences and Natural Resources.

n agricultural engineer, brings to the FAPC food safety team an understanding of process and process control, which may kill or limit the growth of pathogens. Others contribute an understanding of meats and of minimally processed vegetables, two food groups that are susceptible to microbial outgrowth and transmission of food-borne infections and toxins.

Through the team approach, this group of scientists performs fundamental research on the development of critical points for the processing of foods and on methods of isolating and enumerating pathogens. This includes pathogens in foods, on processing surfaces, or in the environment where food is being processed or handled. The team also assesses the effects such controls have on the quality characteristics of the food being processed. Consumers use quality characteristics such as color,

texture, aroma, and taste when purchasing or re-purchasing foods, and are hesitant to allow these quality characteristics to be significantly lowered. That is true even though safety also is a major concern they have with the food supply. The goal is to optimize quality while assuring through the development of critical control points that the process will yield a safe product.

Internal and External Linkages:

Cooperation among the various OSU administrative units, including several departments and the OSU Food and Agricultural Products Center, provide major input, resources and effort. Cooperation with other state universities, such as Langston University, is also important. Oklahoma food and agricultural products processors and producer groups continue to provide support and cooperation in this program. Various producer or non-producer groups hoping to begin value-added businesses, and those involved in food and agricultural products distribution and retail sales, also are valuable linkages.

Target Audiences

The primary focus will be on agricultural products processed in Oklahoma but also will be applicable to other regions. Those benefiting from the research include producers, processors and consumers. A portion of efforts will focus on developing or expanding value-added processing in rural communities of Oklahoma.

Program Duration

Approximately 10 projects are currently supported in the area of food and fiber quality and safety, and will continue through and beyond the life of this plan.

Allocated Resources

(\$'s x 1000)
(SY = Scientist Year)

Current (1998)		FFY 2000		FFY 2001		FFY 2002		FFY 2003		FFY 2004	
\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's
1,752	4.0	1,787	4.1	1,823	4.2	1,859	4.2	1,896	4.3	1,934	4.4

CSREES National Goal 3: A healthy, well-nourished population.

Issues

Health-conscious consumers and new information on lifestyle-related illnesses have increased the need and demand for nutrition and health research efforts. Oklahoma has high rates of heart disease, cancer, cerebrovascular disease and chronic obstructive pulmonary disease. DASNR has established the goal of improving the diet, health and nutrition of Oklahoma's citizens. OAES research supports this goal in many ways, including the improvement of agricultural practices designed to assure an abundant supply of nutritious food at reasonable cost, assessment of consumer eating behaviors, evaluation of health risks in the elderly, and investigation of the roles of micronutrients in health and disease. Special attention is directed toward nutritionally and physiologically at-risk populations. The Division is uniquely positioned to address these issues through interdisciplinary research between faculty in Agricultural Sciences and OSU's College of Human Environmental Sciences (CHES), as well as with the CHES and the OSU Wellness Center and the OSU College of Osteopathic Medicine in Tulsa.

Performance Goals

Improve diet, nutrition and health throughout the life cycle.

Output Indicators

- 1 Results of research on the effects of specific nutrients on specific health issues.
- 2 Results of research on factors influencing the nutritional health and food consumption behavior of Oklahomans, particularly at-risk groups such as children and the elderly.
- 3 Development of improved nutrition education materials.

Outcome Indicators

1. More appropriate food choices by Oklahomans.
2. Enhanced fitness and health of Oklahomans.
3. Reduced health care costs for Oklahomans.

Key Program Component

- Roles of micronutrients in health and disease

Issues of nutrient needs for health and the prevention of disease are critical. Several CHES faculty, supported by resources from OAES, focus on research which identifies ways of helping people meet their nutritional needs. Major studies center on trace minerals and nutrient interactions.

Effects of diminished estrogen and depletion of chromium, manganese, copper, or magnesium are being investigated. Metabolic changes associated with women's

health, such as bone density, glucose intolerance, and serum lipids, are being examined. Related studies focus on factors influencing consumer eating behaviors and nutrient adequacy on chronic disease risk. Objectives are to identify factors that lead to poor food choices, which can lead to inadequate micronutrient intake and increased risk of chronic diseases.

Analogues of vitamin A are being synthesized and evaluated for biological activity relative to cellular growth and differentiation as chemopreventative and chemotherapeutic agents for various types of cancers. This should result in compounds with higher activity and lower toxicity than natural retinoids and provide additional insight into structure-activity relationships.

Internal and External Linkages

Collaborations between faculty with OAES appointments in the OSU CHES and those in DASNR departments are very productive. Partnerships underway with the USDA Human Nutrition Research Centers at Beltsville and Grand Forks, with other universities (both within and outside of Oklahoma), and with the private sector, also contribute to these projects. For example, current cooperative projects with Langston University include a strengthening grant and a proposal to USDA to investigate obesity in Native American and African American children.

Target Audiences

Many of the projects in this Program area target the population of Oklahoma, with particular emphasis on at-risk populations including pregnant teenagers, children and the elderly. Other projects target state health and nutrition professionals, institutions and organizations.

Program Duration

OAES has a long-term commitment to addressing the role of diet in maintaining health throughout the life cycle. This research area, which includes approximately 7 projects, will continue well beyond the life of this Plan of Work.

Allocated Resources

(\$'s x 1000)
(SY = Scientist Year)

Current (1998)		FFY 2000		FFY 2001		FFY 2002		FFY 2003		FFY 2004	
\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's
862	1.7	879	1.7	897	1.8	915	1.9	933	1.9	952	1.9

CSREES National Goal 4: Greater harmony between agriculture and the environment.

Issues

Oklahomans want to provide a reasonable measure of security for future generations while continuing to use natural resources to meet their needs. The range of environmental concerns of the public includes real or perceived threats to air, water and soil quality as well as to wildlife and ecosystem health. The goals of protecting and managing natural resources, expanding and promoting strategies for integrating pest management in rural and urban environments, and achieving effective and efficient waste management systems, particularly from intensive animal production systems, provide opportunities for OAES research in the area of agriculture and the environment. There also are opportunities for improved land stewardship that integrates wildlife and natural resource management with agricultural production.

Performance Goals

Protect air, water, soil and other natural resources; expand and promote integrated pest management practices in rural and urban environments; develop effective and efficient waste management systems; and develop sensor-based nutrient management systems.

Output Indicators

1. Sustained and/or increased agricultural production consistent with environmental safety and protection.
2. State agricultural production indicators.
3. Increased use of IPM in agricultural production systems.
4. Results of research on optimization of environmentally sound agricultural production practices.

Outcome Indicators

1. Reduction of excessive nutrients in surface and groundwater from sensitive watersheds.
2. Reduced use of environmentally deleterious agricultural chemicals.
3. Improved game and non-game wildlife and other natural habitats.

Key Program Component(s)

- Fundamental Inquiry

Basic research areas in several departments within the Division are geared towards the evaluation and enhancement of plant host defense responses induced by biotic and abiotic stress and the development of effective biocontrol methods for management of plant diseases. Such efforts directly and/or indirectly impact the reduction of pesticide usage and the enhancement of water quality in Oklahoma lakes and streams.

- Integrated Pest Management

Most research projects dealing with plants or animals will have some aspect of the IPM component. A good example is a stored grain study in which agricultural engineers are seeking to keep stored grain insects in check with less fumigation and with better results. This is an area wide project in cooperation with Kansas State University and USDA/ARS. By making use of closed-loop fumigation technology and proper aeration, sanitation, and monitoring, the researchers expect to reduce fumigation by 50 percent while retaining control of insect populations.

An interdisciplinary team of agronomists, agricultural engineers, agricultural economists, entomologists and plant pathologists have come together to create the Alfalfa Improvement Team (AIM). This team makes IPM its predominant research thrust on the control of alfalfa insects. Working with USDA/CREES' Southern Regional IPM Grants Program, the Oklahoma Alfalfa Hay and Seed Association, and the Oklahoma Cooperative Extension Service, Oklahoma Agricultural Experiment Station scientists are using plant height, daily heat units, insect population monitoring, and other techniques to control insects. Protection begins with variety selection, looking for insect tolerant varieties. Mesonet data helps researchers develop protocols for proper timing of spraying, irrigation, and harvesting.

Urban IPM studies are examining the effect of using the right plants for yard, lawn, and garden plantings, and monitoring carefully for pests, diseases, and weeds. The ultimate goal—in the city as it is on the farm—is to reduce the use of pesticides. This work is being conducted mainly in the Oklahoma City and Tulsa areas. Closely associated is greenhouse IPM research. Again, good monitoring and plant selections are under study. Plant pathologists and entomologists are cooperating in the

greenhouse IPM work to control tomato spotted wilt virus. This is an expensive problem in the greenhouse industry that is carried by the insect vector, thrips.

In research supported by the Animal and Plant Health Inspection Service (APHIS) and cotton grower checkoff funds, researchers are using IPM techniques to monitor boll weevil populations in southwestern Oklahoma cotton fields. Coordinated by APHIS and OAES scientists, area-wide applications are made to every acre when boll weevil populations reach threatening levels.

- **Sensor-Based Precision Agriculture**

Oklahoma State University researchers are conducting a project to develop optically based sensors and control systems to sense crop fertility needs and the presence of pests such as weeds and to variably apply fertilizers or pesticides based on the crops needs. They are developing scientific-precision reflectance sensors capable of measuring the intensity of light reflected from plants at two wavelengths, along with differential GPS based latitude and longitude. They will use these data to indirectly measure total nitrogen in wheat, bermudagrass for forage, and two turf grass species and to correct nitrogen deficiencies in these crops. As part of this research, they will study variability in plant growth and total plant N occurring at submeter distances, and optimum yields occurring when variability is treated at the submeter level. This year, they obtained an eight-bushel per acre wheat yields increase using a sensor based application algorithm at one of two locations treated at this resolution. They will use the sensors to map variability of plant biomass as submeter distances within fields. As part of this research, they are integrating satellite sensor based optical data to better manage agricultural fields and commercial turf.

During the next two years, the researchers will continue development of optical sensors. They will refine application algorithms for nitrogen fertilizer in wheat, and they will extensively test variable-rate sensor/applicators that are equipped to implement these algorithms. They will continue research on integrating satellite and machine based sensor measurements into decision making tools to enable Oklahoma farmers to manage wheat and other crops at less than field scale and as fine as one meter resolution. Currently, the departments of Biosystems and Agricultural Engineering, Plant and Soil Science, Horticulture and Landscape Architecture, and Agricultural Economics are team members for this project.

- **Natural Resource Management**

Wildlife resources present challenges and opportunities over the next decade. Certain popular species, such as bobwhites, have been in a 20-year decline. We are analyzing this problem from two standpoints. First, we have studies underway to examine the genetic health of bobwhite populations as related to landscape circumstances. We have another study evaluating the response of quail populations to weather variables in Texas and Oklahoma. This research will help to assess effects, if any, of global climate change. The opportunities for wildlife resources include a strong interest from the general public and the potential of increased revenue

for ranchers through commercial birding tours and lease hunting. We will study and analyze the abundance of bobwhites relative to land use and cover at the scale of farms and ranches in central and western Oklahoma. The results will aid in ranch management for individuals who want to diversify income opportunities. The relation between wildlife populations, land use, and weather variables will remain topical into the future.

The environmentally concerned public will hold agriculture accountable for losses of wetlands and critical wildlife habitat and the resulting loss of biodiversity. Our rangeland management research has shown that urban sprawl and suburbanization are also major contributors to habitat fragmentation, which results in loss of biodiversity. Clean-till cropping, large blocks of monocultures, and loss of vegetated field borders are considered by the environmentally concerned public to be the major contributors to habitat fragmentation, which is viewed by conservation biologists as a major influence on species emigrations and extinctions. The effects of these alternative land uses on biodiversity have not here-to-fore not investigated in the Great Plains. The rangeland management research team is currently focusing on the influence of land use on biodiversity to include how land use and management practices influence species of wildlife that are declining.

Society is beginning to expect agriculture to operate food production systems with minimal negative "externalities", that is, minimal costs paid by society. Examples of externalities resulting from food production systems are sedimentation of surface water impoundments, air pollution from dust, and loss of fish and wildlife habitat. At the same time, food production systems will be increasingly expected to be profitable to the individual producer and to the rural community in the absence of governmental subsidies. Consequently, a major thrust of the rangeland management research team is to integrate alternative objectives into traditional livestock production systems that result in both ecologically sound and profitable food production systems. One such alternative is to combine fire and cattle grazing in a dynamic sequence to increase landscape heterogeneity on rangelands. In the proposed system, supplementation inputs for cattle would be reduced to increase enterprise profitability while at the same time enhancing biodiversity and critical wildlife habitat.

Management research in Forestry is directed toward two thrust areas: (1) quantification of the forest resource in biological and economic terms, and (2) evaluation of the environmental consequences of forest management. The primary target for applied research results has shifted from industrial forest products companies having a primary objective of intensive timber management toward non-industrial and public forest landowners interested in non-intensive forest management practices to achieve broad resource stewardship goals.

Research in forest biology will continue to focus on developing a better understanding of the effects of environmental variables on tree and forest growth, function, health and sustainability. Included are projects addressing global climate change issues as well as investigations of ecological processes and their effects on

forest management components. Forest biology research is linked to additional projects in forest biometrics which seek to develop and evaluate new methods of assessing forest condition and predicting future condition. Results from research in quantitative forest management are expected to assist natural resource managers in balancing economic stability with public desire for non-commodity benefits. This effort is supported by research in forest economics to develop valuation procedures that allow the integration of multiple forest uses when making natural resource decisions.

The research program in water resources will continue to emphasize basic research of hydrologic and biogeochemical processes on forest watersheds, research on effects of forest management on water quantity and quality, and the application of new technology to solve water resources problems.

- Water Quality

rust of water quality research in the OAES involves controlling runoff in one form or another and the resulting effects on downstream water. There are large numbers of cooperative studies underway involving several different departments and disciplines. The leading factor under study in the OAES is the reduction of nitrates in ground water sources, whether the nitrates originate from man-made fertilizer or from animal waste sources. Agricultural engineers and soil scientists are working together to study the movement of nitrates through soil profiles. This will depend on soil type, type of application, and amount of rainfall or irrigation. The current research is looking at nitrate movement through soils in cotton plantings under irrigation.

of many tons of poultry litters from eastern Oklahoma broiler houses has greatly increased pasture production while increasing downstream water problems. OSU research programs are seeking parameters for maximizing pasture potential while reducing the environmental impact on the watershed. One study is cooperating with the University of Wisconsin and with Texas A&M. OAES scientists from agronomy, agricultural economics, biosystems and agricultural engineering, are also working with an OSU zoologist and an algae taxonomist with the University of Oklahoma Health Sciences Center.

f pollution from forest roads is an on-going study important to eastern Oklahoma. Many forest roads create result in considerable erosion that winds up in downstream waters. Hydrologic models are being developed for large areas of forested land with different topographical features to study this type of erosion, and also that stemming from various types of logging operations.

Wellhead protection systems for evaluating sources of pollution to community water sources are aimed at protecting small communities and rural areas that cannot afford major water treatment facilities. This involves going into buildings, looking for backflow devices on faucets coming from wells, and sampling for pH, hardness, alkalinity, and fecal coliforms.

- **Animal Waste Management**

Current needs of the animal industry related to waste management dictate that a balanced research program be pursued which searches for both short and long-term solutions to problems. Since odor is identified as the number one priority of the animal industry, current work is focused on evaluation of sources of odor and odor dispersion in the atmosphere. This work is being integrated into a model of odor production and dispersion, with the objective of predicting the probability of odor becoming a problem to neighbors surrounding confined animal operations. Concurrently, research is also being conducted on lagoon dynamics, attempting to determine the ideal operating conditions and biota for lagoons. The longer-term focus of research is to develop procedures to convert animal waste to useful products in addition to soil nutrients. Studies of bioconversion physical treatment processes will be evaluated for their potential to add value to animal and other waste products.

Waste Semi-Arid Agro-Ecosystems is an OAES and USDA/CSRS research project in the Oklahoma Panhandle involving research on waste from any animal confinement unit, but is aimed primarily at swine operations because of the large numbers of swine feeding operations in that area of the state. The primary concern is learning how to use some of the three million gallons of swine lagoon effluent produced in the region each year as a fertilizer without damaging the environment. This project is concerned with learning the physical application methods—primarily irrigation sprinkler systems—as well as preventing pollution of ground and surface waters and reducing associated odors.

Internal and External Linkages

There will be continued focus on integrated research within Oklahoma State University units; current interdisciplinary Team ventures involve faculty from various departments working in the areas of Water Quality, Bioconversion Systems (Waste Management), Sustainable Agriculture and IPM. Also important are cooperative efforts with other state institutions (the Samuel Roberts Noble Foundation and others), with regional universities (for example, the newly formed Six-State Animal and Poultry Waste Management Consortium, which includes Oklahoma State, Michigan State, Purdue, Missouri, Iowa State, and North Carolina State), and with the USDA/ARS.

Target Audiences

All Oklahomans benefit from the enhancement of community air, water and soil quality. Specific members of the target audience include producers of agricultural crops, including cereals, peanuts and forage crops, and animals, including beef, swine and poultry. A recent area of enhanced emphasis has been the management of solid wastes from confined animal operations. Users of natural resources (hunters, fishermen and other recreationists) also are targeted. Increased emphasis has been placed on research related to issues of homeowners and other urban consumers, such as parks and golf courses.

Program Duration

This program of approximately 35 projects will continue during the five-year life of the plan and beyond, as appropriate.

Allocated Resources

(\$'s x 1000)
(SY = Scientist Year)

Current (1998)		FFY 2000		FFY 2001		FFY 2002		FFY 2003		FFY 2004	
\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's
5,977	14.7	6,097	15.0	6,218	15.3	6,343	15.6	6,470	15.9	6,599	16.2

CSREES National Goal 5: Enhanced economic opportunity and quality of life for Americans.

Issues

Quality of human life is enhanced through physical wellness, social, economic and emotional well being, intellectual opportunities and a supportive environment. Enhanced quality of life interfaces with, and overlaps, many other OAES priorities. Specific goals related to this Program include the economic sustainability of rural communities and the complex, interrelated economic and sociological issues of urban communities.

Performance Goals

Increase the economic competitiveness and sustainability of rural communities and industries; increase educational and technical assistance for development of community services and facilities; expand focus on public policy in food, agriculture and natural resources as part of a global economy; and expand food and agricultural product processing, and product and process development.

Output Indicators

1. Better or alternative methods for diversifying local economies.
2. Alternatives and options identified for expanding family income streams.
3. Methods identified to aid communities in providing services and facilities.
4. Results of research in projects related to quality of life and economic opportunity.

Outcome Indicators

1. Improved economic status of Oklahoma communities.
2. Enhanced quality of life for communities through the provision of services and facilities.
3. Opportunities provided for income enhancement and improvement in social well being.

Key Program Component(s)

- Community Planning and Services

DASNR is committed to serving the citizens of Oklahoma through its strong ties to clientele in rural areas and urban communities. The continued reduction in rural community employment opportunities, the related shifts in population from rural to urban areas, and the accompanying decreases in farms, ranches, and other agribusiness, all have contributed to the decline of many small towns throughout Oklahoma. Three specific areas of research include analysis of imperfect markets, economic development options/alternatives, and community services/facilities.

Imperfect markets lead to misallocation of resources and distortions in the development of rural areas. A focal point for research within OAES involves a series of studies of imperfect markets as they relate to rural economic development. Issues of market interdependencies, data and parameter estimates in general equilibrium modeling, and methods of formulating/evaluating policies for correcting market distortions are being addressed. Topics include estimating the effects of imperfect competition in the timber processing industry on raw material prices and income. Rural transportation systems and the role of cooperatives in value-added activities are also areas of research falling under this focal point.

An additional focal point for research related to rural issues is the analysis of alternatives and options for diversifying the local economic base of rural communities. Models are being developed to quantify and measure the results of changes in the local economic base. Additionally, models and data sources are being built which will allow targeting of business/industry prospects based on clusters of existing economic activity. This targeting will allow more efficient economic development efforts at the local level.

Finally, there is a body of research within OAES, which focuses on community services and facilities. These services and facilities, such as health care, solid waste collection/disposal, etc. are important not only for local quality of life but also to enhance the competitive economic position of a region or area. Economic issues being addressed include methods to estimate demand and cost/revenue projection.

The OAES research provides economic information for communities considering service or infrastructure choices.

- **New Economic Opportunities**

With a focus on converting low value biological raw material to higher value products, bioconversion research is currently pursuing bioconversion of agricultural biomass residues to fuel-grade ethanol. A multidisciplinary and multiuniversity team of microbiologists, plant scientists, engineers, and economists from OSU and University of Oklahoma are taking a holistic approach to the process, evaluating production, harvest, transport, processing, and bioconversion processes to develop improved and more cost effective methods in all of these areas. The overall objective is to develop a fuel that is competitive with gasoline. The conversion process being utilized combines catalysis and fermentation. Present conversion work is being conducted at the laboratory to small pilot scale. In the near term, work at full pilot scale is anticipated. Future work will include development of improved microbes through use of molecular biology, development of new transport technologies, and evaluation of the production of other useful chemical products from the process.

Difficult economic times in the early 1980s made it clear that Oklahoma needed more agricultural alternatives. The OAES committed to major thrusts in developing alternative crops for state growers. The Wes Watkins Agricultural Research and Extension Center (WWAREC) was planned, established, and now operates under the premise that it would be a central focus for OSU research in alternative crops. Located in southeastern Oklahoma, it is operated in conjunction with the USDA/ARS in a joint facility known as the South Central Agricultural Research Laboratory. The facility has become a U.S. center for watermelon research. A watermelon survey will continue to expand as watermelon acreages increase, planting dates, planting densities, and fruit growth in relation to size, quality, and vine growth are monitored. In addition, the survey looks at insect control, measures soil texture and composition, soil nutrient values and the corresponding effect on plants. WWAREC scientists in several disciplines also are monitoring how humidity, temperature, spacing, plant and weed competition, and other factors affect the ultimate growth and quality of the fruit. Production profiles are being developed for watermelon, with predicted economic viability of each cultural practice and input being the ultimate goal. The scientists are developing a database of private, public and industry watermelon researchers for the entire U.S. and will be available to anyone via a website.

Other studies examine the effect of treating watermelon transplants with isolates of rhizobacteria for resistance to insects and resulting increases in growth. Principles found in this study could possibly be carried to other crops, hopefully carrying similar positive results.

Other alternative crops at WWAREC include studies on leafy greens, kale, kohlrabi, onion, turnips, and all the cucurbits. A WWAREC squash study is designed to control squash bugs and aphids in various insecticide evaluations, but also to determine

optimum planting dates to avoid insect population peaks. One study is using grain sorghum as a physical barrier between varying levels of a biological control—an extract from the neem plant—to control insects on squash. Cotton and soybean are being grown at the station just to test the efficacy of certain insecticides at different latitudes and temperatures prior to their receiving EPA registration for use on lesser-planted crops. This includes insecticides in the IR-4 program. Studies to compare types of sprayers also are being conducted including electromagnetic. All such studies in the OAES system are conducted related to Integrated Pest Management and environmental concerns.

Agricultural economists are researching the development of a frozen dough business to be located at Alva, Oklahoma, that will make and ship frozen dough for a myriad of products such as pie and pizza crust, cookies, etc. Working with the Oklahoma Department of Agriculture, the scientists are cooperating on the design and layout of the manufacturing facility, and helping to build markets for the products. They also are cooperating with a closed-membership cooperative of farmers and businessmen who will own and operate the business.

A rare recipe from the Civil War era is bringing economic opportunity to Oklahoma with the help of researchers at the FAPC. It is a sourdough-based recipe that is shelf-stable. Because it is a fermentation-based product, the challenge of taking it from the kitchen to a commercial bakery is significant. Scientists are working to get the scale-up process and modifications to the recipe. The product is intended for restaurants, retail and institutional markets.

Agricultural engineers and food marketing scientists are working with a small Oklahoma City entrepreneur to find a co-packer for making and distributing a commercial ricotta cheese. This product will be marketed to up-scale Italian food outlets.

Scientists in FAPC are researching the characteristics of wheat protein that make good bread products. High protein wheat receives a better price, and low protein wheat is discounted. It is now known that certain proteins in the wheat are instrumental to good bread making, while other types are not. It is not just total protein that counts, but what kind that is very important. Food scientists in FAPC laboratories are identifying and determining which are the preferred proteins and how they are involved. When results are available, they will cooperate with wheat breeders, so varietal development can begin. They are also working to develop a new test that will rapidly and accurately reveal the type and total protein a specific wheat sample may contain. The wheat industry will soon be giving discounts or premiums based on the results of these testing procedures.

Another wheat-based research study involves the development of better trout bait. It has financial significance for at least one state-based entrepreneur. FAPC scientists

are working with fish experts in the OSU zoology department to determine the best recipe for trout attractions.

FAPC food scientists are working with OSU and USDA/ARS researchers at the WWAREC, to develop better packaging methods for cut watermelon products. Cut watermelon and cantaloupe products are growing in popularity, but are not a very stable product. Shelf spoilage is common and losses are high, creating unduly high prices on such packages. The researchers are examining the microbial content of cut melon pieces, color, water loss, and other factors that affect spoilage and consumer preference.

Perfectly good watermelons are often left in the field because they are disfigured, scalded, or otherwise deemed of low quality by pickers. These cull melons add up to significant losses. Now FAPC scientists are looking at a way to possibly use these as by-products by developing nutraceuticals from the pigments of watermelons. The nutraceuticals being examined are free-radical compounds derived from the watermelon pigment—called lycopene—that contains anti-carcinogenic properties. The scientists are trying to learn the best methods for extracting, stabilizing, and marketing the lycopenes as a viable product.

- **Public Policy**

Structural change issues continue to affect production agriculture, related agribusiness industries, and rural communities. Agricultural policy changes and international economic policies affect total production of crops and livestock, which in turn affects market prices and farm income. On-going research of the OAES is attempting to measure the financial condition of agricultural producers by type of farm enterprise. Questions are raised regarding economic uses of land and production resources and research is addressing what land may be best suited for alternative uses based on environmental and economic considerations. Rural communities are impacted by policies affecting agriculture. Research is being conducted to assist communities target industries that have a high probability of being successful in rural areas. Community simulation models are being developed for use with communities to assist them in planning infrastructure changes in response to changing conditions in rural economies.

Internal and External Linkages

Existing partnerships will continue, and appropriate new ones initiated, within the Experiment Station; cooperations involving multiple academic departments, the new FAPC, and WWAREC have already assisted many rural families to diversify operations and improve their economic status. A new urban initiative, involving cooperation with a local community development group in Tulsa, is designed to enhance the quality of life and the availability of services for a specific urban population. External partnerships will include Experiment Station efforts with the USDA/ARS, the Oklahoma Department of Commerce, and public utility companies. Other state agencies such as the Health Department and medical/health care organizations will also be potential partners. Beyond Oklahoma's borders, a multi-state research initiative with Nevada, New Mexico and Utah is being planned to explore the development of economic analysis tools such as target industry or cluster assessment.

Target Audiences

The target audience includes local elected officials, community and state leaders, local businesspersons (including home-based businesses), potential businesspersons and agencies, and associations representing these groups. Producers seeking alternative production approaches also benefit from these initiatives. Several projects are directed towards families. In addition, we seek additional opportunities to interact with and serve under-represented groups including Native American nations and Oklahoma's African-American and Hispanic populations.

Program Duration

The 14 current projects in this program area will continue through the five-year duration of the program and beyond, as appropriate.

Allocated Resources

(\$'s x 1000)

(SY = Scientist Year)

Current (1998)		FFY 2000		FFY 2001		FFY 2002		FFY 2003		FFY 2004	
\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's	\$	SY's
1,535	5.1	1,550	5.2	1,566	5.2	1,582	5.3	1,597	5.3	1,613	5.4

Stakeholder Input

Input on research directions from stakeholders within the OAES is solicited through many ways in addition to the traditional communication channels through department heads. Each department prepares its own strategic plan in concert with that of the Division. Faculty and staff input is actively sought in standing and ad hoc committees, and faculty teams may jointly prepare “white papers” on specific issues of concern. Informal “Visits with the Dean” are scheduled monthly, and faculty are invited to stop by without appointments to discuss ideas, projects or any issues of concern.

External stakeholder input is also received from many different sources. Information, review, listening and update sessions are held periodically with user groups to identify needs and share results of research. For example, the Dean’s Advisory Council, which represents major state commodity areas and geographic regions, has a three-year rotating membership and meets twice a year or more to provide input on key planning issues. Commodity-based Foundations, Commissions and Councils, composed of citizen-selected representatives, are another source of input. Each of these organizations is composed of members spanning the state’s ethnic and socioeconomic groups. Additionally, there is frequent interaction with commodity-based organizations, the Oklahoma Farmers’ Union and the Oklahoma Farm Bureau. Other opportunities for face-to-face interactions with our constituents are provided at numerous field days and community programs.

The regular review and revision of the DASNR Strategic Plan provides another opportunity for stakeholder input, as Strategic Plan Development Committees include representatives of various user groups outside the Experiment Station whose input is carefully considered.

We continue to seek input from agencies and associations that represent the state’s businesses and communities, such as the Oklahoma Small Business Bureau. State agricultural representatives in the Oklahoma Department of Agriculture are in frequent communication, as are Oklahoma legislative and administrative groups (state Senators and Representatives). We also work closely with Federal agencies, such as USDA-ARS, USDA-NRCS, USDA-FSA and USDA-RDA.

Direct input on specific needs is obtained from county, district and state extension advisory groups, and continues to be relayed by extension personnel to appropriate research units. The OAES also initiates communication with under-served and/or under-represented citizens including Oklahoma’s Native American nations, the African-American community, and other minority groups. Our faculty have frequent contact with professional peers throughout the world. This too is an important source of information.

In addition to traditional peer-reviewed articles, publications of many types (newsletters, fact sheets) and public information outlets such as television and radio are used to aid information dissemination, and current use of web-based outlets is growing rapidly.

Collaboration with Appropriate Entities

Specific internal and external linkages appropriate to each of the five Program Areas have been presented in those sections of the Plan of Work. The OAES works cooperatively in many projects with representatives from other institutions of higher learning (the University of Oklahoma, the OU Health Sciences Center, Langston University, the University of Tulsa, Oral Roberts University, and many others), federal research groups (USDA/ARS laboratories in the Stillwater area, the WWAREC, Lane, OK, the Grasslands Research Laboratory in El Reno, OK and the Great Plains Field Station in Woodward, OK) and research institutions (the Samuel Roberts Noble Foundation, the Kerr Institute, etc). The OAES seeks and supports productive collaboration and partnership with Oklahoma's small, medium-sized and large industries and business enterprises. We also encourage and support numerous collaborations between OAES faculty and partners in other states, as well as in other nations.

Integrated Research and Extension Activities

The OAES has a long history of conducting research on the issues, needs and problems of the people of Oklahoma. OAES works closely with those conducting the educational and informational programs of the Oklahoma Cooperative Extension Service (OCES), as well as, extension personnel at institutions across the country. This permits the OAES to develop research programs that compliment many of the extension programs in Oklahoma and around the country. This results in the delivery of timely research-based knowledge and information to target audiences. This process occurs constantly between individuals and teams with varying appointments. In addition, many of the OAES research scientists have joint appointments with the OCES. Joint appointments result in the most obvious integration of research and extension programs.

Well identified and functioning integrated teams presently exist in Integrated Wheat Improvement, Management and Marketing; Beef Nutrition and Management; Community Planning and Services; Food Safety; Value Added for Food and Agricultural Products; Mesonet; Integrated Pest Management; Turfgrass Improvement and Management; Cotton Production; Alfalfa Production; Pesticide Programs; Stored Grains; Alternative Crop Production; Animal Waste Management; Beef-Wheat Pasture Management; Forage Production; and Sustainable Agriculture. Other, less extensive, programs often exist where one individual with a joint appointment conducts both research and extension.

The integration between research and extension is part of our culture within the Division of Agriculture Sciences and Natural Resources. The extensive use of joint appointments coupled with strong encouragement toward problem-solving teams is the foundation of the culture. Team members meet regularly to plan and exchange information. They also regularly receive input from one or more advisory group. While the OAES does some very important basic research, the desire to produce pragmatic knowledge and information useful to citizens of Oklahoma and the United States supports an active, broad extension program. Even researchers with no extension appointment are encouraged to be

active in outreach as many extension personnel conduct important applied research. In addition, most County Extension Educators feel comfortable depending on extension and research faculty alike as they seek answers to citizens' needs.

OAES will document that, from all sources, an amount equivalent to no less than 25% of federal funds received under section 3 of the Hatch Act will be expended on OAES scientists with joint OCES appointments during each of the years covered in this plan.

Merit and Peer Review

All Experiment Station projects, whether supported by Hatch or McIntire-Stennis funds, are peer reviewed prior to submission. This includes the Special Grants. It should be noted that stakeholder input into the planning process, position priorities, and research areas to be pursued by the scientists could be considered as the initial step in the review process. This valuable input helps in the merit and relevancy of our projects; it is a continual during the decision process to fill new positions, and direct research efforts and approaches to high priority needs.

Each department in OAES is required to have three reviews for a project (selected by the appropriate Department Head), with one of those reviews being external to the department. In those cases, this will be from another department in the Division, from another College at OSU, or another state with expertise in the area. These reviews are approved at both the departmental and OAES Directorate levels before submission to CSREES. The principal investigator is required to respond to the comments provided by the reviewers before final approval is granted. Most departments utilize the attached checklist.

Multi-State Activities

Twenty-five percent of allotted Hatch funds are expended as Multi-State Research funds. These funds are expended on the following Oklahoma Agricultural Experiment Station projects:

OKL1438	NC-107
OKL1890	NC-170
OKL2070	NC-193
OKL2350	NC-210
OKL2308	NC-220
OKL2078	S-009
OKL1873	S-183
OKL2033	S-222
OKL2280	S-269
OKL2310	S-273
OKL2309	S-274
OKL2333	S-277
OKL2340	S-279
OKL2347	S-280
OKL2357	S-283
OKL2381	S-286
OKL2388	S-287
OKL2233	W-170
OKL2344	W-177
OKL2257	W-190

Level of Federal Formula Funds

We will participate in Multi-State projects that are coordinated through the Regional Experiment Station Director's Associations. Additionally, we will have MOA's and MOU's for specific projects with some institutions.

Certification

Dr. Sam E. Curl, Dean and Director
Oklahoma Agricultural Experiment Station
Oklahoma State University

/

Date

Appendices:

Division of Agricultural Sciences and Natural Resources Strategic Plan
Oklahoma Agricultural Experiment Station Project Proposal Evaluation Checklist