+ **Plan of Work for Agriculture and Forestry Research**
**Clemson University**

July 9, 1999

## Introduction:

The Agriculture and Forestry Research System is headquartered in Clemson South Carolina and works in conjunction with the Cooperative Extension Service to operate Research and Education Centers at four locations across South Carolina and manages research facilities on the coast and adjacent to the main campus in Clemson.

This plan of work is a comprehensive statement of Agriculture and Forestry Research's intended research activities for the next five year, as required by the Agricultural Research, Extension and Education Reform Act of 1998 (AREERA), and as allowed under the USDA's "Guidelines fo r Land Grant Institution Plan of Work." The plan was developed collaboratively with The Cooperative Extension Service's Plan of work and is based in current strategic plans.

CERTIFICATION:

This Plan of Work for the period October 1, 1999 to September 30, 2004 for Agriculture and Forestry Research at Clemson University is respectfully submitted on Friday, July 9, 1999 by:

_____ Date:

Dr. James R. Fischer
Dean and Director
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**PLAN OF WORK NARRATIVE FOR**
**AGRICULTURE AND FORESTRY RESEARCH AT CLEMSON UNIVERSITY**

I. Preface and Authority

Federal Register/Vol 64, No. 74/Monday, April 19, 1999/Notices

The Critical Short Term, Intermediate and Long Term Agricultural Issues in the State of South Carolina

There is no question that our society is changing at a more rapid rate than ever before. At Clemson University we are committed to defining our role in today's society and to preparing for that role to continuously evolve over time.
To this end, Clemson public service and agriculture faculty members and administrators have been heavily involved in futuring activities, soliciting input and sharing findings with America's other land grant universities on our shared responsibilities and challenges.
Clemson faculty recognized that the *Issues to Action* report by the National Association of State Universities and Land Grant Colleges identified common issues for all land grant universities, but that action plans would have to be developed and implemented individually with stakeholder input.

This led to the formation of faculty task forces and to production of a nationally broadcast series of teleconferences on the role of land grant universities in the 21st century. These teleconferences provided a variety of perspectives on land grant roles and responsibilities, and served to create a national dialogue on actions to be taken by land grant universities.

The basis was then established for a faculty-developed action plan with stakeholder input that ensures Clemson University will remain a leader in serving the needs of the people in our state, region, and nation. The action plan is not a static document, but a process that is evolving over time as we gain experience from implementing the plan and from receiving feedback from faculty, administrators, staff, and stakeholders. Where does academia fit in the agricultural industry of the future? How does academia work with the mega-corporations? What happens to rural communities?

For nearly a decade Clemson has been wrestling with an ongoing challenge: How do we meet the needs of society today and prepare to meet the needs of tomorrow? We no longer live in the agrarian society in which land grant universities served only the needs of the family farmer. Instead, we live in a technological and information society that demands more and more information and products at an increasingly fast pace. Along with the needs, the very structure of society is changing at a dramatic rate, as are the food and fiber industries that land grant universities have traditionally served.

Specific agricultural issues in South Carolina

short term issues include:

- economic and physiological stress resulting from the current crisis in agriculture - recent discoveries of plant diseases
- impact of the continuing drought.

intermediate issues include:

- enhancing economic development in rural areas
- increasing research into youth and family development issues
- building partnerships with the private sector to enhance the impact of research programs
- sustainability of air, water and soils for enhanced agricultural production and conservation of natural resources.
- defining alternative agricultural enterprises to alleviate stress from production of traditional commodities, i.e. tobacco

long term issues include:

- utilization of the natural resource base in an environment of rapid popu lation growth, urbanization and sprawl.

The research programs outlined in this plan of work are designed to address these issues.

## II. Submission of the 5 year plan of work for Agriculture and Forestry Research at Clemson University

### A. General

1. Planning Option

The plan of work is a 5 year prospective plan that covers the period of fiscal year 2000 through 2004, with the option to submit annual updates to the 5 year plan of work. The 5 year plan of work may be prepared for an institution's individual functions.

2. Period Covered

The five year plan of work should cover the period from October 1, 1999 through September 30, 2004.

3. Projected Resources

The resources that are allocated for various planned programs in the five year plan of

work, in terms of human and fiscal measures, should be included and projected over the next five years.

4. Submission and Due Date

The 5 year plan of work must be submitted by July 15, 1999 to the Partnerships unit of the Cooperative State Research, Education and Extension Service, U. S. Department of Agriculture. (Bhewitt@reeusda.gov)

5. Certification

The 5 year plan of work has been signed by the 1862 Research Director,
see page 1.

6. Definitions

See Federal Register/Vol 64, No. 74/Monday April 19, 1999, pp 19245-19246.

B. Components of the Five Year Plan of Work

1. Planned Programs

a. National Goals: The five year plan of work for Agriculture and Forestry Research at Clemson University is based on the five national goals established in the Cooperative State Research Education and Extension Service (CSREES) Agency Strategic Plans and lined to the five national goals within the Res earch, Education and Economics (REE) Mission Area of the U.S. Department of Agriculture.

Currently the national goals are:

Goal 1: An agricultural system that is highly competitive in the global economy.
Goal 2: A safe and secure food system.
Goal 3: A healthy, well nourished population.
Goal 4: Greater harmony between agriculture and the environment.
Goal 5: Enhanced economic opportunity and quality of life for Americans.

b. Format: The five year plan of work should be reported in the appropriate matrix format, each cell of which identifies planned programs that fall under one or more of the national program goals

c. Program Descriptions: Program descriptions presented in a narrative form or in each cell of the matrix for a planned program will be related to one or more of the five national goals. A description of the program model being implemented at Clemson and details on the eight programs of Agriculture and Forestry Research at Clemson University are presented here.

Public Service research initiatives at Clemson University are designed to meet the needs of the state's citizens and at the same time be on the cutting edge of science and technology as viewed by peers. Some research needs are more critical and time sensitive than others, and must therefore be given priority over other research needs. Once the needs of the citizens have been met in one area, research emphasis must be shifted to the next priority area. A static set of research priorities will not suffice, because information needs constantly change, and the resource base expands and contracts with new legislative initiatives, grants, retirements and the conclusion of research initiatives.

The Agriculture and Forestry Research System at Clemson uses two primary approaches to meet research needs in South Carolina:, the research project, and the research program.

The Research Project:

Research projects are initiated by individual faculty members to address specific, highly focused research subject area in one of the following five PSA goal areas that align with the strategic plan and which are mirrored in the goals of the Government Performance and Results Act (GPRA).

Agrisystems Productivity and Profitability
Economic and Community Development
Environmental Conservation
Food Safety and Nutrition
Youth Development

Research projects are normally funded for up to a five-year period.

Faculty may purchase the time of other faculty on a contractual (consultant) basis using their allotted project funds to assist in the conduct of the project.

Each research proposal is reviewed by AFR for relevance, capacity and impact.

All research projects are peer reviewed, sent to USDA for approval and included in the Current Research Information System (CRIS).

Annual reports are required on each project. Final reports are required on each completed project.

All PSA research investments must be accounted for by a research project.

Research projects must be submitted according to the following time line:

| | |
|---|---|
| April | Proposals for new projects submitted to AFRS |
| May | Approved projects are sent out for peer review |
| June | Projects sent to USDA for Approval |
| July | Projects are approved and funding becomes available. |

The Research Program:

Research programs are designed in a cooperative effort by numbers of faculty (from multiple colleges if appropriate) when a need for research in the state requires multi-disciplinary expertise, interdepartmental resources and sometimes input and technical assistance from across the region or nation.

As with research projects, programs must be focused in one of the five PSA goal areas that align with the strategic plan and which are mirrored in the goals of the Government Performance and Results Act (GPRA). Programs must be coordinated as appropriate with other PSA program initiatives.

Faculty may develop program areas of research and form program teams based on their current or proposed research projects, using their strategic planning process in concurrence with their department chair and Dean.

Program team members may purchase the time of other faculty on a contractual (consultant) basis using their allotted project funds to assist in the conduct of the program.

Once a program has been defined, all related costs to include those for infrastructure needs, will be calculated to determine program investments. This calculation will help establish the program base budget.

Programs must be submitted electronically for review in a two part format. The first part will outline related activities and accomplishments in the last five years by the program team members, and the second part will provide the planned program activities for the next five year period.

Characteristics of a Research Program Environment

- A web site will be established for each program, and will feature a full range of descriptive

information on the program and selected information on each project associated with the program.

- There will be increased opportunities for interaction and collaboration among faculty who share similar interests and expertise.

- There is the potential for increased collegiality among faculty, technical staff, graduate and undergraduate students and administrators centered around the program area.

- Each faculty member's home page will give them access to current information on their individual project and program expenditures by cost category, as well as the investment history on both.

- The South Carolina Growing component of CU-AIMS will provide a readily accessible electronic and downloadable resource for media and public information on the program, its direction and its contributions to the state and nation.

- There will be increased opportunity for faculty to share facilities, equipment and staff and thus maximize resources.

- Research programs can be effectively marketed to the SC General Assembly because of the relatively board focus of the research effort when presented in a program format, and the clear identification with one of the five PSA goals. will increased recognition

- Program results for all reporting purposes will be available on the program home page. This will eliminate the need for faculty to duplicate report s on programs and progress throughout the year. The faculty's ability to share their work with their colleagues at other institutions will be enhanced, by their ability to pull current information off their home page or off the program home page and send it electronically or in hard copy.

- The program system is totally compatible with all USDA reporting and accountability guidelines to include the Current Research Information System (CRIS).

**AGRICULTURE AND FORESTRY RESEARCH PROGRAM 1: TURFGRASS**

1. Issue to be addressed: The Turfgrass Program, relating to Goal 1 and Goal 4.

The Turfgrass Program at Clemson University is a multi-disciplinary program, involving many research, Extension and teaching personnel working together both on the Clemson campus and throughout the state of South Carolina.

Turf production, establishment and maintenance whether on the sod farm, on the athletic field or on the golf course is an agricultural enterprise that is profitable (Goal 1) and is being researched. Turf, being an agricultural crop, is routinely supplied with fertilizers; treated with pesticides to control insects, pathogens and weeds; is subjected to various agronomic tillage practices. Consequently, environmentally sound practices to forestall pollution of nutrients and pesticides in surface and ground waters is being researched (Goal 4).

Under Goal 1, we are currently releasing two new fescue varieties and have a seeded bermuda grass nearly ready for release. These new varieties are well adapted to our state and should benefit our turf industry. Also, under Goal 1, we are examining and measuring the effects of sub-air irrigation on a multi-variety chipping green at a commercial chipping green. It is anticipated that the information from these experiments will be used in PGA courses where sub-air is required for greens. In other experiments, we are monitoring microbial populations that degrade nematicides. Nematicides that are frequently applied are subject to immediate degradation and are, therefore useless. Better timing of nematicide applications based upon nematode thresholds rather than periodic and frequent applications will likely make the nematicides more effective and cause less harm to the environment (Goals 1 and 4).

2 Performance Goals: To increase turf quality and reduce non-source pollutants (i.e. fertilizer and pesticides)

Output Indicators:
1. Refereed journal articles, patents
2. Improved varieties

Outcome Indicators:
1. Better environment with reduced use of pesticides
2. Increased job opportunities and investments in the state

3. Key Program Components:

Research projects will focus on: Better practices for disease and pesticide resistance and pesticide use, improved water quality, greener, more resistant grasses and use of aeration to improve golf greens.

4. Internal and External Linkages:

Departments of horticulture, plant pathology, plant physiology, entomology, soils, agronomy, economics and toxicology, as well as the Cooperative Extension Service. State Departments of Health and Environmental control, Parks, Recreation and Tourism, Commerce and Natural Resources, Golf Superintendents Association and the Turf Grass Foundation.

5. Target Audiences:

Urban and rural homeowners, commercial lawn care firms, golf course superintendents an d owners, and growers.

6. Program Duration:

Five years

7. Turf Grass Program. Allocated Resources (Planned) by Goal:

| | FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 | |
|---|---|---|---|---|---|---|---|
| 1 | 10 | 53 | 07 | 30 | 79 | 4 | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | 07 | 02 | 05 | 20 | 53 | 09 | |
| 5 | | | | | | | |
| | 17 | 55 | 12 | 00 | 32 | 23 | |

Turf Grass Program FTE Distribution:

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

## AGRICULTURE AND FORESTRY RESEARCH PROGRAM 2: WATER QUALITY

1. Issue to be Addressed: The Water Quality Program, related to Goal 1 and Goal 4

The goal of the water quality program is to develop strategies by which economically viable land use can coexist with good water quality. In order to accomplish this goal it is critical to characterize processes that control contaminant movement, contaminant bioavailability and toxicity, and contaminant degradation and assimilation by natural biogeochemical processes.

The water quality program will have several research areas composed of related projects.

Typical projects include a combination of field data collection and modeling to develop methodologies that are applicable to a wide range of situations. Runoff samples collected from several points (tile outlet, inflow into a pond, outflow from pond, and outflow from a downstream wetland) within an agricultural watershed provide data used to determine changes in pollutant levels as flows pass through the waterways. Such data, along with laboratory analyses, can be used to develop cause and effect relationships and perform mass balances. These relationships are then used to estimate impacts and evaluate techniques for risk mitigation as a function of land use, nutrient applications, crop characteristics, soil properties, and weather conditions. Additional efforts incorp orate Geographical Information Systems and Global Positioning Systems to simplify the detailed data inputs required for modeling watersheds and allow assessment of ecological risk.

2. Performance Goals: Data on measured chemical and sediment constituents and quantities in ground and surface waters shows whether there is a perceived or real problem with water quality. Impacts of changing land use and development on water quality is critical for watershed planning and long term economic growth. Identification of sources and fates of pollutants helps policy makers determine what steps are required to insure a safe water supply. Integration of GIS with water quality models permits "What if ...?" questions to be asked so that risk of environmental damage is considered early in project development.

Output Indicators:

1. Research published in peer-reviewed research journals
2. Extension publications based on peer-reviewed journal articles

Outcome Indicators:

1. Improved water quality an safety for citizens of South Carolina
2. Better information for policy decisions

3. Key Program Components:

Research projects will focus on: Monitoring and Assessment, Point Source Discharge Evaluation, Watershed Processes, Best Management Practice Development, Mathematical Modeling, Ecological Risk Assessment, and Risk Mitigation.

4. Internal and External Linkages:

SC Departments of Health and Environmental Control, Natural Resources, Parks, Recreation and Tourism, the Forestry Commission, Forestry Association, industry, growers

5. Target Audiences:

Commercial producers, rural water districts, processing industry forest industry, rural homeowners.

6. Program Duration:

Five years

7. Water Quality Program. Allocated Resources (Planned) by Goal:

| FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 | |
|---|---|---|---|---|---|---|
| 1 | 9 | 0 | 5 | 5 | 2 | 5 |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | 10 | 01 | 20 | 06 | 54 | 70 |
| 5 | | | | | | |
| | 59 | 01 | 36 | 72 | 16 | 76 |

Water Quality Program FTE Distribution:

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| | | | | | | |
| 7 | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |

**AGRICULTURE AND FORESTRY RESEARCH PROGRAM 3: FRUIT**

1. Issue to be addressed: The Fruit Program, related to Goal 1 and Goal 4.

Some of the objectives of the Fruit Program are to expand the genetic resources for peach rootstock / scion development / enhancement through traditional and molecular technologies, to develop profitable and economically sound production practices and to ensure a high quality, marketable and profitable product. A major program is the development of the Guardian peach rootstock which offers both tolerance and resistance to harmful nematode species that are somewhat controlled by nematicides (Goal 1). Not using nematicides will be beneficial to the environment (Goal 4). We are using reflective films in peach orchards to increase yield (Goal !). We are developing integrated pest and crop management systems (IPM and ICM) for various fruits grown in our state. Less pesticides will be used that harm the environment (Goal 4). Other objectives involve the development of integrated crop and pest management systems that would lead to enhanced environmental quality.

2. Performance Goals: Increase profitability and enhance the environment

Output Indicators: 1. Refereed journal articles, patents, licenses
2. Varietal releases, germplasm releases

Outcome Indicators: 1. Improved varieties of fruit (% acreage adoption)
2. Employment of IPM (% acreage adoption)

3. Key Program Components:

Research projects will focus on: Reduced pesticide usage, stabilize current production of large fruit industry, increase production of small fruit industry, disease and insect resistance.

4. Internal and External Linkages: Horticulture, Plant Pathology & Physiology, Entomology, Ag Engineering, Ag Economics, SC Department of Agriculture, Regulatory agencies, processors, Virtual Fruit Center, NC & GA Land Grants, chemical sales and equipment industry, commercial producers, packers, limited resource farmers, hobbyists.

5. Target Audiences:

Urban and rural homeowners, commercial producers, the processing industry, packing houses.

6. Program duration:

5 years

7. Fruit Program. Allocated Resources (Planned) by Goal:

| FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 | |
|---|---|---|---|---|---|---|
| 1 | 174 | 879 | 301 | 458 | 370 | 054 |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | 575 | 764 | 033 | 384 | 19 | 39 |
| 5 | | | | | | |
| | 749 | 643 | 334 | 843 | 189 | 393 |

Fruit Program FTE Distribution:

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

**AGRICULTURE AND FORESTRY RESEARCH PROGRAM 4: FIRE ANTS**

1. Issue to be addressed: The Fire Ant Program, related to Goal 1, Goal 4 and Goal 5.

The non-indigenous Fire Ant undermines both plant and animal production and decreases the profitability of the agricultural enterprise in South Carolina. They are a nuisance to humans, plants and animals. Farmers, public and private land managers and homeowners spend significant sums of money on fire ant control. The fire ant is a frequent and well documented cause of medical attention with 3 deaths attributable to fire ants in South Carolina in the late 1990s. We are releasing imported parasites and parasitoids of fire ants in several SC locales. Hopefully these biocontrol agents will survive, spread and multiply in our climate and greatly suppress fire ant populations. These biocontrol agents if successful, will decrease control costs for farmers (Goal 1) and because of less chemical control measured being applied will improve the environment and will allow other native ant and other insect species to return to higher population levels (Goal 4). We are also researching the impact of fire ants on native plants, fish, birds and reptiles (Goal 4).

2. Performance Goals: To increase agricultural productivity and to enhance the environment

2. Performance Goals:

Output Indicators:
1. Refereed journal articles, patents, licenses
2. Biological control releases

Outcome Indicators:
1. Better environment w/reduced pesticide use
2. Reduced medical costs
3. Reduced management costs
4. Outdoor areas

3. Key Program Components:

Research projects will focus on: BMP for IFA management, IFA Biocontrol, IFA Economic/Social Impacts, improved quality, IFA Ecological characterization

4. Internal and External Linkages:

Entomology - Crop & Soil Environmental Science - Ag Economics - Aquatic, Fisheries & Wildlife, Horticulture, Extension, MUSC, DNR, Quail Unlimited, Pesticide Industry, National GAP program , legistative groups

5. Target Audiences:

Homeowner, green scape managers, farmers, recreational and athletic managers.

6 Program Duration:

Five Years

7. Fire Ant Program. Allocated Resources (Planned) by Goal:

| FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 | |
|---|---|---|---|---|---|---|
| 1 | 83 | 73 | 77 | 96 | 31 | 82 |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | 79 | 16 | 71 | 45 | 39 | 53 |
| 5 | 96 | 43 | 94 | 49 | 08 | 71 |
| | 98 | 31 | 42 | 491 | 78 | 05 |

Fire Ant Program FTE Distribution:

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

**AGRICULTURE AND FORESTRY RESEARCH PROGRAM 5: DAIRY PROFITABILITY**

1. Issue to be addressed: Dairy Profitability Program, related to Goal 1, Goal 4 and Goal 5

This program will examine alternative means of dairy waste disposal in line with accepted environmental standards, reduce animal nutrient excretion through pasture-based management, and alter nutrient content of dairy products to improve consumer acceptance and benefits to human health. Research on dairy waste disposal will be conducted with a new waste handling system that will address the measures needed to maintain the profitability of dairies in the Southeast. In concert with the ways of handling waste are the steps to take to reduce the intensive nature of dairy operations by exploring the better use of pastures. With these changes in feeding also will come the benefits of altering the composition of milk products that consumers will prefer.

2. Performance goals: The reduction of waste is a major concern in the Southeast. With the urbanization of farming communities, there has been a need to reassess the best management practices for dairy operations. Through new procedures for handling and treating waste, the profitability of dairies will improve in the Southeast. The steps taken to achieve a lower waste output will also provide for milk that is of higher quality because of the enhanced nutrient intake for the cows. This added value approach will positively affect profitability of dairies.

Output Indicators: 1. New procedures, practices, journal articles, patents
Value added, new lagoon practices

Outcome Indicators: 1. Economic competitiveness in the industry
Increased environmental sensitivity

3. Key Program Components:

Research projects will focus on: Waste management, pasture-based grazing, food (milk) quality

4. Internal and External Linkages:

Animal and Veterinary Sciences, Agricultural Economics, Agricultural Engineering, Agronomy, Natu ral Resource Conservation Service, Department of Health and Environmental Control, Food Science and Human Nutrition, Biological Sciences, other Land Grant Universities, Animal Industries, USDA, NSF, Dairy Management, Inc., American Jersey Cattle Associatio n

5. Target Audiences:

Dairy Industry, Department of Health and Environmental Control, Food Production Industry

6. Program Duration:

Five Years

7. Dairy Profitability Program. Allocated Resources (Planned) by Goal:

| FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 | |
|---|---|---|---|---|---|---|
| 1 | 76 | 05 | 2 | 72 | 42 | 28 |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | 65 | 09 | 76 | 71 |
| 5 | | | 47 | 63 | 65 | 66 |
| | 76 | 05 | 24 | 544 | 883 | 855 |

Dairy Profitability Program FTE Distribution:

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

## AGRICULTURE AND FORESTRY RESEARCH PROGRAM 6: FOOD SAFETY

1. Issue to be addressed: Food Safety Program, related to Goal 1

The goal of the Food Safety Program is: (1) to develop or improve strategies for controlling or eliminating microbial pathogens (such as E. coli, Listeria, Campylobacter, and Salmonella) in foods, (2) to apply those strategies to improve the safety and extend the safe shelf-life of food systems, and (3) to transfer the knowledge and technology to the food industry. The specific research areas to be addressed include development of antimicrobial compounds such as bacteriocins, ozone, chelators, fatty acids, and other biocides. In depth study of the metabolic activity of bacteriocin-producing microorganisms as well as the activity of these biocides against pathogens will be a major research focus. The technology developed will be transferred through food industry contacts, cooperative industry research projects, patent agreements with industry, and through cooperative extension activities.

2. Performance Goals: General performance goal: Conduct research projects that develop compounds, methods and strategies to inhibit the proliferation of pathogenic bacteria in food systems. These research developments will then be transferred to industry and the general public through refereed journal articles, public presentations, public interviews, trade and popular press articles, symposia, industry contacts, workshops, patent agreements, and cooperative projects.

Output Indicators:
1. Refereed journal articles, presentations, patents, abstracts, awards, popular trade publications.
2. Conducting workshops, symposia, training sessions.
3. Submitted and funded grant proposals targeting food safety.

Outcome Indicators:
1. Safer food supply with fewer foodborne illnesses.
2. Innovative processing and packaging techniques used by the food industry to improve the safety and extend the safe shelf-life of food
3. Trained professionals with increased knowledge of food safety issues and increased ability to address them.

Key Program Components:

Research will focus on the isolation of new antimicrobial compounds for use in foods, the development of antimicrobial packaging systems, the development of new food processing techniques, and the education of food handlers and processors on food safety.

Internal and External Linkages:

Departments of Food Science/Human Nutrition, Packaging Science, Microbiology and Molecular Medicine, Animal and Veterinary Sciences, Chemical Engineering, Biological

Engineering, Environmental Toxicology, SC Department of Health and Environmental Control, SC Department of Agriculture, Food Industry Association of South Carolina, North Carolina State University, University of Georgia, Auburn University, Alabama A&M, Texas A&M, and the Greenville Hospital System.

Target Audiences:

Food processors, food service operators, food handlers, food regulatory agencies, food packaging suppliers, food production personnel, consumers.

6. Program Duration:

Five years

7. Food Safety Program. Allocated Resources (Planned) by Goal:

| | FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 |
|---|---|---|---|---|---|---|
| Goal #1 | 288,774 | 295,993 | 303,393 | 310,978 | 318,752 | 326,721 |
| Goal # 2 | | | | | | |
| Goal # 3 | | | | | | |
| Goal # 4 | | | | | | |
| Goal # 5 | | | | | | |
| Total | 288,774 | 295,993 | 303,393 | 310,978 | 318,752 | 326,721 |

Food Safety Program FTE Distribution:

| | Goal # 1 | Goal # 2 | Goal #3 | Goal #4 | Goal #5 | Total |
|---|---|---|---|---|---|---|
| Staff | 2.83 | | | | | 2.83 |
| Faculty | 5.90 | | | | | 5.90 |
| Total | 8.73 | | | | | 8.73 |

**AGRICULTURE AND FORESTRY RESEARCH PROGRAM 7: ANIMAL IMMUNOLOGY**

1. Animal Immunology Program, related to Goal 1, Goal 4 and Goal 5

This program will examine the detrimental effects on the immune and reproductive systems of animals and humans, which various levels of different insecticides, herbicides and other zenobiotics cause. This will make it possible to identify possible ways to re-mediate the action of these chemicals. The exposure of domestic and wild animals as well as humans to chemicals in the environment is a serious concern of all. The exposure of animals leads to possible introduction of these chemicals into the food chain. Therefore, humans could be exposed both directly in the environment and through the food chain. To eliminate these possibilities, it is important to detect the chemicals in the environment and to also determine their effects on the biology of animal s. Research to develop tests for detection of chemical action on animals will provide sensitive measures of these chemicals in the environment.

2. Performance goals: The development of sensitive tests or measures of chemical action on biological systems like the immune and reproductive systems, will lead to advances in understanding the subtle effects of chemicals on animals and humans. Steps to re-mediate chemicals from the environment and stop their introduction into the food chain will lead to safer animal food products for consumers. Bioassays and detection systems of chemical action on animals and humans will be developed through these research approaches.

Output Indicators:
1. Journal articles, patents
2. New remediation practices

Outcome Indicators:
1. Identify risk factors on human and animal health
2. Identify negative effects of PCB's
3. Improve animal production

3. Key Program Components:

Research projects will focus on: Reproductive efficiency of animals, catf ish immunity, and study of naturally occurring toxins

4. Internal and External Linkages:

Clemson's Food safety program and departments of Biological Sciences and ADVS, USDA, industry, Medical University of South Carolina, NIH, NSF,
SC Pork Board, SC Poultry Board,

5. Target Audiences:

The animal industry, SC Departments of Health and Environmental Control and Natural Resources, the medical/health community.

6. Program Duration:

Five Years

7. Animal Immunology Program. Allocated Resources (Planned) by Goal:

| | FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 |
|---|---|---|---|---|---|---|
| Goal #1 | 264,911 | 271,534 | 278,322 | 285,280 | 292,412 | 299,722 |
| Goal # 2 | | | | | | |
| Goal # 3 | | | | | | |
| Goal # 4 | 331,139 | 339,417 | 347,903 | 356,600 | 365515 | 374,653 |
| Goal # 5 | 66,228 | 67,883 | 69,581 | 71,320 | 73,103 | 74,931 |
| Total | 662,277 | 678,834 | 695,805 | 713,200 | 731,030 | 749,306 |

Animal Immunology Program FTE Distribution:

| | Goal # 1 | Goal # 2 | Goal #3 | Goal #4 | Goal #5 | Total |
|---|---|---|---|---|---|---|
| Staff | 2.36 | | | 2.95 | O.59 | 5.90 |
| Faculty | 1.76 | | | 2.20 | 0.44 | 4.40 |
| Total | 4.12 | | | 5.15 | 1.03 | 10.30 |

**AGRICULTURE AND FORESTRY RESEARCH PROGRAM 8: AQUACULTURE**

1. Issue to be addressed: Aquaculture Program, related to Goal 1, Goal 4 and Goal 5

The aquaculture program is a multidimensional effort to develop and disseminate information concerning the commercial production of aquatic species appropriate or potentially appropriate for production in South Carolina. Research is conducted on freshwater, estuaries and marine species (both fishes and invertebrates). Areas of research include the development of systems which will increase the economic viability of fish production and increase competitive margins, enhance water quality and reduce water quantity utilized in production systems, and enhance the design of systems which will enable landowners to profitably engage in aquaculture enterprises.
Specific projects will involve studies on animal health, environmental physiology, mechanical engineering, water quality management, alternative production approaches and production economics.

The Partitioned Aquaculture System (PAS) currently under development is addressing several of these problem areas. The PAS separates the fish production and water treatment functions of a conventional aquaculture pond so that each can be controlled. 1998 production reached 17,000 pounds per acre with 1/8 the water per pound of fish and no discharge to the environment. This system also eliminates bird predation, increases harvest efficiency and feed conversion, and makes disease treatment practical. Work is being done on automating instrumentation and control on this system.

2. Performance Goals: Increase fish production and profitability, minimize water use and dis charge, and optimize performance through automatic controls.

Output Indicators:
1. Research published in peer-reviewed research journals
2. Extension publications based on peer-reviewed journal articles

Outcome Indicators:
1. Improved technology for aquaculture in South Carolina
2. Improved potential an expanded aquaculture industry in South Carolina

3. Key Program Components:

Research projects will focus on: Development of a partitioned aquaculture system understanding environmental constraints to production, alternative production approaches for crawfish and control of infectious disease in intensive aquaculture systems

4. Internal and External Linkages:

Department of Aquaculture, Fisheries and Wild life, Department of Agricultural and Biological Engineering, Department of Agricultural and Applied Economics, South Carolina Department of

Natural Resources, South Carolina Sea Grant Consortium, industry.

5. Target Audiences:

Aquaculture industry, commercial producers, landowners, farmers and the processing industry.

6. Program Duration:

Five Years

7. Aquaculture Program. Allocated Resources (Planned) by Goal:

| | FFY 1999 | FFY 2000 | FFY 2001 | FFY 2002 | FFY 2003 | FFY 2004 |
|---|---|---|---|---|---|---|
| Goal #1 | 127,852 | 131,048 | 134,324 | 137,683 | 141,125 | 144,653 |
| Goal # 2 | | | | | | |
| Goal # 3 | | | | | | |
| Goal # 4 | 159,815 | 163,810 | 167,906 | 172,103 | 176,406 | 180,816 |
| Goal # 5 | 31,963 | 32,762 | 33,581 | 34,421 | 35,281 | 36,163 |
| Total | 319,630 | 327,620 | 335,811 | 344,206 | 352,811 | 361,632 |

Aquaculture Program FTE Distribution:

| | Goal # 1 | Goal # 2 | Goal #3 | Goal #4 | Goal #5 | Total |
|---|---|---|---|---|---|---|
| Staff | 1.66 | | | 2.07 | 0.41 | 4.15 |
| Faculty | 2.00 | | | 2.50 | 0.50 | 5.00 |
| Total | 3.66 | | | 5.47 | 0.91 | 9.15 |

2. Stakeholder Input Process

Agriculture and Forestry Research, based on the advice and recommendations of the faculty Committee for Merit Assessment of Research Programs, has established a permanent Merit Assessment Committee.

The composition of the Merit Assessment Committee was determined with input from the faculty Committee for Merit Assessment of Research Programs and from the Public Service and Agriculture Advisory Board, and consists of representatives from the following areas:

2 - Representatives from each school
3 - Outside representatives from the state and region
1 - Representative from Extension agents
1 - Representative from family and youth development
1 - Representative from Strom Thurmond Institute
1 - Representative from regulatory services
1 - Representative from a college outside of the College of Agriculture, Forestry & Life Sciences

The 3 outside representatives are a committee of the Clemson University Public Service and Agriculture Advisory Board. This board is comprised of 30 individuals from across the state and nation from the following sectors: Production, business, service, government and public interest. Demographically, there are 22 males, 26 white, and 20 from South Carolina. The Merit Committee of the Advisory Board reports on the activities of the Merit Assessment Committee to the full board at their semi-annual meetings. Responses and comments from the board are presented at the subsequent meeting of the Merit Assessment Committee.

The Public Service and Agriculture Advisory Board has been instrumental in expanding research initiatives to reach a population previously potentially under served by research. This population is youth. The new Institute for family and Neighborhood life will have a significant research component. Increased research in areas of youth development, 4-H and families and on neighborhoods and family life will benefit the entire state.

The Merit Assessment Committee meets two times each year to review programs, and the Dean and Director of Agriculture and Forestry Research serves as committee chair. Members rotating off the committee will be replaced from the same school or area. Administrators will not serve on the committee.

The Agriculture and Forestry Research System will supply administrative support and any operating monies for the committee.
In 1998, initial appointments to the committee will be divided equally between 1, 2, and 3 year appointments; thereafter, terms will be for 3 years. With appropriate input, appointments to the Committee will be made by the Director of the Agriculture and Forestry Research System.

3. Program Review Process

The purpose of the Merit Committee is to perform a "merit review" of programs as defined and mandated in the USDA guidelines under the Hatch and McIntire - Stennis Acts.

The primary responsibility of the Merit committee is to review submitted program plans submitted by groups of faculty, departments or schools and recommend their implementation to the PSA administration. The committee will not review individual project proposals which will continue to be peer reviewed using existing procedures as established by the Agriculture and Forestry Research System. New project proposals would however, have to fit under a program approved by the committee. The Faculty is the body to make program recommendations to the Merit Assessment Committee.

Faculty will develop program areas of research using their strategic planning process. These proposed programs will be prepared for the Merit Committee in the appropriate format and must be submitted to ARF no later than March 1 of each year. AFR will screen the program proposals and send copies to all committee members no later than March 15 of each year.

The Merit Committee will use the following evaluation criteria to review each program plan which has been submitted:

A. Relevance (40%)

- Is this a truly innovative approach to dealing with a critical problem facing South Carolina, the region, and nation?

- Is this an important concern such that the research addresses a regulatory, political and social issue that requires timely response and attention?

- Have stakeholders (advisory boards, etc.) and the public identified this area as being important to the state, regional, national, and international levels?

- Does the program mesh with the adopted goals of Clemson PSA?

- Does this program/project respond to a major administrative or legislative emphasis?

- Is this program/project area widely supported at other land grant universities, government agencies and in the private sector?

- Is it a specialized activity found only at Clemson University?

B. Capacity (40%)

- Expertise

- Facilities

- Funds

C. Impact (20%) (The scope of the impact should be considered from the state to the international level)

- Scientific

- Economic

- Social

- Policy

4. Hatch Multi-state Research

Agriculture and Forestry Research is involved in the following Hatch Multi-state Research initiatives:

| | |
|---|---|
| S-9 | Plant genetic resources conservation and utilization |
| S-65 | Multistate research coordination, Southern Region |
| S-183 | Phenology, population dynamics, and interference: a basis for understanding weed biology and ecology |
| S-259 | Rural labor markets in a global economy |
| S-261 | Interior environment and energy use in poultry and livestock facilities |
| S-262 | Diversity and interactions of beneficial bacteria and fungi in the rhizosphere |

S-263 Enhancing food safety through control of food-borne disease agents
S-264 Microirrigation of horticultural crops in humid regions
S-265 Development and integration of entomopathogens into pest management systems
S-267 Biological control of selected arthropod pests and weeds
S-269 Biological control and management of soilborne plant pathogens for sustainable crop production
S-271 Solid-phase extraction techniques for pesticides in water samples
S-275 Animal manure and waste utilization, treatment and nuisance avoidance for a sustainable agriculture
S-276 Rural restructuring: causes and consequences of globalized agricultural and natural resources systems
S-277 Breeding to optimize maternal performance and reproduction of beef cows in the Southern Region
S-278 Food demand, nutrition and consumer behavior
S-280 Mineralogical controls on colloid dispersion and solid-phase speciation of soil contaminants
S-281 Dynamic soybean insect management of emerging agricultural technologies and variable environments
S-282 Managing plant-parasitic nematodes in sustainable agriculture with emphasis on crop resistance
S-283 Develop and assess farming technology and its economic and environmental impacts
S-285 Reproductive performance of turkeys
S-288 Nutritional systems for swine to increase reproductive efficiency
NC-140 Rootstock and interstem effects on pome and stone fruit trees
NE-162 Rural economic development: alternatives in the new competitive environment
NRSP-4/IR-4 National agricultural program to clear pest control agents for minor uses
W-181 Modifying milk fat composition for improved manufacturing qualities and consumer acceptability

5. Integrated Research and Extension Activities

Agriculture and Forestry Research and the Cooperative Extension Service have developed integrated working relationships which foster very effective knowledge development and transfer systems for the citizens of South Carolina.

Joint appointments of faculty between research and Extension, and the joint appointment of assistant directors develops strong and productive working relationships, minimizes duplication of effort and supports internal linkages and communications between research and Extension. Planning discussions

are underway to enhance integration of research and Extension though the use of additional joint research Extension program initiatives

Agriculture and Forestry research programs and Cooperative Extension programs are conducted at jointly managed Research and Education Centers in the various regions of South Carolina at Blackville, Charleston, Columbia, Georgetown and Florence. Each center has specific focus areas for research and Extension, to include turfgrass, agroecology, beef cattle and nutraceuticals. The potential to expan d cooperative research and Extension efforts at the Research and Education Centers is currently under discussion. Plans are also being developed to integrate the research and Extension five year plan. Research and Extension are also supporting a fully i ntegrated marketing, public relations and communications initiative.