ANNUAL REPORT OF ACCOMPLISHMENTS

Alabama Agricultural Research Programs (AARP)

at the

Alabama Agricultural Experiment Station
(Auburn University)

and

The Winfred Thomas Agricultural Research Station
(Alabama A&M University)

and

The George Washington Carver Agricultural Experiment Station
(Tuskegee University)

for

Federal Fiscal Year

2002

October 1, 2001 – September 30, 2002

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EXECUTIVE SUMMARY

Alabama is fortunate to have three land-grant universities - Alabama A&M University, Auburn University, and Tuskegee University - with distinct programs at each institution based on clientele needs. However, our universities increasingly collaborate on research in areas where the needs of our clientele (producers, processors, agribusinesses, consumers, stakeholders, alumni, students, and others) merge. As administrators of Alabama Agricultural Research Program (AARP), we are working cooperatively to enhance partnerships among our universities in all areas of research, education, and extension; with other universities in the region, nationally, and internationally; and with state and federal laboratories and agencies. Effective partnerships are the springboard for efficient use of our resources, both human and fiscal, to meet the needs of our state clientele and the nation. Alabama's three land-grant universities have played key roles in the development of agricultural enterprises in Alabama. The agricultural research programs of these universities have recently entered into a memorandum of understanding to form the Alabama Agricultural Land-Grant Alliance (AALGA) to better address critical issues in food, agricultural, and natural resources in the state, region, and nation through multidisciplinary, multi-institutional, science-based teams that focus on opportunities and challenges facing farmers, consumers and agribusinesses. The AALGA also seeks to provide quality education that prepares professionals for career opportunities in food, agriculture, and natural resources.

In recognition of the importance of international agriculture programs in promoting the competitiveness of U.S. agriculture in the global market place, Alabama's agricultural research programs support and participate in efforts of International Program Offices. These offices, located on each campus, promote international market development and other international initiatives that strengthen the U.S. economic competitiveness and provide professional and cross-cultural experiential learning opportunities for students, staff, and faculty.

This Annual Report of Accomplishments and Results is a reflection of research activities for the 2002 fiscal year as reported in the Plan of Work required by AREERA (Agricultural Research, Extension and Education Reform Act) of 1998.

Five state programs are reported in the Five-Year Plan of Work under the various REE goals. These state programs are:

State Program 1:	Attain Globally Competitive Alabama Agricultural and Forestry Production Systems
State Program 2:	Enhance Food Safety, Quality and Processing Technologies
State Program 3:	Improve Human Nutrition and Health
State Program 4:	Develop and Enhance Sustainable Ecosystems to Protect Natural Resources and Bio-diversity
State Program 5:	Ensure Socioeconomic and Self-Empowerment of Families and Communities

Several multi-disciplinary research projects are grouped under the Key Program Components associated with each state program.

ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS FOR AGRICULTURAL RESEARCH PROGRAMS IN THE STATE OF ALABAMA

POINTS of CONTACT: This plan is jointly submitted by: *Dr. John Jensen* (Auburn University), *Dr. Walter Hill* (Tuskegee University) and *Dr. McArthur Floyd* (Alabama A&M University). Although questions and other comments regarding the document can be directed to any of us, technical concerns should be addressed to John Jensen, who is providing leadership in this effort.

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Adoptions by Reference:

- Alabama Agricultural Research Plan for the 21st Century
- Programs School of Agricultural and Environmental Sciences
- Handbook for Research Project Leaders for the Alabama Agricultural Experiment Station
- Administrative Manual for Evans-Allen Cooperative Agricultural Research-Project Approval
- Globalizing Agricultural Science and Education Programs for America (GASEPA)

ANNUAL REPORT OF ACCOMPLISHMENTS AND RESULTS

PLANNED PROGRAMS

Following is the Annual Report of Accomplishment and Results for the Alabama Five-Year Plan of Work which is based on the five national goals within the Research, Education and Economics (REE) Mission Area of USDA:

Goal 1: An Agricultural System that is highly competitive in the Global Economy

State Program 1: *Attain Globally Competitive Alabama Agricultural and Forestry Production Systems*

Overview

Effective functioning of America's agricultural system in a highly competitive globalized economy is a major contributor to the national economic growth and well-being of the American people. Markets for Alabama's farm and forest products are international in scope, are dynamic, and require careful study if Alabamians are to benefit from changes in trade policies, immigration laws, labor relations, human capital, transportation, communications technology, consumer preferences, and other forces shaping the national and international markets for Alabama's food, fiber, ornamental horticulture, and forest products. The ability of Alabama farmers and agriculturally based products to successfully compete in today's aggressive national and global markets depends on careful market analysis research on the development of new alternative and innovative products and dissemination of information on new production methods based on sound scientific data to farmers. The Land-Grant Universities in Alabama have initiated research programs to keep the agricultural industry in Alabama competitive.

For example, scientists at Tuskegee University initiated research on new alternative food products, plant and animal genomics, food production efficiency, biotechnology, and small farm viability. The programs have resulted in the development of new sweetpotato and peanut based products, profitability of small farms, alternative animal feed from agricultural by-products, new sweetpotato varieties, gene mapping of chickens and other poultry species, and development of transgenic sweetpotato plants with a high protein content.

At Auburn University, scientists have initiated research in multiple areas of plant and animal research. These programs have resulted in new and improved crops and cropping methodology in agronomic and horticultural crops, improved detection and differentiation of viral poultry diseases, and the use of estrogen-progesterone growth implants to improve an animal's response to disease. Other research in fisheries and aquaculture has resulted in improving protein content of feed to increase catfish growth, improving marine shrimp production in Alabama, and the creation of artificial reefs and nursery habitats for red snapper production. Still other research activities have reduced insecticide use in Alabama by increasing the efficiency of predaceous insects as biological control agents and thus reducing pesticide runoff.

At Alabama A&M University, research efforts have focused on the economics and social well-being of families and farmers, improved crop production via enhanced agronomic performance and manipulation of genetic structures, Agroforestry, natural resource management and the development of alternative specialty crops.

The accomplishments thus far are encouraging and are on target with stated objectives. The success of these programs will ultimately result in new markets for agricultural products, development of pest resistant and high nutrient content of forestry, horticultural, agronomic crops, germplasm, production efficiency for small ruminants and rapid genetic analyses and characterization of poultry genome. The results will also assist in the development of small farm technology to keep underserved limited resource farmers in profitable farming business. Further, the results provide for new and innovative methods for improved crops and their use as alternative foods, improved animal and poultry health and production, and new profitability in aquaculture.

The three universities have also placed high emphasis on providing experiential learning and graduate education opportunities for undergraduate and graduate students enrolled in various academic programs associated with the research described above and throughout each goal.

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures ($)	SY	Approximate Expenditures ($)	SY	Projected Expenditures	SY	Projected Expenditures ($)	SY	Projected Expenditures ($)	SY
1862 (AL)	15,411,148	56	13,957,013	42	14,654,863	42	15,378,606	42	16,156,987	42
1890 (ALAX)	1,247,000	7	1,408,995	8	1,479,444	8	1,553,416	8	1,631,086	8
1890 (ALX)	775,250	6	820,938	6	861,984	6	905,083	6	950,337	6
Totals	17,433,398	69	14,918846	56	16,220,501	56	17,837,105	56	18,738,410	56

Allocated Resources ($) and Scientists Years (SY).

Key Theme: Value added foods:

Statement: At Tuskegee University, studies continue with the development of novel functional food. Pursalane and sweetpotato greens were evaluated for their phytosterol content and as functional food source. Phytochemicals in these foods are known to reduce blood cholesterol levels and decrease overall heart disease risk. Several isoflavones were identified in the pursalane and sweetpotato greens. Several sensory research analyses have shown that these novel vegetables are generally accepted in the diet. Incorporation of such novel functional foods in diets of at-risk communities will assist in the reduction of heart disease and increase in the nutritional well being of the targeted underserved communities.

Statement: The poultry and livestock industry must continue to serve as sources of high quality protein in Alabama, the U.S. and the world. Consumer preference for certain muscles from meat animals continues to remain high. Traditional attempts to improve muscle yield focuses on genetic selection and optimum nutrition and management. At Auburn University research is being conducted that is increasing the quantity and efficiency of lean meat production through the increased myofiber number via interference in the circuitry that leads to muscle formation in the egg in poultry. This approach will provide producers with the ability to improve protein deposition, growth efficiency, and muscle yield in broilers and livestock.

Key Theme: Economics

Statement: Auburn University researchers are evaluating and identifying predictable risks for various sectors of agriculture. The results of these studies will help describe more fully the potential gains and losses that can be expected from engaging in various agricultural enterprises.

One area of research is focusing on low-income people that are excluded from financial services such as microfinance governance, efficacy of credit for low income housing mortgage loans and the limitations of traditional banking in offering loans for young micro and very small firms in transition economies. Another continuing area of research is in better production technologies for the catfish industry in the Piedmont region, which should help producers increase yields and net returns. Also, analyses the impact of certain policy alternatives on peanut farmers is being conducted that has already helped correct some legislators' misconceptions of the effects of policy interventions, and prevented some errors in estimating whose earnings will be affected and by how much.

Key Theme: Improved Crop Systems

Statement: The peanut is an economically important crop in the state of Alabama and Southeastern United States. In an effort to increase the efficiency of peanut production through the use of resistant cultivars scientists at Tuskegee University are employing biotechnological approaches including genetic engineering and tissue culture to map and clone disease resistant loci in the peanut. A genetic map was constructed using peanut mutants resistant to late leaf spot and leaf rust diseases. Over one hundred DNA markers consisting of eleven linkage groups have been mapped. Genomic maps are useful in phytogenetic studies, germplasm utilization and breeding programs. Identification of genetic markers linked to resistance genes will be very useful in marker-assisted selection and map-based clones. Studies are still in progress.

Statement: The improvement of cotton, a principle textile fiber and a prominent oil crop in Alabama, depends on the addition of new genes either through breeding or genetic engineering. These genes must, however, be identified or marked before they can be employed. Researchers as Alabama A&M University have examined several strategies for dissecting fiber specific genes using cotton mutants. For example, parental DNAs were amplified in a polymerase chain reaction using SSR and ITS primers to screen the F1 and F2 DNAs. Successful amplification of SSR bands from both parents has been accomplished. Bands are now being cloned and processed for sequencing to determine SNPs.

Statement: Auburn University researchers are using genetically-engineered bacteria that glow (bioluminescence) in the dark to track the movement of bacteria precisely and sample the tissue to determine gene activity in response to bacterial pathogen. Learning why some plants are resistant to bacteria and others are not will help plant breeders develop new ways to manage bacterial problems in crops. They found that resistant plant tissue immediately responds to the infection by toughening cell walls, forming lignin-like tough structures and release toxic biochemicals that kill the bacteria. Similar reactions occur in the susceptible plants, however, too late for the plant to resist infection. The research resulted in basic understanding of initial reactions of plants to bacterial infection that can be used in breeding programs. Eventually, this program will result in resolving bacterial disease problems without use of antibiotics and highly toxic chemicals.

Statement: Cotton is the leading natural fiber crop in the world. Due to the widespread use of high speed spinning technology in the yarn and textile industry, the demand for high strength fiber in raw cotton has increased. Improvement of cotton fiber quality through conventional breeding is limited because of the complexity of fiber quality genetics. Hence, scientists at Alabama A&M University are identifying and characterizing genes related to cotton fiber quality through biotechnology, a useful tool for understanding the mechanisms of fiber development and improving cotton fiber quantity and quality. Five cDNA clones highly expressed in a twenty day-post-anthesis (dpa) fiber tissue of 3-79 cotton. The clones were subjected to higher levels of

expression in the fiber than in other tissues tested. This is among few reports related to fiber-associated gene expression in G. harbadense and could lead to better understanding the mechanism of fiber development in cotton.

Statement: Auburn economic researchers explored this issue by surveying consumer preferences for Satsumas in grocery stores located in nine Alabama and Georgia cities. Some 605 people were surveyed and asked to look at 20 posters that had a photo of the orange and other information about the crop. They also were questioned about the visual and other marketing attributes of Satsumas, such as color, size, blemishes, seeds, price, whether they were grown organically, and whether they were grown in Alabama or the United States. The rational was that consumers do have to judge a fruit by its cover rather than by taste since few grocery stores allow free sampling of produce these days. Though the data is still being analyzed, some initial concepts were established from the study. For example, it appears that the industry does not have to go totally organic to market their fruit in the region, but they do need to ensure that their fruit are seedless. As more data is analyzed, this information will help producers focus on the attributes that consumers value the most, thus reducing the costs of production, processing, and increasing the value of the product.

Statement: Reniform nematode is a little-studied pest for which there is no known resistance in cultivated cotton. Genetic engineering, therefore, offers the only current hope for overcoming this actively spreading pest. Root cultures offer the most consistent and economical means for evaluating Reniform resistance without resorting to field tests, and are being used by Alabama A&M University scientists to address the challenge to cotton production as effected by Reniform nematodes. Single nematode DNA has been amplified using gel-based markers. A root culture system for several cotton cultigens has been established. Only liquid culture, with no hormones provided the greatest root growth, based on length. DNA form positively-identified reniform nematodes using ITS1 and 18S ribosomal primers and bands. Single nucleotide polymorphisms were noted for all populations.

Statement: Minor horticultural crops, such as landscape and nursery crops, often need chemical treatment to protect them from a wide range of pests. However, many chemical companies with products that may be useful for this process do not have the time or resources to collect the data necessary for these chemicals to broaden their labels. Auburn University researchers are part of a national cooperative program called IR-4 Research Program that is evaluating pesticides for use in minor crops throughout the U.S. To date this work has led to the expansion of many pesticide label registrations. These new minor crop registrations give producers more control options, which in turn can lead to increased productivity. Since 1997, the group nationwide has obtained 1,192 herbicide registrations for minor horticultural crops.

Statement: Researchers at Alabama A&M University have developed a neural network model for detecting deficiencies of nitrogen and calcium in leaves of wheat from spectral reflectance reading of those leaves. This allows determination of a deficiency situation without destructive sampling or tedious extraction and evaluation. It also enables rapid assessment of nutrient status and thus immediate remediation before a substantial negative impact occurs upon the growth or yield of the crop.

Key Theme: Improved Poultry Systems

Statement: Improved control of economically important diseases of commercial poultry will lead to cheaper cost of production, which will ultimately lead to lower costs for consumers of poultry

products at the supermarket. Over the past 25 years, Auburn researchers have developed and/or tested most of the vaccines and detection methods for the control and diagnosis of infectious bursal disease viruses and reovirus infections of chickens. Improved detection and prevention of these viruses saved money for poultry producers and consumers alike.

Statement: Auburn University researchers are exploring the development of edible transgenic plant vaccine in alfalfa for controlling. Thus far, they have developed a transgenic arabidopis, which produce antigenic IBD viral protein. They will soon start feeding trials in chickens. This work is multi-disciplinary and multi-institutional in nature and could revolutionize the way chickens are vaccinated around the world. Several patents applications from this novel work have already been submitted to Auburn's Technology Transfer Department. The work could save millions of dollars annually in losses due to viral diseases of poultry. Auburn researchers are studying the genes of meat producing birds to determine which genes influence disease resistance in chickens.

Key Theme: Improved Animal Systems

Statement: Scientists at Tuskegee University continue their research on developing resource management for sustainable small ruminant industry in Alabama. Several studies have been conducted to determine the use of alternate feed including cottonseeds, yeast culture and copper feed additives and supplements and several different types of hay. Good resource management that incorporates alternative feeds such as plant byproducts and feed additives and supplements provides beneficial effect on diet digestibility and animal performance which can be transferred into less input for better animal output and more profitable production system.

Statement: A genetic map based approach for reproductive traits developed by Tuskegee University scientists is being used for rapid synthesis of expressed sequenced tagged sites (EST) in poultry. These sequences are also used for comparative sequencing in other poultry species (quail, guinea fowl, pigeon and turkey). Results indicated that diet influences the level of heterosis for performance traits such as body weight gain and feed conversion when crude protein levels are at least 20% of the diet. The findings of this research are useful in comparative genomic analysis of other less studied poultry species. The procedure is simpler, faster and less expensive in placing coding sequences on the chicken genetic map.

Statement: Auburn University research is generating exposure-response relationships that are necessary for development of regional emission reduction strategies and recommendations for improving management and sustaining productivity of grassland ecosystems that support animal agriculture. Published data other research indicate that, within the range of ambient ozone concentrations typically experienced in the South region during the March-October growing season, yield of ozone-sensitive forage crops is decreased on average by approximately 10%. Based on altered plant tissue chemistry resulting from ozone exposure, nutritive quality decline in ozone-sensitive forage crops can be expected to approach the same order of magnitude. Integration of nutritive quality assessment with yield response is necessary in order to more fully characterize potential economic impacts of ozone on grassland system productivity. This work was the first to show that measurable nutritive quality loss can occur in forage crops, even in the absence of visible foliar injury, as a result of exposure to ground-level ozone. This “hidden” loss has been documented for a number of warm season-adapted forage crops that, based on plant physiology theory and lack of visible injury, have historically been considered to be relatively ozone-tolerant. A second area of research was conducted evaluating the impact that tropospheric ozone has on buddleia. This work is designed to identify which cultivars will perform best in urban environments with minimal visible injury or growth reductions. In addition, this work is

determining what ozone injury looks like so that homeowners and growers do not mistake the injury for a nutrient or biotic problem and apply chemicals unnecessarily.

Statement: Auburn University researchers have been examining the components of biting fly saliva to find ways to use this substance to develop a vaccine against biting flies. Their molecular evaluations have revealed a wide range of possibilities. Anti-feeding vaccines for blood-feeding flies are attractive for several reasons - ease of administration, specificity for a particular target species, longevity of effect, and environmental acceptability. This approach is particularly appealing for control of insects such as horn flies and related pests of livestock that do not have a wide array of anti-clotting factors in their saliva. Researchers at Auburn University have isolated, purified, and cloned the cDNA encoding an important anti-thrombin (designated as thrombostasin) in horn fly saliva that is necessary for these insects to take blood. Studies are currently underway using a rabbit model to determine if vaccination with a recombinant form of this important molecule can stimulate the formation of specific neutralizing antibodies to thrombostasin and if blood-feeding on an immunized animal can affect the amount of blood ingested. If successful, this approach is entirely unique and could eventually save livestock producers millions of dollars and eliminate the use of insecticides for horn fly control

Key Theme: Development of Alternative Specialty Crops

Statement: Alabama A&M University researchers are evaluating canola genotypes and plant introductions (PIs) to develop new winter-type canola lines for the mid-south region. Following the discovery of the stem-boring insect, clover stem borer (Laguria mozardi Latreille) in the pith of several canonal cultivars in 2001, the level of infestation was found to be lesser during the past year. The Cabbage Seedpod Weevil Ceutorhynchus obstrictus was the most prevalent insect found this year. Damage to the pods varied significantly between cultivars.

Statement: At the request of Alabama's tomato growers, Auburn University researchers are implementing at the field level the technologies of beneficial bacteria as crop inoculants. Scientists are working with tomato growers in the state to determine how these technologies can be used practically in Alabama to help growers lower their input costs and hence survive economically. Results indicate that vegetables can be produced with reduced inputs of pesticides and fertilizer, though more research is needed to fully implement the methods. During the last decade, the number of acres in Alabama devoted to tomatoes decreased by approximately 50 percent, and the value of production decreased by approximately 60 percent. The number of farms growing vegetables, sweet corn, and melons decreased from 2,203 in 1982 to 996 in 1997. If this research finds new ways to grow tomatoes and other vegetable crops successfully in Alabama under the current intense economic and biological pressures, these businesses may be able to rebound and again provide solid economic benefits to the state.

Statement: Tuskegee University developed and tested sweetpotatoes varieties with high protein and amino acid composition, thus enhancing the nutritional content of these specialized varieties. High dry matter varieties were selected from field and greenhouse studies as potential sources for sweet potato flour for use in making a variety of added value sweetpotato products.

Key Theme: Fisheries and Aquaculture

Statement: Auburn University research has focused on developing techniques suitable for Alabama to utilize the low salinity water. The first year yield ranged from a few hundred pounds per acre to a few thousand pounds per acre but was extremely variable. After studies on the quality of water and requirements of the shrimp, recommendations were made to correct limited

nutrients. In 2002, five producers grew shrimp with yields ranging from over 2,000 to as much as 5,000 pounds per acre after following recommendations developed through Auburn research. Further refinement of recommendations to adjust for variation in well water in different regions should help producers with lower yields.

Statement: Auburn University research is seeking to determine the factors that keep these reefs from being productive and seeking practical solutions to restoring these reefs, including the use of hatchery produced oysters and volunteers to grow juvenile oyster for stocking. Results to date suggest that periodic low oxygen events, sedimentation and lack of recruitment (larval supply) are contributing factors. Experiments to overcome these factors will result in recommendations for restoring specific reefs at specific sites. Current research is focusing on planting hatchery-produced oysters at high densities on mounds of shells where oxygen levels will be higher and sedimentation less of a factor. The oysters will be protected from exploitation and will form the basis of a broodstock reserve that will increase larval supply.

Key Theme: Water Quality

Statement: Auburn University research is evaluating the potential effectiveness of rotational stocking systems to improve productivity and utilization of desirable forages, reduce grazing animal activity in riparian areas and streams, to allow recovery of riparian vegetation, and improve stream water quality. Livestock activities associated with unmanaged stocking systems have heavily damaged the vegetation and soil of many riparian areas close to grazed pastures. Total exclusion of cattle through fencing is not a sustainable remedy in the southeastern U.S.

Statement: Researchers at Alabama A&M University monitored eighteen different streams at a total of fifty-four (54) locations throughout the Wheeler Lake Basin (WLB) to evaluate the effects of individual seasonal trends in nutrient concentrations (N&P). These locations were geo-referenced using a GPS unit to allow revisits to the same sites for future resampling. Although seasonal variations did occur, these variations reflected differences associated with rural and urban activity and not land use types. The highest concentration of N and P was detected in the summer season. As a result of this study, counties and streams in northern Alabama were ranked based on the N and P levels.

Key Theme: Economics and Social Well-Being of All Families and Farmers

Statement: Technologies are available to convert grasses, such as switchgrass and other perennials, to electricity and liquid fuels, such as ethanol. Many grasses can also be used as a substitute for hardwood to produce high quality paper. Auburn University research is aimed at developing these crops and technologies so that producers and the nation can reap the associated benefits. To date the project has developed optimal production practices for use of switchgrass as an energy crop, and work has started on evaluating a range of common forage grasses for both energy and paper production. The result will be a more viable rural economy.

Statement: Alabama A&M University scientists, in collaboration with seven other Historic Black (1890) Land-grant Universities have begun to address the educational deficit of agricultural biotechnology in underserved communities of the south. Educational outreach biotechnology teacher – training workshops have been held at several locations in collaboration with faculty and staff from the University of California, Davis. Also, on-farm demonstrations using biotech crops or products (with controls) such as Bt sweet corn; virus-resistant yellow straight neck and zucchini squash, Messenger-treated sweet pepper and Roundup-Ready soybean have been evaluated for limited resource farmers. Sixteen meetings/training sessions involving more than

400 individuals have been held with Extension Agents, small farmers/producers and high school teachers to discuss benefits and risks associated with biotechnology.

Statement: Tuskegee University worked with individuals and groups of minority farmers assisting them with improving record keeping; assessing different one-on-one approaches to improve record keeping and obtaining timely, reliable credit

Statement: The development of social-emotional competence in childhood is the single best predictor of individuals' success in school and their future contributions as productive members of the work force. The two most important influences on social-emotional competence during early childhood are the family and childcare experiences. For children from low income families who at risk for academic failure and problem behavior, good quality early child care significantly reduces later problems. An Auburn University study is examining family and childcare factors that are associated with children's social and academic competence, and physical health. The information produced by this project provides guidelines for parents, educators, and policy makers on how we can maximize children's adjustment and competence, and ensure that every child enters school ready to learn. The findings from this project are reported in professional journals and conferences, and in magazines for parents (e.g., *Parents' Magazine*, *Sesame Street Parents' Magazine*), and provide a basis for Cooperative Extension programs focused on parent education and child care quality improvement.

Key Theme: Recruitment and Education of Individuals for Career Professions in the Food and Agricultural Sciences

Statement: Key faculty members from Alabama A&M University, Tuskegee University, and Auburn University have collaborated on USDA CSREES Higher Education projects focused on leadership development processes. The first collaboration entitled "Partners for Social Change: Developing Leadership In Agricultural Students" allowed the synthesis of learning and establishment of leadership emphasis at the institutions. A primary area of common purpose has been around developing leadership programming and transferring leadership skills to students and faculty from diverse disciplines. The goal underlying the effort has been to instill in undergraduate students studying agriculture the skills and knowledge necessary for them to become effective, productive, collaborative, innovative, dynamic members of the communities to which they belong as students and to which they will belong as members of adult society. Students from the three Alabama land-grant universities participated in assessing, understanding, and practicing leadership skills to impact positive social change. The program was designed through the collaborative efforts of three key faculty from each university who were supported by a diverse group of students. The diversity spanned academic majors, classification, and country of origin, ethnicity and university environment. Students involved in the program received networking opportunities; enhanced value brought to potential career paths, and enhanced personal effectiveness demonstrated by stepping forward into leadership roles. Further, the collaboration provided an avenue to enhance interaction and knowledge transfer between the three Alabama Land-Grant institutions. This grant demonstrated, within these institutions, that commitment to the highest standards for continuous personal and professional development through collaboration to enhance and facilitate communication and interaction uniquely enhanced student-learning opportunities. The collaboration has continued as "Frameworks for Learning" enabling the College of Agriculture to establish a leadership development emphasis and multi-state leadership development programs.

Key Theme: International Collaborations

Statement: Researchers at Auburn University have helped fish and shrimp producers in several nations, (United States, Ecuador, Colombia, Thailand, Madagascar, Brazil, and Honduras) develop Codes of Conduct with best management practices for preventing negative environmental impacts of fish and shrimp aquaculture. They also have helped catfish farmers in Alabama develop best management practices, and served as their representative in discussions with state and federal government agencies related to environmental regulations. Shrimp Agriculture in developing tropical countries is in crisis because increased populations and bad land husbandry practices are leading to land degradation and loss of productivity. Alley cropping, an agroforestry practice designed to sustain crop production while restoring organic matter and nitrogen to the soil, is one possible management technique for highly erodible lands. Auburn University researchers are exploring ways to adapt alley cropping to different growing conditions in countries like Haiti and Brazil. Results so far show that alley cropping is more effective than rock wall terraces, contour canals, or grass rows at sustaining crop yields. Alley cropping also reduces sediment loss and runoff from plots. Applications of leaves and stems from hedgerows to the soil double corn yield and that pruning three times per season increases yield by 50%. This group is the only research team exploring the use of alley cropping for soil erosion control in the Southeast and possibly in the world.

Statement: Tuskegee University worked with scientists and farmers in Tanzania and Ghana to improve production practices, improve nutrition of families and develop small businesses.

Goal 2: A Safe and Secure Food and Fiber System

State Program: ***Enhance Food Safety, Quality and Processing Techniques***

Overview:

The safety of the food supply is a major concern to policy makers, consumers, distributors, processors, producers, and suppliers. Enhancing the quality and safety of our food supply requires continuous innovation in production, processing, packaging, and distribution practices. All of Alabama's land-grant universities are striving to meet those demands and to address current and emerging food safety, food quality, nutrition, and health issues, particularly as they relate to consumers, society, industry, and regulatory concerns.

Scientists at Auburn University have initiated research to reduce and prevent surface contamination on fresh fruit and vegetables by human pathogens. They are also conducting research to identify and map proteins linked to biological processes, such as diet and adaptation, and to delineate genomic and proteomic mechanisms of metabolic fat control in pigs.

Scientists at Tuskegee University have initiated research programs that are aimed at developing procedures for using low dose UV and gamma radiation to prolong storage of fruits and vegetables. Other researchers are using natural anti-microbial agents to control food borne pathogens in meat and egg products.

Researchers at Alabama A&M University are focused on finding solutions to the problem of allergenicity of peanuts and to improving the texture, tenderness, shelf-life, and taste of poultry meat.

The success of the research efforts in this area will result in a safer fresh food supply, and an understanding of the effects of genetics, environmental stress, and pathogenic factors on proteins. We will also have a better understanding of food animals and their fattening process. Also, outcomes of the metabolic fat control study are relevant to human dietary concerns. Additionally, final results will provide non-chemical food preservation procedures for a safer food supply.

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	4,837,516	23	3,928,689	13	4,112,123	13	4,331,380	13	4,547,948	13
1890 (ALAX)	196,200	1	116,865	1	122,708	1	128,843	1	130,285	1
1890 (ALX)	219,793	2	239,971	3	251,969	3	264,567	3	277,795	3
Totals	5,253,509	26	4,285,525	17	4,486,800	17	4,724,790	17	4,838,768	17

Allocated Resources ($) and Scientists Years (SY).

Key Theme: Food Safety – Animal Products

Statement: Scientists at Tuskegee University continue to develop methodology to make meat and egg products from safer microbial pathogens by using natural and anti-microbial agents. The application of bacteriophages as potential natural antimicrobial agents in maintaining and enhancing the safety of food products continues to be explored and studied. Studies at Tuskegee University have shown that application of bacteriophage ETU3 to milk and beef products inoculated by E. Coli 0157:H7, Shigella and Salmonella was effective in inhibiting growth of all the three tested pathogens. Development of effective control measures using novel anti microbial agents such as bacteriophages have a great potential in controlling food borne pathogens and extending shelf life of food products. This will consequently reduce the incidence of food borne illnesses and death.

Statement: Alabama A&M University scientists are developing strategies to increase the efficiency of encapsulated butylated hydroxyanisole (BHA) activity in comminuted meats. Extending the shelf life of ground meat increases the profit margin of producers without increasing the unit price to consumers. The rancidity of treated meat has been greatly reduced; however, the efficiency of encapsulation was not optimized in most recent evaluations. When completed the commercialization of encapsulated antioxidants will add a new dimension to the processing of poultry meat.

Statement: Scientists at Tuskegee University continue to develop methodology to make meat and eggs safer from microbial pathogens by using natural anti-microbial agents. Earlier studies on laboratory media provided evidence that when used in combination with chelators, lysozyme, lactoferricin-B, and bacteriocin nisin are effective in reducing populations of gram negative bacteria. Studies were therefore initiated using ground beef as a model food system. Results indicate that unlike the laboratory media, the effectiveness of nisin, lactoferricin-B, and lysozyme against E. coli 0157:H7 is

substantially reduced. Further work is in progress to enhance the effectiveness of these anti-microbial chelators.

Statement: Researchers at Alabama A&M University studied the effect of dietary acid-detergent fiber (ADF) concentration on fecal shedding of *E. coli* O157:H7 in lambs. Enterohemorrhagic *E. coli* O157:H7 is an emerging food-borne pathogen. Fecal shedding of the pathogen by ruminants is the mode of entry into the human food chain. Since diet is a major determinant of intestinal microflora, the potential exists to reduce *E. coli* O157:H7 shedding by ruminants through pre-harvest dietary intervention. The results from these studies indicated that regular all-concentrate diets, when fed to lambs as the sole nutrient source, increase fecal shedding of the pathogen. By increasing the ADF content of the concentrate diet between 10 and 20%, shedding of the pathogen can be minimized without adversely affecting meat production efficiency. Reduction in fecal shedding of the pathogen should result in reduction in contamination of food items and losses associated with the disease.

Key Theme: Food Safety – Fruits and Vegetables

Statement: Tuskegee University scientists in collaboration with USDA-ARS scientists continue their research efforts in developing non-chemical methods of controlling post harvest losses of fruits and vegetables. Studies at Tuskegee and USDA-ARS laboratories have demonstrated that low dose UV-C light irradiation will elicit disease resistance in harvested fruits and vegetables and extend the shelf life of sweetpotatoes, onions and tomatoes. Results of these studies have resulted in the design of an apparatus that can deliver low dose UV-C light to the surface of fruits on a conveyor belt. Using this apparatus, post harvest decay of apples can be reduced by 25% after 28 days of storage.

Statement: Auburn University researchers are exploring the effectiveness and safety factor of the bacteria *Bacillus thuringiensis* (Bt), a naturally occurring substance the kills many destructive caterpillar pests. Finding alternatives to traditional insecticides to control insect pests would benefit not only the environment, but also make fresh fruits and vegetables even safer and healthier for human consumption. Auburn scientists are helping determine the likelihood of insects developing resistance to transgenic plants that contain these proteins. Their lab has the only beet armyworm colony in the world that is resistant to Bt, and the only known colony resistant to the type of protein found in Bt transgenic plants. Results of their studies show that resistance to a Bt protein does not necessarily translate into cross resistance to Bt formulations. This is important because organic farmers can now feel safer about using Bt transgenic plants and Bt. The research also has led to the development of a model documenting the highest level of foreign gene expression in plants using Bt to control insect pests and a patent for this model has been submitted.

Key Theme: Genetic/Biochemical Modification of Foods

Statement: Wholesome and safe muscle foods are an excellent, highly available source of critical nutrients, including essential amino acids and B complex vitamins and folic acid among others, for humankind. A negative aspect to muscle foods is that these food products may contain too much fat. Auburn University researchers are applying genome and transcriptome analysis of the fattening process in meat animals to find such new strategies. A full understanding of the biochemistry and metabolic regulation involved in fattening in meat animals allows us to devise sustainable, animal- and producer-friendly approaches to enhance the efficiency of production of muscle foods that are highly nutritious and serve as an important component of the human diet. The AU laboratory was largely responsible for describing the mechanism of biochemical action

of a currently used feed additive in swine diets (PAYLEAN/ Elanco) that lowers fattening and enhances muscle growth in pigs. The uniqueness of this work lies in the fact that this level of understanding of regulation of fattening can be exploited to develop practical means of lowering fattening in pigs. They are expanding this to obtain a more comprehensive view of regulation of fattening in pigs.

Key Theme - Food Safety and Risk Analysis

Statement: Increasing food production security from farm to fork and prevent agroterrorism attacks on the United States. Auburn University researchers are working on these issues. One project is helping identify the cause of avian cellulitis, which is a poultry skin disease that costs the poultry industry and consumers $80 million per year. The research has revealed ways of preventing the disease and dealing with the disease should it occur. This in turn has dramatically lowered the cost of the disease, the savings of which have then been passed onto the consumer, ensuring the continued availability of a safe and economical product.

Goal 3: A Healthy, Well Nourished Population

State Program: ***Improve Human Nutrition and Health***

Overview

The socioeconomic status of some Alabama residents restricts their ability to practice healthy dietary habits, including choosing healthy foods and handling food safely. The nutritional quality of diets can assist in the prevention of serious health problems. Our research efforts aim at protecting and enhancing the health of Alabama citizens. Through understanding both societal issues affecting consumers' overall diet-related health and the relationship between diet and specific body function, better quality diets, including increased utilization of food crops and the development of dietary guidelines based on ethnicity, age, and consumption preferences, can be developed.

At Alabama A&M University, scientists are studying the nutrient composition of the shiitake mushrooms and its role in nutritional diets. They also are evaluating the diets of the elderly population residing in assisted living long-term care facilities and congregate feeding programs.

At Tuskegee University, scientists have initiated a research program that focuses on improving human nutrition and health of the African American population in the Black-Belt region of Alabama through diet modification and nutrition education.

Scientists at Auburn University are conducting research that evaluates the nutrition compositions of foods, including factors that affect shelf life.

The accomplishments thus far have resulted in development of recipes utilizing novel vegetable sources of high omega-3 fatty acids, i.e., sweetpotatoes and purslane. There is also a greater understanding of food quality and product shelf life of foods. The results are helping the elderly select appropriate foods and portion sizes while preventing the potential of confusing foodstuffs and other substances in the lines of older citizens. The research remains on target with stated objectives.

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	2,227,188	4	1,977,742	10	2,222,355	10	2,333,769	10	2,187,410	10
1890 (ALAX)	134,150	1.2	140,017	1	147,017	1	154,367	1	162,085	1
1890 (ALX)	164,785	1	174,439	2	183,160	2	192,318	2	201,933	2
Totals	2,526,123	6.2	2,292,198	13	2,579,532	13	2,680,454	13	2,551,428	13

Allocated Resources ($) and Scientists Years (SY).

Key Theme: Nutrient Composition of Foods and Nutrition Education

Statement: Non-traditional green leafy vegetables contribute to the larger group of functional foods in American diet. With proper nutrition education and diet modification, these functional foods can be incorporated in the diets of African-American population in the Black-Belt region where risk of cardiovascular (CVD) diseases are quite high. Tuskegee University scientists have employed clinical as well as food and nutrition education strategies in efforts to reduce the risk of CVD in these communities. Food and nutrition educational materials that focus on how to lower CVD through proper diets were developed through focus groups and are being distributed in the target communities.

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Statement: Auburn University researchers are exploring regulation of fattening in pigs, goats, and cattle at the expression level for the many genes involved with these metabolic processes. They are using experimental approaches to identify genes critical to optimal marbling and production of desirable, lean animal products. From these results, production strategies can be developed to produce highly desirable muscle foods and ensure continued viability and sustainability of livestock agriculture. Our lipid metabolism and regulatory gene expression profiling in swine fat, liver, and muscle tissue have identified critical controlling transcription factors for overall fat deposition and energy repartitioning in pigs [they are studying more than 100 genes presently]. They were also the first to show that such products as PAYLEAN effect repartitioning of energy use between fat and skeletal muscle in pigs via regulation fatty acid oxidation. The long term benefit of this work is that producers can eventually produce highly desirable, tasty, and healthier muscle food products at reasonable production costs, which will ensure a continued availability of highly nutritious muscle foods to all U.S. consumers.

Key Theme - Diet Modification for Targeted Populations

Statement: DHA (docosahexaenoic acid) is a dietary essential omega-3 fatty acid that is important in visual and neural development of infants. It is important that an adequate supply of DHA be provided in the diet of pregnant and lactating women and in infant formula given to

bottle-fed babies. The major source of DHA in traditional diets is cold water marine fish, which is not consumed daily by the American population. Therefore, it is important that novel sources of DHA be found for pregnant and lactating women and for bottle-fed infants. Auburn University researchers explored new ways of adding essential fatty acids to the diets of new born infants and lactating women. In February 2002, the first infant formula containing DHA and ARA was introduced in the United States. Research conducted at Auburn University contributed to the FDA approval of the addition of these fatty acids to infant formula. Lactating women who do not consume adequate amounts of high DHA fish may also benefit from research conducted at Auburn University. A novel approach to increasing omega-3 fatty acids, such as DHA, in the U.S. food supply is to feed animals a source of omega-3 fatty acids, which in turn becomes part of the animal food products they produce. For example, hens fed a source of DHA lay "designer" eggs enriched in DHA. When these "designer" eggs are consumed by nursing mothers, the infant receives greater amounts of DHA during the crucial developmental period. In one AU experiment, the content of DHA in breast milk was increased 2.5 times that of baseline when lactating women consumed daily two "designer" eggs.

Goal 4: Greater Harmony between Agriculture and Environment

State Program: ***Develop and Enhance Sustainable Ecosystems to Protect Natural Resources and Biodiversity***

Overview

Society demands that our quality of air, water, and soil be protected. Contamination of these resources and food, threatens the continued existence of many plant and animal species. Sustained productivity of Alabama's agricultural, silvicultural, and other natural resource-dependent industries will require immediate and long-term efforts to maintain quality. Considerable agricultural waste and residues are generated through the animal, poultry, and crop production systems in Alabama. In a sustainable agriculture system, these residues and wastes could be incorporated into the soil to enhance soil productivity, improve water infiltration and plant root environment, and to improve soil quality by improving aggregate formation and stability. Excessive application, however, can result in groundwater contamination with nitrate, phosphates, and trace metals. Chemical composition of organic wastes and plant-residues affect transformation reactions mediated by soil microorganisms. Understanding the controlling factors in relation to microbial population and enzyme activities and mineralization is highly desirable for designing better management strategies.

Research at Tuskegee University is looking at the long-term effects of the application of broiler litter to agricultural lands and its effect on ground water contamination. Studies are also being conducted on soil conservation using grass hedges and on the use of plasticulture technique in an integrated pest management system.

Scientists at Auburn University are conducting research that focuses on water quality and waste management issues, ozone studies, improved farm management through precision agriculture and remote sensing, and the productivity of soils and the systems that affect them.

Alabama A&M University researchers are evaluating the utilization of composted poultry litter on the production of alternative crops such as shiitake mushrooms and in agronomic crops such as cotton to improve productivity and find ways of disposal of poultry waste. Additional research evaluates the mechanism of remediation of heavy metals in soils.

The accomplishments thus far are encouraging and are on target with stated objectives. The ultimate goal is to use the data to design effective broiler litter management strategies for the different soil types in Alabama. Further, these studies have resulted in new and innovative strategies in waste management, including new approaches to combining poultry waste and cotton gin waste into pellets for field application. In the remote sensing/precision agriculture area, improved management for row crop operations through understanding the sensed data in zones can reduce overall applications of treatments by concentrating on the less productive zones instead of overall field treatments. Understanding the biogeochemistry of soils and their systems has revealed how ecosystems process nutrients and the importance of moisture in wetland productivity as well as the role of soils and its mineralogy to the remediation process.

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	12,538,179	36	11,825,926	38	12,417,222	38	13,038,083	38	13,689,988	38
1890 (ALAX)	188,200	1.5	92,610	1	97,240	1	102,101	1	107,207	1
1890 (ALX)	324,802	2	268,414	2	281,834	2	295,925	2	310,721	2
Totals	13,051,181	39.5	12,186,950	41	12,796,296	41	13,436,109	41	14,107,916	41

Allocated Resources ($) and Scientists Years (SY).

Key Theme: Water Quality and Waste Management

Statement: Agricultural lands have been used as an inexpensive solution to the disposal of broiler litter in Alabama. Tuskegee University scientists have focused their research on addressing the environmental concerns of ground water pollution and long-term effects on the agricultural ecosystems of broiler litter applications to agricultural lands. Results of earlier studies indicated that the trace elements on nitrogen transformation varied from soil to soil. Several farms with different soil types in Alabama that have received broiler litter application for over 20 years have therefore been identified and soil samples have been collected for analyses.

Statement: Auburn University researchers are involved with a cooperative multi-state project meant to determine the effect of chromium (Cr) supplementation on reproductive performance of sows. The preliminary results indicate that the total number of pigs born per litter tended to increase (approximately one pig per litter) as Cr supplementation increased. The number of pigs born alive and weaned per litter followed the same trends, but only numerically. Two trials were conducted to investigate the effect of early dietary restrictions on compensatory growth responses and N excretion. Pigs subjected to dietary amino acid restrictions during the grower phase compensated completely in terms of growth rate and body composition. In addition, restricted pigs reduced N excretion not only during the restriction phase (20%) but also during the realimentation phase (34%) because of compensatory N retention. Reproductive efficiency and the efficiency of nutrient utilization are two primary factors that determine the profitability of pig enterprises. Chromium supplementation may increase the productivity of high producing sows. Compensatory growth can have a positive impact not only on the overall productivity and efficiency of pig production, but also on the environment by reducing the excretion of unused nutrients. Thus, these two areas can contribute greatly to successful and sustainable pig production.

Statement: Scientists at Alabama A&M University are evaluating the environmental impact of land applied animal waste, especially that of swine (sus scrofa domesticus) and poultry. Defining optimal levels of N and P concentrations, as well as enteric pathogen for safe disposal and the improvement of soil and water quality is the ultimate goal of this research.

Statement: Auburn University researchers are looking for new ways to protect the environmental while still allowing producers to function economically. They have explored novel methods of treatment including constructed wetlands, anaerobic digestion, and refeeding the waste. The work related to the constructed wetlands study is the first and only long-term study involving poultry waste and is the first attempt using any animal waste type to characterize the long term effect of using wetlands on the environment with respect to the fate of nutrients in the soil and effluent. The completion of the data analysis will provide guidance as to the use of these treatment systems and the effectiveness in their removal of nutrients and the fate of phosphorus in the soil around and below the wetland area.

Statement: Managing animal manures is a challenge for agriculture. Manures contain nutrients that can be beneficial to crops and soils, but also can pollute water systems. Auburn University researchers are developing, evaluating, and refining physical, chemical, and biological treatment processes in engineered and natural systems for management of animal manures and other agricultural wastes. The project began in October 2001, so no results are yet available. However, results may allow livestock and poultry producers to find better ways of handling animal waste.

Key Theme: Soil Conservation

Statement: Scientists at Tuskegee University continue to focus on methods of controlling soil erosion to ensure sustainable agricultural production on small limited resource farms. Previous studies have shown that Eastern gamagrass (Tripsacum dactyloides) grown as grass hedge to control erosion can be incorporated in a farming system of a small-scale farm. Current studies are focused on adaptability of several Eastern gamagrass to several acid soil types in Southeastern U. S and as a phytoremediation agent. Preliminary results indicate that eastern gamagrass performed favorably across soil types and pH levels studied. The use of Eastern gamagrass for phytoremediation in addition to its ability to tolerate acid soils, control soil erosion, and its potential as a forage crop can play an important role in a small farm system.

Statement: Long-term fertility/soil test calibration experiments provide a rich source of information on soil changes over time. Auburn University has maintained and monitored such long-term experiments at eight Alabama locations, and these experiments are providing the basis for a southern regional effort through SERA-IEG-6 on Soil Testing and Plant Analysis to document research-based soil test calibration and recommendations for cotton on Coastal Plain soils. A regional publication is forthcoming.

Key Theme: Urban Issues and the Environment

Statement: Auburn University scientists are investigating production practices for trees grown for the South's landscape market. Specifically, are the only researchers in the country looking at the influence of chilling on ornamental trees? Chilling is understood to critically affect fruit crops but it often is overlooked in ornamental trees because there is less concern about production of seeds or fruits. However, a large number of shade trees planted in the South are native to the North, so AU researchers looked at the chilling requirements of trees commonly used in the North that don't do as well in the South, such as linden, ginkgo, dogwood, cherry, and red maple. The industry premise about the poor performance of these trees has always been that it's just too hot

for them in the South. Research results have shown that the problem is not how hot it becomes, but that's it never gets cold enough for the trees in the winter. The scientists have identified specific varieties or cultivars that will perform well in the South. For example, they found that a silver linden called 'Sterling' *tilia tomentosa* is well suited for South. They also have found that some red maples will thrive better in the South, with some selections being practically evergreen in southern landscapes. They also found that gingko will survive adequately as far south as Orlando, Fla., but from production standpoint, it is not as easy to grow in Alabama. The results of this study will help nurseries and plant outlets better choose the cultivars they provide in the southern market, and also help growers better choose the cultivars they want to produce. Ultimately, everyone will save money and better enjoy their trees.

Statement: Auburn University researchers are developing an IPM program that will prevent, reduce, or eliminate losses caused by termites in urban settings. The work has concentrated on Formosan subterranean termite, an exotic species that is more aggressive and destructive than native termites. Formosan termites are spreading and establishing in more states. Public concerns have risen that this species may replace native ones to become the dominant species and cause more damage. Researchers have identified more than 20 ornamental plants that harbor termites and may facilitate the distribution of Formosan termite. This new information will be very useful for state inspectors who may pay special attention to these plants to prevent termite introduction to new areas, useful to pest control professionals who may treat such plants to kill termites, useful to the public who may check for termite in these plants before buying and planting on their property. Preventing Formosan termites from establishing in new areas will save millions of dollars damage and cost for control. The researcher also have proved that two subterranean termite species showing habituation to vibration disturbance in the field, which indicates that using the new technology of a baiting system is an effective tool for termite control. Bait technology uses less than 90 percent of the pesticide used in traditional control methods, but achieves good control. This finding has special meaning for enhancing the urban environment. They also have evaluated novel wood preservatives for use in structural and engineered wood materials to control wood-destroying pest insects. A new combination of two low toxic components demonstrated high efficacy and long-extended function to kill termites.

Statement: Ammonia losses from animal housing systems have been identified as a major source of small particle air pollution. These small particles, less than 2.5 microns, have been shown to negatively affect human health. Reducing ammonia losses from animal housing systems has been identified as a major goal of EPA regulatory policy in the future. Aluminum sulfate (alum) has been used successfully in the poultry industry to control ammonia loses, but had not been explored as a possible tool for livestock producers. Auburn researchers have explored the efficacy of this product for calf-rearing, including addressing concerns that alum, which is acidic, might adversely affect the skin and hoofs of calves. Use of alum in calf housing has not been previously investigated as a means of reducing ammonia loss. The results indicate the a little as three pounds of alum in a standard 4-foot by 7-foot calf hutch can reduce ammonia losses by as much as 50 percent. Rates of ammonia volatilization were reduced in those hutches where alum was applied at the time of bedding the hutch with pine shavings. Aluminum sulfate (alum) has been used successfully in the poultry industry to control ammonia loses, but had not been explored as a possible tool for livestock producers.

Statement: Auburn University researchers are exploring the food web consequences of metal hyperaccumulation by plants by documenting the metal concentrations of insects collected from natural stands of hyperaccumulator plants. Field surveys of nickel (Ni) hyperaccumulators in California, New Caledonia, and South Africa have identified 10 insect taxa that feed on Ni-hyperaccumulator tissues and they contain more than500 μg Ni/g. They have shown that

hyperaccumulation is a defense tactic against herbivores and pathogens and they hope to take this work into the field to examine the impact of metal hyperaccumulation on plant-animal mutualisms, search for metal-resistant herbivores and pathogens, and determine if defense via metals decreases the role of carbon-based defenses in hyperaccumulating species. Results of the studies have shown that some metal mobilization can occur in areas that naturally support hyperaccumulator plants. This work indicates that metal mobilization into food webs should be monitored at sites where hyperaccumulator plants are being used to extract metals from soils.

Key Theme: Integrated Pest Management

Statement: Tuskegee University scientists have pioneered soil solarization research in Alabama for the past decade. Soil solarization, trapping of solar radiation under clear plastic mulch is used as a biological control method of diseases, weeds and other pests of vegetable crops. Research at Tuskegee University continues to investigate the efficacy of plastic culture in integrated pest management of vegetable crops in Alabama. Several weed species, soil and foliar borne diseases can be significantly managed by soil solarization. Soil solarization can have a tremendous impact on the reduction of the used of chemical pesticides in managing weeds and soil borne diseases.

Statement: At the request of Alabama's tomato growers, Auburn University researchers are implementing at the field level the technologies of beneficial bacteria as crop inoculants. Scientists are working with tomato growers in the state to determine how these technologies can be used practically in Alabama to help growers lower their input costs and hence survive economically. Results indicate that vegetables can be produced with reduced inputs of pesticides and fertilizer, though more research is needed to fully implement the methods. During the last decade, the number of acres in Alabama devoted to tomatoes decreased by approximately 50 percent, and the value of production decreased by approximately 60 percent. The number of farms growing vegetables, sweet corn, and melons decreased from 2,203 in 1982 to 996 in 1997. If this research finds new ways to grow tomatoes and other vegetable crops successfully in Alabama under the current intense economic and biological pressures, these businesses may be able to rebound and again provide solid economic benefits to the state.

Statement: Auburn University Insect management studies conducted for control of foliage feeders evaluated several "newly" labeled insecticides and potential candidate insecticides. Results of two studies enabled scientists and extension specialists to make recommendations for control of beet armyworms and soybean loopers under an "Emergency Exemption" from the Alabama Dept. of Agriculture and Industries and EPA. Since other available insecticides on peanuts do not adequately control these two pests, the data these studies generated were valuable in proving the efficacy for the foliar insecticide, Tracer. Although a state wide outbreak of these insects did not occur, several "pocket" of infestations occurred across South Alabama and growers were able to effectively manage these pests and prevent serious foliage damage to peanuts. An estimated 10,000 acres of peanuts was treated under the Section 18, "Emergency Exemption." Effective control of these insect pests resulted in $535,000 value in increased yield due prevention of crop damage.

Key Theme: Remote Sensing and Precision Agriculture

Statement: The use of non-destructive technologies (e.g. electrical conductivity mapping) to facilitate detailed mapping (intensive mapping) of soil properties can be beneficial in two ways: 1) the depiction of soil properties is improved so better interpretations and management systems of the soil can be developed, and 2) detailed soil mapping is relatively time-consuming and expensive, so these technologies may improve the efficiency of soil mapping. In particular, the

electrical conductivity mapping may hold benefits for both agronomic and urban applications, where soil mapping can range from $5 per acre (agronomic soil mapping), to $500 for an acre parcel (urban applications). Where electrical conductivity mapping is feasible, improved surveys can be developed. Seasonal high water tables can occur in sandy, Coastal Plain soils above soil features that are considered diagnostic of seasonal high water table depths. These findings can lead to improved assessments of site conditions for OSDS placement in these sandy soils. This can result in substantial savings for a home builder, considering initial costs of OSDS installation range from $2000 to $5000, and repairs on malfunctioning systems (due to installation in poor soils) can be costly.
Regional

Statement: Researchers at Auburn University are studying the use of remote sensing in production agriculture. In particular, remote sensing of soil properties tends to work best in Alabama's Wiregrass region. This ability is beneficial for developing soil surveys, and for delineating zones for precision crop management. In addition, they have used remote sensing technologies to describe corn yield variability during the growing season. Their data indicates that from 30 to 60% of the yield variability of a corn field can be described when the crop approaches the reproductive stages. However, in order to render management decisions effective (e.g. split applications of fertilizers), this predictive capability must occur earlier in the growing season. Future research will address this. They are also using electrical conductivity mapping to evaluate soil variability across fields. Similar to remote sensing technology, the electrical conductivity mapping may allow for a non-destructive, rapid, relatively continuous depiction of soil properties that can be useful for both urban applications and agronomic management of soils. Unlike remote sensing, the electrical conductivity signatures are reflective of subsurface soil properties. Using both remote sensing and electrical conductivity mapping, they are developing better, more cost-effective methods of soil sampling and monitoring crop nutrients for site-specific fertilizer applications, which may lead to increased producer profits. They have also determined that significant soil saturation (soil wetness) occurs in sandy Coastal Plain soils that do not exhibit features diagnostic of wet soils. This is important for on-site sewage disposal system placement or timber production, where the ability to determine the depth to seasonal high saturation is important for interpreting site characteristics. It is clear that a combination of soil features and landscape position must be used to assess the height of seasonal high water tables in these situations.

Key Theme: Restoration and Best Management Practices (BMP)

Statement: Current Auburn University research in forage and grassland ecology is evaluating the potential effectiveness of rotational stocking systems to improve productivity and utilization of desirable forages, reduce grazing animal activity in riparian areas and streams, allow recovery of riparian vegetation, and improves stream water quality. One study was done to determine the amount of day time hours cattle spend in riparian areas and what might draw them away from those areas. Results of the study showed that even placing a large water tank in a shaded area away from the riparian zone did not effectively lure cattle away from creeksides. It appears that the animals were in the riparian area not so much for water as for shade and a cooler environment. This suggests that the only way to keep cattle away from riparian areas is to fence out of that area. Riparian areas can be protected by including the riparian area in a small pasture and exposing that pasture to animal activities for a very brief period of time during the rotational scheme. Results suggest that these areas can be used by livestock for short periods of time without impact, so they don't have to be totally excluded, just controlled.
State

Key Theme - Soil Conservation, Quality and Bio-indicators

Statement: Auburn University research is generating exposure-response relationships that are necessary for development of regional emission reduction strategies and recommendations for improving management and sustaining productivity of grassland ecosystems that support animal agriculture. Published data other research indicate that, within the range of ambient ozone concentrations typically experienced in the South region during the March-October growing season, yield of ozone-sensitive forage crops is decreased on average by approximately 10%. Based on altered plant tissue chemistry resulting from ozone exposure, nutritive quality decline in ozone-sensitive forage crops can be expected to approach the same order of magnitude. Integration of nutritive quality assessment with yield response is necessary in order to more fully characterize potential economic impacts of ozone on grassland system productivity. This work was the first to show that measurable nutritive quality loss can occur in forage crops, even in the absence of visible foliar injury, as a result of exposure to ground-level ozone. This "hidden" loss has been documented for a number of warm season-adapted forage crops that, based on plant physiology theory and lack of visible injury, have historically been considered to be relatively ozone-tolerant. A second area of research was conducted evaluating the impact that tropospheric ozone has on buddleia. This work is designed to identify which cultivars will perform best in urban environments with minimal visible injury or growth reductions. In addition, this work is determining what ozone injury looks like so that homeowners and growers do not mistake the injury for a nutrient or biotic problem and apply chemicals unnecessarily

Goal 5: Enhance Economic Opportunity and Quality of Life for Americans

State Program: ***Ensure Socioeconomic and Self-Empowerment of Families and Communities***

Overview

One-fourth of the American population lives in rural areas. Alabama is 40% rural, based on 1990 census data. Further, the Black-Belt Counties (BBCs) of South Central Alabama, which run from the Georgia border in the east, to the Mississippi border in the west, pose a unique challenge for the land-grant system due to the demographic, social, and economic distinction of the region. For example, these counties are heavily rural, ranging from 36 to 100%, versus the national and state averages of 25 and 40%, respectively. The counties have a large non-white population, ranging from 44 to 86%, versus the national and state averages of 17 and 27%. The BBC poverty rate range of 20 to 39% is more than twice the state average (19%) and more than two and a half times the national average of 15%. The average annual unemployment rate ranges in the BBCs from 7.6 to 18%, versus the national average of 5.4% and the state average of 5.1%. In addition, the median income ranges from $14,000 to $24,000 versus the national and state averages of $31,000 and $26,000. Finally, the percent of high school graduates ranges from 49-62% in the BBCs, versus the state average of 67%. The well-being and societal contributions of this population hinges on having viable communities, businesses and economies. This viability becomes significantly important in rural communities where the majority of the residents are poor.

Forces of change continue to dramatically affect rural areas and communities including exposure to global economic trends, technological revolution, and diversification of community economic foundations formerly almost entirely dependent on agriculture and other extractive industries. Not only is there increasingly more reliance on technology for economic growth and job development, but also the nation is making transition of refocusing and retooling a significant amount of its technology to global and international competitiveness.

In this changing context, there is a serious concern about the fate of the rural communities and the underserved, particularly in the Black-Belt region of Alabama. Based on the historical nature of underdevelopment for this region, while at the same time acknowledging specific areas of potential for development, research at Tuskegee University focuses on the assessment of the current measures for economic growth, equity issues and quality of life indicators as elements of sustainable rural development in the Black-Belt of Alabama.

At Auburn University, research is being conducted on natural resource and environmental issues that affect the rural population of Alabama. Another major research area is in the identification of issues that affect marriages and families in Alabama and to better understand the patterns of consistency and change in marriages.

Alabama A&M University researchers have designed programs to ascertain the impact of technology and sustainable agriculture practices on the well-being of farmers, particularly small- and medium-sized farms in Alabama. The research results have provided information on areas of the small-scale and limited-resource farm that can be targeted for value added and be assisted by access to and participation in specific USDA programs.

Further outcomes of the research under this goal will enable the forestry industry in the state to more effectively support rural development in the state and assist farmers in developing sustainable farming practices and other enterprises.

Inst.	FY 2000		FY 2001		FY 2002		FY 2003		FY 2004	
	Approximate Expenditures	SY	Approximate Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY	Projected Expenditures	SY
1862 (AL)	1,218,759	5	1,149,524	3	1,207,000	3	1,267,350	3	1,330,719	3
1890 (ALAX)	135,110	1	383,670	2	402,853	2	422,995	2	444,144	2
1890 (ALX)	505,304	3	286,819	3	301,159	3	316,216	3	332,026	3
Totals	1,859,173	9	1,820,013	8	1,911,012	8	2,006,561	8	2,106,889	8

Allocated Resources ($) and Scientists Years (SY).

Key Theme: Economic Viability and Sustainable Communities

Statement: The economic viability of the Black Belt Counties of Alabama continues to be the focus of Tuskegee University in efforts to ensure socioeconomic and self empowerment of families and communities. The research involves the assessment of current measures of economic growth, quality of life indicators and equity issues as elements of sustainable rural development in Black Belt of Alabama. Current research is focused on socio economic factors on sustainability of agriculture in these counties for limited resource farmers. Rural residents engaged in entrepreneurial activities tend to have very small business, limited or no profits, limited or no access to financial capital and limited use of computer technology for operating and management tasks. Another major factor for farm survival is the ability to access and participate in USDA programs. Research indicates that for minority and limited resource farmers, this participation is limited at best, if non-existent. In terms of insurance and conservation programs, non-participation falls into three categories: many thought the programs did not apply to them or

that their farms were too small to participate; that the costs of participation outweighed the benefits (payments too small or late); and that they were unaware of many of the programs, including qualifications for participation and deadlines. In the area of farm loans, past treatment by program officers and denial of loans has led to the lack of program participation by eligible farmers. Alternative and specialty crops are another avenue for small farm survival. For more full-time farmers, these crops comprise higher value vegetables including collard greens and bell peppers, coupled with markets that supply fresh produce to local consumers and merging markets such as school systems. A rising farm product that has become attractive to part-time farmers has been goats. Meat goats are preferred to milk or fiber goats, most farmers had herds ranging from 5 to 50 animals. Finally, majority of minority farmers surveyed do not have an estate plan to transfer farm assets, including land, to succeeding generations. Outreach programs are therefore targeted towards educating the clientele on available services and technical assistant programs.

Statement: Studies at Auburn University have found that relatively little attention is being paid at the county level to natural resource issues compared to traditional agricultural programming. This is so despite clear evidence that Citizen Advisory Committees at the county level support increased support for natural resource programming. In addition, research focusing on the pulp and paper industry in Alabama has documented some of the environmental problems associated with the manufacture of paper. Through this research, a web-based directory of citizen organizations that have emerged around issues of natural resource management in Alabama has been established, expanded, and maintained www.ag.auburn.edu/grassroots. This directory currently lists approximately 120 groups. The web-based directory has attracted considerable attention by citizen groups, the news media, and political leaders. The Alabama League of Environmental Voters used this directory as the starting point for their organizational efforts. Because many local citizen groups exist only in the context of a specific struggle, and then often disappear, a web-based directory appears to be the best way to represent their efforts. A printed directory would be out of date before it was distributed. The impact of research on ACES programming is as yet unclear. In addition, citizen groups have found research on the pulp and paper industry of value and have started to include issues of rural development along with more traditional bio-ecological-wilderness concerns in their campaigning.

Statement: Researchers at Alabama A&M University are evaluating the impact of sustainable agricultural practices and technologies on the well-being of small farmers in North Alabama. Personal contacts and telephone interviews with agricultural teachers, extension personnel, and primary change agents in technology transfer were used to solicit information about the knowledge and understanding of stakeholder groups regarding sustainable agricultural practices and the effectiveness of different information delivery systems. Results showed that small farmers have adequate knowledge and positive attitudes toward agriculture sustainability. However, there were significant differences between location within the state, age, years of experience, ethnicity, and prior association with the technology. This study provides environmental, economic, and educational information to small and limited resource farmers about sustainable practices and marketing strategies for alternative enterprises.

Key Theme: Families and Children

Statement: The apparel and textile industry employs approximately 100,000 people in Alabama, which constitutes over a quarter of the manufacturing workforce. This industry is a significant source of employment for rural residents, and its continued viability is critical to the economic base of Alabama. An Auburn University project is exploring the dynamics of consumer demand and acceptance in image-driven markets, with a particular focus on home textile products derived from Alabama cotton. This project seeks to enhance Alabama market competitiveness through

the development of better understanding of consumers- product choices in multiple textile categories using an online format. The project will develop a new methodology to conduct style testing by assessing consumers' visual preferences as assessed online. It will develop an interactive methodology to identify key consumer segments most interested in innovating home textile designs. This approach is relevant to questions of product design, product prototyping and production decisions, diffusion of design innovations, and long-term market positioning in the textile industry.

Statement: Why people stay in abusive relationships is a puzzling question, but many people do remain in difficult and sometimes dangerous situations. Understanding the reasons for this helps mental health and social workers as well as victims make wiser decisions about how to deal with this dilemma. Researchers at Auburn University are developing a model, based on interviews with couples that may help predict how relationships will progress. One of the goals of this research was to assess the extent to which stay/leave decision-making processes in abusive dating relationships are similar to stay/leave decision-making processes in non-abusive dating relationships. Results indicated that relationship satisfaction and alternatives were equivalent across groups. Investments, however, were differentially related to commitment for the two groups. Results of this work may someday help couples enjoy better, long-term relationships that are free from abuse.

II. Stakeholder Input

Stakeholder input into the planning and priority setting of Alabama's Agricultural Research Programs (AARP) is continuous and includes formal and non-formal processes. The formal process includes conducting statewide surveys of citizens, commodity and advisory groups, farmers, urban and rural families, faculty and students, and policy makers. Additionally, input is sought through the Annual Farmers' Conference, the Professional Agricultural Workers Conference, the Annual Agriculture Week, Advisory Councils, and the five Research and Extension Centers throughout the state in conjunction with the Alabama Cooperative Extension System (ACES) including the Tuskegee University Extension Program. Furthermore, the Director of the Alabama Agricultural Experiment Station (AAES) has appointed a Faculty / Industry Council which meets periodically throughout the year to address issues of agricultural concern. The role of the Council is to advise the Director with regard to priorities which are used to formulate future plans for the AAES. Farmers and other key constituent groups have input via their respective associations/commodity groups. The Associate Directors of the AAES (including selected associated academic schools and colleges at Auburn University), and the Research Directors at Alabama A&M University, and Tuskegee University, have their own Advisory Councils who provide counsel on research program directions.

In addition to the stakeholder-input mechanisms described above, the Director of AAES established a Futuring Task Force (FTF) made up a steering committee that seeks input from hundreds of stakeholders around the state. These individuals will identify opportunities that will be available to the State's agroindustrial complex to the year 2025 and discuss and recommend programmatic directions for the AAES as well as provide evaluation and assessment of current programs.

III. Program Review Process

The Research Directors ensure that the Merit Review Process for 1890 Evans-Allen Research Proposals remain consistent with guidelines published in the Administrative Manual for Evans-

Allen Cooperative Agricultural Research (Sec C: Program Administration, Subsection 2b: Project Approval Procedures-Merit Review – p5).

The Director of the Experiment Station and other Administrators ensure that projects/programs are merit reviewed and that they adhere to criteria listed in the Administrative Manual for the Hatch Act as amended and the Handbook for Research Project Leaders for the Alabama Agricultural Experiment Station.

IV. Evaluation of the Successes of Multi- and Joint-Activities

The Alabama Agricultural Experiment Station and the Alabama Cooperative Extension Service have many joint activities and the research portions of the integrated activities are supported by Auburn University through formula funds; however, Extension programs are supported through Smith-Lever formula funds and reported under a separate Plan of Work. The research components of these integrated projects are representative of the five state programs identified in the Alabama Agriculture Research Program's Five-Year Plan of Work and coordinated with the USDA REE goals. The amount of Hatch funds committed to each goal is listed as follows: Goal 1, $1,264,684; Goal 2, $403,744; Goal 3, $179,184; Goal 4, $1,731,577; and Goal 5, $207,232.

Stakeholder input is vital to the establishment of the integrated projects through setting priorities and helping to plan well-balanced projects. This input is through the Alabama Agriculture Experiment Station and College of Agriculture, Auburn University, from stakeholder input such as the Annual Farmer's Conference, the Professional Agricultural Workers Conference, Advisory Councils, commodity group meetings, and with the five Research and Extension Centers throughout the state in conjunction with the Alabama Cooperative Extension System including the Tuskegee University Extension Program. Also included in the stakeholder input process is the Associate Director of the AAES and the Research Directors at Alabama A&M and Tuskegee University and their advisory councils. Stakeholder input aids in identifying and addressing the needs of the under-served and under-represented populations in the state. Stakeholder input is also from the Alabama Cooperative Extension System's very comprehensive stakeholder process that utilizes a network of 67 county extension advisory boards and county and state-level program advisory committees.

There are several disciplines with combined research and extension appointments, located at Auburn University. These joint appointments are recognized as state specialist appointments. There are four state specialists in agronomy, two in animal and dairy science, two in poultry science, two in pest management, one in horticulture, two in wildlife management, and one in agricultural economics. These appointments are supported by Hatch and Smith-Lever funds. However, most of the 26 integrated projects have multiple research scientists and extension cooperators on each project.

The integrated projects are titled differently for the research and extension components. Also, often there are several extension components for each research title. For instance, under the research title "Farm-level economics of the Alabama crop and livestock sector," the extension counterparts are entitled "Agricultural business profitability," "Aquaculture," "Live stock performance programs to enhance profitability," and "Economic peanut management for Alabama producers." Another major research title is "Improved culture practices of crustacean and molluscan shellfish in Alabama" with the extension counterparts "Marine fisheries, seafood and coastal issues," "Aquaculture," and "Fisheries and aquatic environments." A total of 99 subtitles in extension correspond to the 56 major topics in research. The importance of the integrated projects is to develop the research and provide the vehicles needed through extension to deliver the results to the users.

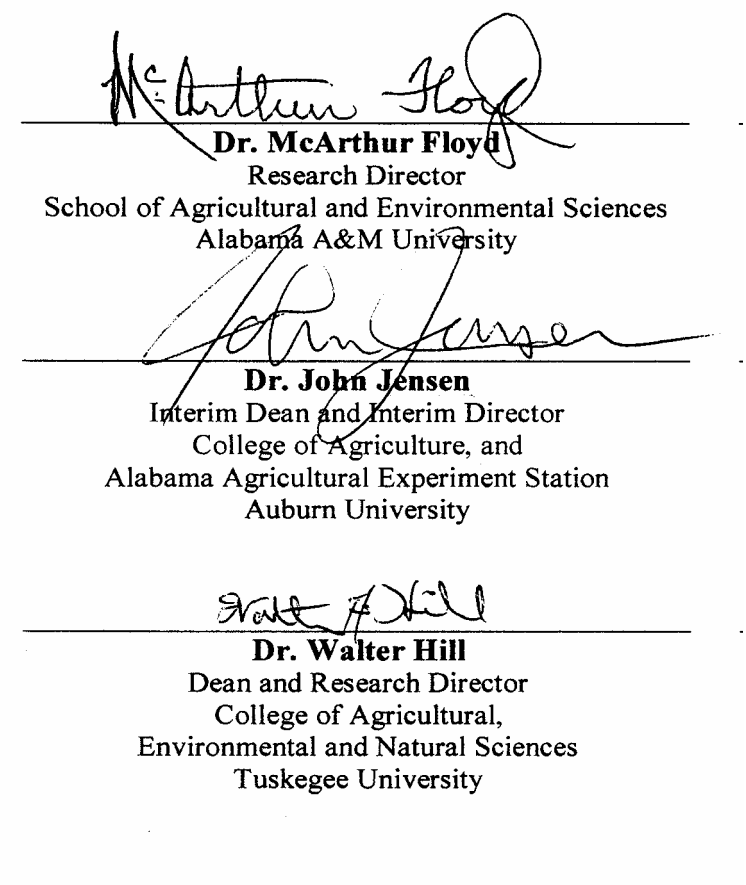
VI. Integrated Research and Extension Activities

An addendum will follow.

V. Multi-state Extension Activities

These activities will be covered under the Five-Year Plan of Work from the Alabama Cooperative Extension Service.

Certification of the *Annual Report of Accomplishments and Results for Alabama Agricultural Research Programs*, Federal Fiscal Year 2002:



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