United States Department of Agriculture
Cooperative State Research, Education, and Extension Service,
Office of the Administrator

Panel Report

Portfolio 1.3: Food and Non-Food Products

Supporting Objective 1.3: to provide science-based knowledge and technologies to generate new or improved high-quality products and processes to expand markets for the agricultural sector

CSREES Goal 1: Enhance Economic Opportunities for Agricultural producers

May 18 – 20, 2004

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GOAL 1: ENHANCE ECONOMIC OPPORTUNITIES FOR AGRICULTURAL PRODUCERS

Sustaining and expanding new markets for agricultural products is critical for the long-term economic health and prosperity of the food and agricultural sector in the U.S. American farmers and ranchers have superior natural resources, cutting-edge technology, a high level of learning and management skills, and a supporting infrastructure to increase the production capacity that exceeds domestic needs. U.S. agricultural productivity expands global markets, and results in a consistently positive balance of agricultural trade. Our land resources and production capabilities are the basis for exploring new uses for agricultural resources in industrial and pharmaceutical markets, as well as for world's lowest percentage of disposable income spent for food.

CSREES in partnership with the land grant University System Support USDA mission and its Strategic goals of providing: (1) economic opportunities for U.S. Agriculture, (2) economic opportunities for rural citizens, (3) a safe food supply and secure agricultural production, (4) good nutrition Supporting a healthy populace, and (5) a healthy environment and natural resources base as well as improved federal management services via the Presidents' Management Initiatives.

Economic opportunities for Agricultural producers is goal 1 of the CSREES strategic plan. This goal has five objectives and they are as follows:

1. Provide information, knowledge, and learning to help expand markets and reduce trade barriers.

CSREES supports the generation, teaching and dissemination of science-based information to create new market for agricultural products.

The economic viability of U.S. agriculture depends on the success it has in the global market. New or improved food and non-food products and processes can enhance the competitiveness of U.S. agricultural products in the global market by providing reliable supplies of desired products of high quality to customers. Research, education and extension activities generating reliable information in this area leading to the adoption of these new technologies can help the U.S. maintain its net positive agricultural balance of trade by expanding international markets.

2. Support international economic development and trade capacity building through discovery, learning and engagement.

CSREES and its partners are actively engaged in the production and dissemination of science-based information and education and technical assistance to support economic growth and capacity building in developing and transitioning countries. Sharing Science-based information on new or improved food and nonfood products and processes can help the development of education programs in these countries and improve international trade in food and agriculture.

3. Provide the science-based knowledge and technologies to generate new or improved high quality products and processes to expand markets for agricultural sector.

CSREES Supports the development of new or improved products of high quality through value added processes that enhance market opportunities for agricultural forest products. In addition to producing high quality food products, numerous other industrial, pharmaceutical and nutraceutical products are possible from agricultural and forestry resources. There is potential now for industrial products from biobased material to replace petroleum derived industrial products. In addition to providing some environmental benefits, these new products will play an important role in the sustainability of U.S. agriculture in the future.

4. Provide science-based information knowledge, and education to facilitate risk management by farmers and ranchers.

CSREES encourages research and educational programs for improved technologies for assessing and managing the risk associated with agricultural production systems. Science-based research, education and extension programs dealing with the development of new or improved products and process may minimize the producer risk by creating new uses and new market for agricultural products.

5. Contribute science-based information, analysis and learning to promote the efficiency of agricultural production system.

CSREES and its partners have been engaged in research, education and extension programs to improve efficiency of different agricultural production systems. New technologies such as biotechnology, precision farming and remote sensing will continue to play an important role in improving system efficiency and profitability. Successful commercialization of new or improved products developed from agricultural products may heavily depend on efficient production and supply of raw materials.

This document will describe the food and nonfood product portfolio listed as objective 3.

FOOD AND NONFOOD PRODUCT PORTFOLIO

Vision

Sustainable agriculture through new and improved food and nonfood products from biological materials.

Mission

Support strong research, education, and extension programs to commercialize new processes and new or improved food and nonfood products from biological materials for a sustainable agriculture.

Problem Areas

The CSREES Food and Nonfood Product Portfolio (F&NFPP) covers objective 3 of CSREES strategic goal 1. There are six problem areas (PA) included in portfolio and they are as follows:

New and Improved Food Processing	(PA 501)
New and Improved Food Product	(PA 502)
Quality Maintenance and Food Storage	(PA 503)
Home and Commercial Food Service	(PA 504)
New and Improved Nonfood Processing and Products	(PA 511)
Quality Maintenance and Nonfood Storage	(PA 512)

Recognizing the complexity and diversity of most problems in these problem areas, the program leaders encourage interdisciplinary approaches to address problems in these areas.

The team recognizes that the long-term goals of the programs within F&NFPP can best be achieved through strong research, extension and education programs that are clearly integrated. While the portfolio represents a very complex system in terms of functions and integration of these functions, there is a critical need to develop new models and delivery systems that are effective and performance based. Integrated program functions for the F&NFPP include:

- Generate originate fundamental knowledge on development of new processes and new or improved food and nonfood products through basic research.
- Develop new processes and value added food and nonfood products through applied research.
- Conduct outreach programs for the commercialization of new processes and products developed.

- Provide leadership in the delivery of research-based knowledge through extension, outreach, and information dissemination to strengthen the capacity of public and private decision makers impacting agriculture.

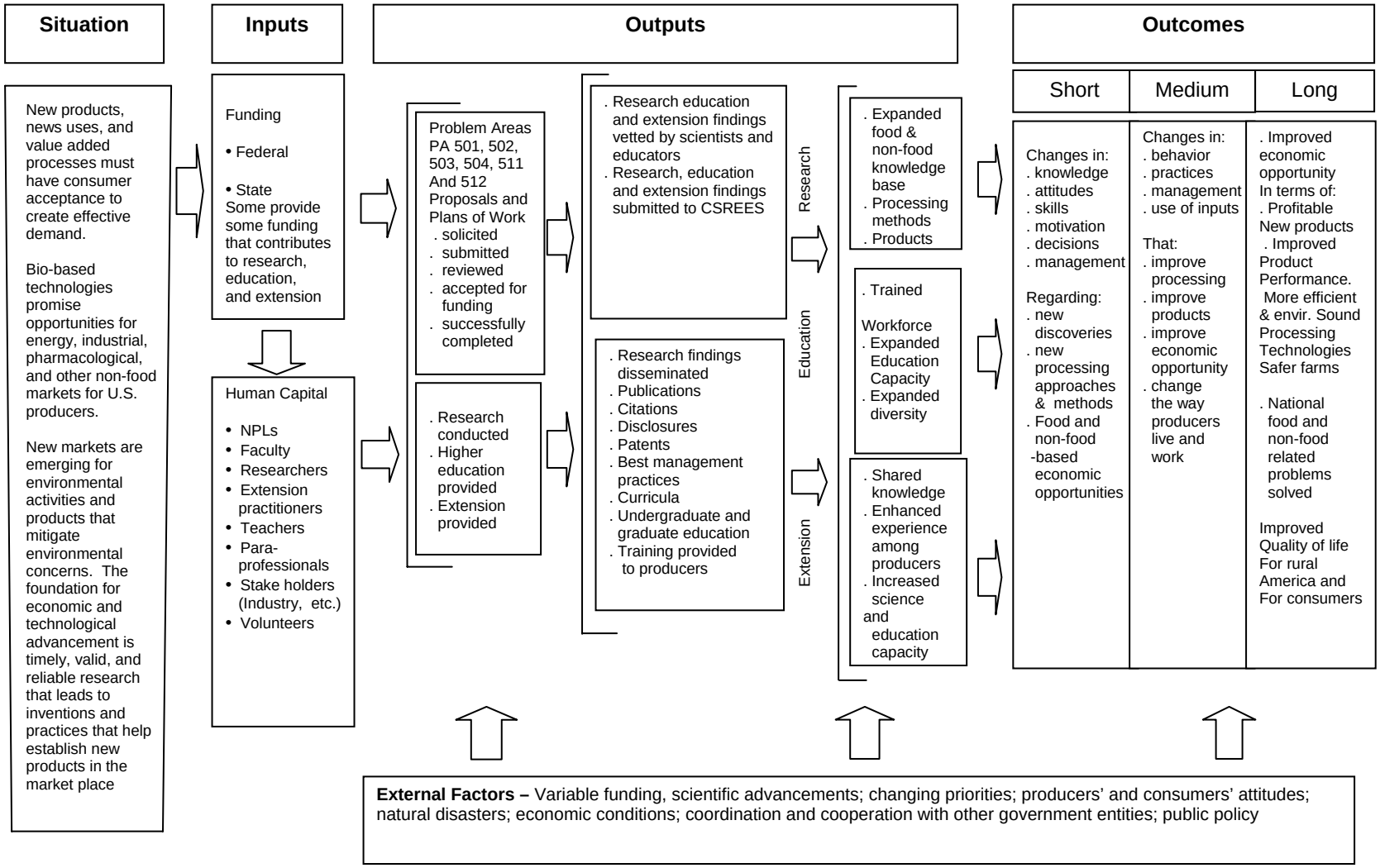
- Strengthen the capacity of institutions of higher education to develop the skills of the Nation's workforce in the food and agricultural sciences.

- Assure the quality, relevancy, and performance of programs supported through Federal funding in the development of new processes and new or improved food and nonfood products.

- Optimize collaboration and cooperation across institutions and agencies in order to achieve broad strategic goals addressing the needs of farmers, ranchers, and the American consumer.

The logic model (Figure 1) illustrates the way in which the F&NFPP responds to situations to achieve program goals.

Fig. 1. Food and Nonfood Product Portfolio Logic Model



The Partnership

CSREES programs are carried out in partnership with the Land-Grant University system and private sector. The F&NFPP demonstrates the linkages and interdependency between the Federal and State components of a broad-based, national agricultural research, extension, and higher education system. The support of the university system is critical to assure relevancy, quality, and performance for the programs administered and led by the agency in the food and nonfood product area. CSREES program leadership serves as both the catalyst and focal point for national research, extension, and education programs dealing with the development of new or improved food and nonfood products in universities and elsewhere.

The F&NFPP leadership also maintains strong program linkages with the USDA's Agricultural Research Service (ARS). The agricultural industry and American consumers are the benefactors of these well coordinated programs administered by CSREES and ARS. A strong university-based research, education, and extension system, linked to the in-house research programs of ARS, will also help the U.S. Agriculture to remain competitive in the global market.

Portfolio Development Process

The portfolio is targeted to critical national needs, issues and priorities relevant to maintaining a sustainable agricultural industry through the development of processes and new or improved food and nonfood products from biological materials. Research, education and extension programs must also demonstrate relevancy in terms of science. The F&NFPP and others are developed based on established national needs. The critical national needs and program priorities are set using stakeholder imputs. The program leaders of F&NFPP have effective links to researchers, educators, extension specialists, members of processing and packaging industry, experiment stations, commodity organizations, consumer groups, advocacy organizations, advisory committees, review panels, national academies, sister agencies, OSTP and Congress. Feedback from these groups and individuals are obtained directly or indirectly for identifying and prioritizing the national needs to assure relevancy of programs within each portfolio (see evidence folder).

Both formal and informal procedures are used to obtain stakeholder input. These may include stakeholder workshops, symposia, technical reviews, peer panel recommendation, white papers, CSREES departmental review reports, presidential directives, interagency, strategic plans for research and development, regulatory policies impacting food quality and safety and industry plans and priorities. These processes and networks help the agency to evaluate the relevancy of programs relative to local, state, regional and national needs and priorities are generated through aggregation of problems and issues first identified at the local or state level.

All the programs managed by CSREES use relevancy and quality as a criteria for pre-award evaluation of projects. Relevancy is established taking into consideration the

industry and/or consumer needs and priorities. The quality is assessed based on the scientific merit, proposed procedure, and potential to succeed.

The F&NFPP and other portfolios are dynamic and they change periodically to address the national needs consistent with cutting edge science. Program descriptions, program reports and request for applications included in the evidentiary folder will demonstrate the dynamic nature of the portfolio.

Following are selected examples of sessions organized to obtain the stakeholder inputs.

Multistate research committee

- NC-136, Improvement of thermal and alternative processes for foods

  This long standing committee is a collection of food scientists, mainly engineering and physical scientists from LGUs all over the country. The committee meets once a year in fall on campus of one of the member universities. The activities include presentation and discussion of current and relevant research and education activities at all experimental stations represented, visioning future research challenges and needs, planning and executing multistate collaborative projects. The current collaborative projects include calibration fluids, DSC, mathematical modeling, gels, oil quality, and phytochemicals. A committee report (2003) is included as evidential information.

- S-1007, the Science and Engineering for a Biobased Industry and Economy -511 and 512

  This new committee was formed in 2003 after two years of preparation. The committee consists of broad scientific principles with common interests in creating value-added industrial products and energy from agricultural biomass and processing industrial waste. Five important subjects addressed are biomass feedstock, biobased non-food products, fuels, and energy, and workforce training and education. The committee has defined its vision, met and discussed with the program directors of various Federal agencies, and initiated collaboration among themselves as well as other researchers. The MRF proposal is attached as evidence.

National strategic planning Workshops

- Nanoscale Science and Engineering for Agriculture and Food Systems, Nov. 2002 (All areas)

  Nanotechnology is a cutting edge science that can potentially impact all fields of science and technology. National Nanotechnology Initiative (NNI) is one of top President's initiatives. CSREES sponsored this national planning workshop to envision a strategic roadmap for nanotechnology research and education that is appropriate for food and agricultural systems. The workshop report is submitted as evidence.

- Emerging Food Processing Technologies, August, 2004 (For 501-502)

  In the recent years, the development of emerging food processing technologies for better food quality and safety has been very competitive in the world, especially among more industrialized countries. The extent of research and education in this area is limited in the States. Without a visionary investment, we may lose the edge in this important technical area, thus adversely impact the food manufacturing industries. A strategic planning workshop approved by the agency is to be held in summer, 2004 to thoroughly examine the situation, identify bottleneck issues, and design a course of action that may call synergistic efforts of Federal agencies, state government, land grant partners, and industry to regain the leadership in this area. The workshop proposal is attached for reference.

- Annual SBIR Phase II Commercialization Workshop

Symposia and Forum organized:

- Nanoscale Science, Engineering and Technology for Food Safety and Quality, 2004 IFT Annual Meeting, Las Vegas, NV, July 12-16.

  This symposium is an educational event that will bring the cutting edge research and education of nanotechnology to food science community. Seven experts from academia, federal government, national research laboratories, and industry will share their knowledge and vision of nanotechnology for future food science and technology research as well as training of future researchers and workforce. The symposium abstract is attached. You may view it as Session 45 within the IFT Annual Meeting Technical Program at http://ift.confex.com/ift/2004/techprogram/

- USA-China Cooperation on Food Science and Technology, 2004 IFT Annual Meeting, Las Vegas, NV, July 12-16.

  Expanding the global markets for US agricultural products is a high priority of USDA administration. International cooperation is an effective way to share the knowledge and understanding of all issues related to food and agricultural technology development and deployment. This forum will serve as an open dialogue with a broad audience of the IFT annual meeting attendees from the States and many other countries. The information of this forum - Forum F8- can be viewed within the IFT Annual Meeting Technical Program at http://ift.confex.com/ift/2004/techprogram/session_3338.htm

- Energy resource shortage: An inevitable challenge to food industry, 2002 IFT Annual Meeting, Anaheim, CA, June 15-19.

  Energy will be a critical issue for future success of food manufacturing industry. Food industry is both energy intensive as well as extensive. Improving energy efficiency of food processes, minimizing the usage of polymer materials derived from non-renewable resources, developing environmentally friendly packaging

materials, and creating value-added products from processing waste are some of the topics discussed by experts. The symposium abstract is attached.

Others

- Intradepartmental Informational Session (USDA – Food Service, USDA – ARS)
- Intra-agency RFA Preparation Sessions (NRI and SBIR)
- Peer Review Panel Groups

Publicly-Funded Agricultural Research and the CRIS System

The U.S. System of publicly-funded science and education in the areas of food, agriculture, and natural resources supports a diverse, complex knowledge base that is vital to food and fiber production and to the economic well being of the nation. The scientific expertise available through the federal and state research system constitutes a valuable national resource with the necessary flexibility to respond to changes in demand for food and other commodities, threats to the sustainability of food and fiber production, and concerns about environmental quality. The CSREES contributes a unique national perspective to the network of research partnerships maintained by the USDA and cooperating institutions. This vantage point is essential to the Agency's regional and national coordination of resources to address diverse research problems.

In recent years, the research agenda for food, agriculture, and natural resources has expanded in response to a broadening array of issues affecting producers, processors, consumers, and other clientele. Changes in the research agenda were given impetus by the U.S. Congress when it reauthorized the USDA programs through the Food, Agriculture, Conservation, and Trade Act of 1990. This legislation emphasized food and fiber needs, long term viability and competitiveness, improvement of the quality of rural life, the assurance of supply of safe food, and enhancement of the environment and natural resource base. The growing consumer interest in environmental and social issues, as well as the increased complexity of contemporary research problems, has necessitated an increase in multi-and interdisciplinary scientific investigations. In addition, new collaborative relationships are being formed with departments outside colleges of agriculture in land-grant institutions and with institutions outside the traditional land-grant system, as well as with other groups.

The evolving U.S. system of food, agricultural, and environmental research encompasses the programs of state agricultural experiment stations (SAES); colleges and departments of forestry, home economics, and veterinary medicine; 1890 land-grant institutions and Tuskegee University; other cooperating institutions, including state and private colleges and universities; and USDA intramural research agencies (primarily the Agricultural Research Service, the Economic Research Service, and the Forest Service). These programs are closely linked to and complement the teaching and extension activities of land-grant and other institutions. At the university level, research programs also are integral to graduate education, through which scientists are prepared to confront future research challenges.

The research system operated as a network of cooperating institutions and agencies funded via state, federal, and private sources. Coordination, joint planning, and priority setting are accomplished through various national and regional mechanisms to ensure the efficient use of valuable resources.

The summaries presented are based on federal state research activity as documented in the USDA's Current Research Information System (CRIS) database. Research within the CRIS system in classified according to two major categories: 1) USDA intramural research, and 2) extramural research, Intramural research refers to programs conducted internally by USDA agencies, This research is supported by USDA-appropriated funds. Extramural research, in contrast, is conducted by state agricultural experiment stations and other university based research organizations and institutions. This research is funded in part through projects, grants, and contracts, many of which are administered by CSREES.

The dynamics of the university-based agricultural research are described in terms of the changing levels of investment to broad problem areas in agriculture and to specific researchable issues identified in this report. In addition to this input analysis, however, other important indicators of programmatic change may be relevant to understanding the dynamics of agricultural science. These include changes in the basic and applied research mix over time, number of disciplines participate in the addressing of a research question, relative shifts in emphasis in research targets, and the distribution of research efforts and support by areas of science or geographic region. Dynamism also might be suggested by changing patterns in the interaction between-and complementarity of research programs within the federal-state system. By addressing these questions, future analyses could contribute to a more comprehensive understanding of agricultural research.

CRIS has several characteristics valuable for program analysis. The system includes research in progress, objectives and procedures of the projects, annual financial and management data, and accomplishments. Based on analysis of annual expenditures and scientist years accounted for in CRIS, coverage of the database system is nearly comprehensive for those projects supported or conducted by the USDA and for those conducted under the aegis of the SAES. However, this database may not include research supported by sources other than the USDA, and some university-based research conducted outside the SAES. As agricultural research base is expanding, and as more and more scientists outside USDA and SAES systems become active in agricultural related research, the manpower data in the CRIS database may be conservative. This consideration may be especially important in those research areas at the boundaries of agricultural research.

Until recently the CRIS database referred Problem Areas as Research Problem Areas (RPAs). Since CSREES portfolios include research, extension, and education programs, it is proposed that different areas be referred to as Problem Areas (PA). However, this transition has not taken place for the retrieval of resource data. In this report the term Problem Area (PA) is used throughout to avoid confusion.

F&NFPP Leadership Team

The members of the F&NFPP leadership team are:

Djimi Adourm
Carmela Bailey
Hongda Chen
William Goldner
Ivan Graff
Chovanda Jacobs-Young
Ramkishen Rao
Bradley Rein

Abbreviated vitae included in the following pages will provide information on their backgrounds, experience and expertise. ***[Deleted for web version.]***

Portfolio Analysis

Overview

In the U.S. during the past several decades the research, education and extension focus has been on improving the efficiency of agricultural production systems. Over the years, the CSREES and its partners have made use of cutting edge technologies to make steady progress in this area. While it is important that this effort must continue, it is equally important that other areas such as finding new uses for agricultural products must be explored because it has the potential to increase agricultural profitability and sustainability by creating new markets for U.S. Agricultural products. Past studies have shown that many industrial, pharmaceutical and other products can be produced from agricultural commodities. Studies have also concluded that industrial products from biological materials have the potential to replace industrial products derived from petroleum.

F&NFPP is designed particularly to encourage research, education and extension (outreach) programs to develop and commercialize new processes and new or improved food and nonfood products from biological materials. More specifically, this portfolio addresses issues dealing with processing and storage of foods, food services, new and improved food products, and new nonfood products and storage. An analysis of the F&NFPP is provided in this section of the report. Specific details pertaining to different problem areas within the portfolio are included in the following sections describing the individual problem areas.

Analysis

Even though research, education and extension programs have been envisioned within F&NFPP, because of its nature and maturity, education and extension related activities within the portfolio have been limited. For this reason, the analysis in this Section primarily deals with the research component of the portfolio with limited discussion of education and extension components.

Research

A CRIS search revealed that were approximately 1500 distinct research and integrated projects citing the portfolio's problem areas during 1998-2002 period. Table 1 shows the distribution of projects within each problem area and it shows that most activities have been centered around four problem areas – 501, 502, 503 and 511. As a result, the time and dollar investments in these four areas were significantly higher than the two remaining three problem areas. This fact will be evident from data presented in later tables.

A detailed review of projects selected in different problem areas show good mix between basic and applied research. Projects also found to be very diverse cutting across many disciplines and different agricultural and forestry products.

Table 1. Number of Research Projects within each problem area during 1998-2002.

Problem Area	Number of Projects
501 – New and Improved Food Process	442
502 – New and Improved Food Products	440
503 – Quality Maintenance in Storage	2604
504 – Home & Commercial Food Service	13
511 – New and Improved Nonfood	586
512 – Quality Maintenance in Storage	45

Table 2. CSREES Funding for F&NFPP by Source During 1998-2002.

(in thousands)	Year					
Funding Source	1998	1999	2000	2001	2002	**Grand Total**
Hatch	$8,230	$8,595	$8,647	$8,740	$8,657	**$42,869**
Mc-Stn	$1,462	$1,674	$1,540	$1,297	$1,231	**$7,204**
Evans Allen	$2,272	$2,443	$1,547	$1,479	$1,411	**$9,152**
Special Grants	$5,674	$6,102	$7,163	$9,102	$9,427	**$37,468**
NRI Grants	$3,800	$6,620	$2,950	$10,764	$5,448	**$29,582**
SBIR Grants	$2,643	$2,384	$1,608	$2,817	$4,173	**$13,625**
Other CSREES	$2,134	$3,696	$12,925	$14,994	$4,015	**$37,764**
Total CSREES	$26,230	$31,514	$36,380	$49,192	$34,359	**$177,675**

The annual CSREES funding for F&NFP during the period 1998-2002 is shown by source in the Table 2. Hatch and McIntire-Stennis allocations remained steady during the five year period. Evans-Allen funding decreased steadily during the same period. Special grants on the other hand, increased steadily and 2002 allocation was 66% higher than the same in 1988. There were significant increases in funding in the "other CSREES" category during the years 2000 and 2001. This increase has resulted from the funding for a Special programs, Initiative for Future Agricultural and Food Systems (IFAF). This program has been discontinued. Even after discounting the influence of IFAF program, there had been a steady increase in the CSREES spending for F&NFPP from 1998 to 2002. The CSREES investment in 2002 was about 30% higher than the same in 1998.

Annual distribution of CSREES funds for different problem areas within F&NFPP during 1988-1992 is shown in Table 3. A direct correlation between activities within the problem areas as indicated by the number of projects (Table 1) and dollar expenditure can be seen on this table. In other words, almost all of CSREES allocations went into the four problem areas 501, 502, 503, and 511. IFAF funding is reflected in different problem area funding during 2001 and 2002. While an increase in CSREES investment is seen in PAs 501, 502, the allocation remained somewhat steady for PA 511. The 202 funding for PA 501 and 502 was higher than the same in 1998 by 73% and 32%, respectively. No set trends were observed in the other two areas.

The total research spending for F&NFPP during the period 1998-2002 is shown in Table 4. Contributions from CSREES, other federal agencies, state and private sources are included in this table. One important observation from this table is that over 40% of the total annual research expenditure for F&NFPP each year came from states. It is also interesting to note that every CSREES dollar has generated $4 - $5 from other sources to meet the research needs in different problems areas within F&NFPP.

A summary of total manpower and total dollar investment for each problem area within F&NFPP are shown in Table 5. As observed earlier almost all of the annual total expenditure was consumed by PAs 501, 502, 503, and 511. The same was true even for the manpower input in terms of scientific years (SY) and professional years (PY).

The F&NFPP is diverse. It cuts across several disciplines and several commodities and forest products. The portfolio covers highly relevant and timely research developed to meet national priorities established based on stakeholder inputs. As stated earlier, there is a good mix of applied and basic research.

The research is also of high quality. It employs cutting edge technologies and multi-disciplinary approaches to find solutions to highly complex problems. The research within the F&NFPP is significant because it has the potential to make agriculture in the U.S. more sustainable by finding new uses for agricultural materials and to provide high quality food products that society demands.

Table 3. CSREES Funding for Different Problem Areas within F&NFPP during 1998-2002.

(in thousands)	Year					
RPA	1998	1999	2000	2001	2002	**Grand Total**
501 NEW AND IMPROVED FOOD PROCESS.	$5,919	$6,683	$6,826	$9,887	$10,255	**$39,570**
502 NEW AND IMPR. FOOD PRODUCTS	$6,354	$8,118	$7,343	$11,404	$8,357	**$41,576**
503 QUALITY MAINTENANCE IN STORAGE	$3,275	$6,303	$5,423	$5,545	$3,944	**$24,490**
504 HOME AND COMMERCIAL FOOD SERVICE	$184	$39	$487	$94	$334	**$1,138**
511 NEW AND IMPROVED NON-FOOD PROD.	$10,095	$10,020	$15,969	$21,935	$10,840	**$68,859**
512 NF QUALITY MAINTENANCE IN STORAGE	$403	$351	$332	$327	$629	**$2,042**
Grand Total	**$26,230**	**$31,514**	**$36,380**	**$49,192**	**$34,359**	**$177,675**

Table. 4. Funding From All Source for F&NFPP during 1998-2000

(in thousands)	Year					
Data	1998	1999	2000	2001	2002	**Grand Total**
CSREES	$26,230	$31,514	$36,380	$49,192	$34,359	**$177,675**
Other Federal	$10,628	$11,693	$15,602	$17,835	$15,774	**$71,532**
State Appropriations	$63,784	$65,812	$71,689	$76,521	$75,941	**$353,747**
Private or Self Generated	$34,742	$38,099	$35,003	$35,800	$36,091	**$179,735**
Grand Total	**$135,382**	**$147,119**	**$158,674**	**$179,351**	**$162,167**	**$782,693**

Table 5. Funding from all sources and manpower input from public sources for different problem areas within F&NFPP during 1998-2002.

		RPA						
Data	Year	501	502	503	504	511	512	**Grand Total**
Sum of Total	1998	$29,283	$37,014	$19,738	$852	$44,031	$4,464	**$135,382**
	1999	$32,559	$38,542	$24,264	$693	$45,969	$5,092	**$147,119**
	2000	$36,988	$38,450	$24,226	$1,382	$53,883	$3,745	**$158,674**
	2001	$40,959	$46,428	$24,550	$791	$63,337	$3,286	**$179,351**
	2002	$44,908	$39,718	$21,315	$1,010	$51,441	$3,775	**$162,167**
Sum of Scientist Years	1998	87	117	62	3	143	17	**428**
	1999	90	110	67	2	142	12	**422**
	2000	104	102	64	3	138	10	**420**
	2001	109	116	63	3	135	9	**434**
	2002	115	108	58	3	197	11	**492**
Sum of Other Years	1998	317	410	213	9	461	49	**1459**
	1999	347	393	233	10	417	36	**1435**
	2000	358	382	254	13	407	40	**1454**
	2001	365	394	235	8	421	37	**1460**
	2002	393	387	217	4	439	35	**1475**
Total Sum of Total		**$184,697**	**$200,152**	**$114,093**	**$4,728**	**$258,661**	**$20,362**	**$782,693**
Total Sum of Scientist Years		**503**	**553**	**313**	**13**	**754**	**58**	**2195**
Total Sum of Other Years		**1780**	**1966**	**1152**	**43**	**2145**	**198**	**7283**

The F&NFPP research program is serving the consumers and industries exceptionally well. There are many short and long term benefits from this research program. Selected examples are as follows:

- Higher Quality Food Products
- Improved production efficiency
- New markets for agricultural materials
- Improved agricultural profitability
- Reduced dependency on imported petroleum
- Improved environment
- Revitalization of rural communities
- New jobs
- Revenue generating products from waste

In addition to these benefits, the F&NFP related research provide research experience needed for the next generation of scientists. On a long term basis, the science-based knowledge resulting from the research will be beneficial to prepare the work force in agricultural related fields for generations to come.

More specific information on relevancy, quality and performance of research programs as included in the following section covering description of individual problem areas.

Several termination reports from CRIS system representing Hatch and NRI projects are included in the evidence material. These randomly selected reports from different problem areas may be useful in getting a sense of type and breadth of the portfolio and accomplishments as well interaction with other problem areas. The breath of the research portfolio can be seen from the listing of CRIS projects included in the evidence folder.

Education

Research at land-grant and other institutions of higher learning complements the education mission of the institutions. Majority on the faculty at these institutions have teaching and research responsibilities. Undergraduate and graduate students working with these faculty members gain valuable research experience Table 6 – shows the number of U.S. Citizens earning undergraduate and doctoral degrees from institutions of higher learning in food and nonfood product related foods.

A listing of projects funded under Science and Education Resources Development (SERD) showed that F&NFP related areas received approximately $1.03 millions during 1998-2002 period for educational development programs. About 55% and 37% of this total were for the food safety and food products related programs respectively.

Extension

Most Food Science and Technology Department in land-grant University system have well established extension programs covering food products, processes, food safety and nutrition. Unfortunately these programs are not recorded in the CRIS system or any other similar database. For this reason, the extend of extension/outreach programs within F&NFPP could not be assessed. A few examples available are discussed in greater details in the Problem Area Descriptions and are not included here.

Table 6. Number of Graduates (U.S. Citizens) in Food and Nonfood Product Related Disciplines

		1999-2000		2001-2002	
Degrees	Disciplines	Land Grant US Citizens	Non Land Grant US Citizens	Land Grant US Citizens	Non Land Grant US Citizens
Bachelors degrees	Agricultural Economics	832	88	764	81
	Agriculture/Food Products Processing Ope	183	0	234	0
	Food Sciences and Technology	597	44	540	45
	Wood Science and Pulp / Paper Technology	103	96	87	60
	Agricultural Engineering	718	27	555	80
	Chemical Engineering	1093	1634	2120	3098
	Material Engineering	85	165	198	294
	Biotechnology Research	56	5	58	66
	TOTALS	3667	2059	4556	3724
Doctors degrees	Agricultural Economics	69	0	54	0
	Agriculture/Food Products Processing Ope	5	0	1	0
	Food Sciences and Technology	60	0	48	0
	Wood Science and Pulp / Paper Technology	1	1	2	1
	Agricultural Engineering	19	0	24	0
	Chemical Engineering	53	101	124	200
	Material Engineering	20	62	45	78
	Biotechnology Research	0	0	0	1
	Polymer Chemistry	0	10	3	11
	TOTALS	227	174	301	291
GRAND TOTALS		3894	2233	4857	4015

DESCRIPTION OF PROGRAM AREAS

Food Products, Processes, and Storage (501, 502, 503)

Overview

Food Science and Technology component of F&NFPP provides national leadership in consultation with the partners and stakeholders and administers grants in a fair efficient manner in the area food science and technology. Leadership roles include identification, development and implementation of priority areas of research, education and extension; reviewing programs and providing direction; and active participation in multi-state research and extension activities. Administration of grants encompasses several mechanisms (National Research Initiative, Small Business Innovation Research, Formula funds, Presidential Initiatives and special Congressional appropriations). The goal of this program is to improve the quality of foods, increase the markets for the producer of foods and prepare future work force. CSREES has been maintaining a data base of funded research through its Current Research Information System (CRIS). Recently, we have started maintaining data base on extension and education also. Problem Areas (PA) 501, 502 and 503 include the food science and technology portfolio. Food Safety Portfolio which is reviewed separately has different PAs.

Current Situation

Goal: The overall goal of the Food Products portfolio is to advance science-based knowledge in the areas of food chemistry, food biology, and food engineering, processing, and quality maintenance during storage and marketing to improve the quality of foods by supporting research, education and extension in the Land-Grant University System and other partner organizations in the public and private sectors. In addition, this goal is accomplished by: 1) Providing leadership in identifying and meeting research, extension, and education priorities of the stakeholders in food science and technology, and 2) By fair and efficient administration of funds made available to CSREES by various mechanisms. These activities are in line with the mission of the CSREES.

Scope and Potential: National Association of State Universities and Land Grant Colleges (NASULGC) in its document entitled "A Science Road MAP for Agriculture" identifies Improving Food Quality and Safety for Better Health and Safety as one of the seven challenges to meeting the nation's agricultural goals (November 2001). The National Academy of Science (NAS) identified 17 research opportunities in reviewing the portfolio of Research, Education and Economics, USDA (Frontiers in Agricultural Research: Food Health, Environment and Communities, NAS 2002). Three of the seventeen areas highlighted were directly related to Food Science and Technology. These are: Bioactive Food Components, Improving the Food, and Improving Understanding of Food Consumption.

Postharvest value addition to raw agricultural food products is no longer an industry issue but is driven by three main engines: consumer preference and well being, international markets, and sustainability. Increasing demands for safe, nutritious, healthful, palatable

and convenient foods and competition in the global markets call for enhancement of existing technologies and invention of newer approaches. The U.S. food processing, packaging and distribution industry is multidimensional and multidisciplinary contributing over $ 900 billion to the gross domestic product (GDP) in domestic food sales (ERS, 2003), accounting for about 8% of the national GDP. This translates in to a value addition of about 80 cents on every 20 cents of raw farm gate value. What is more significant is that the postharvest sector in value addition to food has been able to reduce the share of personal disposable income spent on food purchases to a historical current low level of 10%-the lowest ant country enjoys in the world (ERS 2003). International agricultural trade is one of the surplus enterprises, but not much attention has been placed on the export of consumer oriented processed foods. In addition to economic dimensions, postharvest value addition is now uniquely poised to make unprecedented contributions to the health of Americans by providing healthful foods.

Understanding and minimizing food quality losses during storage, distribution, and marketing can enhance the quantity and quality of foods delivered to consumers, keep food costs low, and enhance profitability for food producers and marketers. CSREES has worked with stakeholders to identify relevant research topics, and has provided research support in several key areas (through PA 503), including: chemical and biochemical changes after harvest/slaughter or during storage; effective ways to reduce physiological deterioration and losses due to insects, spoilage microorganisms, rodents and other pests; containerization/packaging or storage and handling methods to maintain optimum conditions for quality maintenance; and relationships among variables of handling and storage and loss in quality. The protection of the food supply from contamination by human pathogenic organisms and toxins is addressed in other PAs, and will not receive further discussion in this document.

Resources: Total Food Science and Technology funding portfolio of CSREES has been steadily increasing and was at $ 23 million in fiscal year 2002. However, as the percentage of total CSREES funding, funding for food science and technology continues to go down (down from 6% to about 4% in the past decade). Fortunately, our sister agency, Agricultural Research Service (ARS) funds a little more ($ 44 million in FY 2002). Total Federal funding for food science and technology (including other Federal agencies) is around $ 80 million in FY 2002, while the total federal R&D dollars are above 90 billion in the same period. Thus, the Federal Government spends less than 0.1% of the federal dollars on the postharvest value addition to food and food quality preservation areas, which is disproportionately low compared to the economic contribution that this sector makes to the nation, notwithstanding the social and health benefits. Additional resources for this area should be considered both within CSREES and USDA and in Federal Research and Development portfolio. More information is provided on the financial resources in the Funding Section below.

As for human resources, full time equivalents (FTEs) providing leadership (National Program Leaders) for the period of fiscal years 1998-2002 varied from a low of 0.5 FTEs to a high of about 1.0 FTEs. Program Specialist support has been around 0.25 to 0.5 FTEs. Likewise, support staff FTEs has been less than 0.5 at any given time. However,

there has been enough support in the area of financial management of awards through the awards management branch. More support at the program specialist will allow the national program leaders devote more time toward the leadership and administrative activities.

Performance Criteria

Leadership: Identification, development and implementation of high priority areas, fair and efficient administration of grants, identifying funding sources, interagency collaborations, and providing program direction, grants workshops, partnership land grant universities including 1890 and 1994 colleges, and small businesses.

Research: Peer-reviewed publications, presentations, books, chapters in books, patents, and licensing, multidisciplinary approaches, integration of the land grant functions, and returns on dollar investment in Research. Public sector research has lead to development of products, processes, and services in the private sector through technology transfer.

Extension and Outreach: Development of Outreach Centers for Entrepreneurs, Development of partnership with the food producers and application of the results for the end use.

Education: Curriculum development, sabbaticals, equipment grants, capacity and facility building, distance education, and undergraduate and graduate student training.

Performance Indicators

Leadership: Quality and quantity of high priority items seen through implementation, number of grants administered, number of proposals reviewed, number of interagency collaborations, number of programs reviewed and resulting changes, number of grants workshops and growth at and partnership land grant universities including 1890 and 1994 colleges.

Research: Number of peer-reviewed publications, presentations, books, chapters in books, patents, and licensing, and estimates on returns for investment.

Outreach: Number of Outreach Centers developed and number and customers benefited, spin-off companies, number of partnerships developed with the food producers, and number of projects that led to commercialization

Education: Degree programs developed number of sabbaticals, equipment purchased, capacity and facility building, number of distance education programs, number of undergraduate and graduate student trained and employed.

Following are examples that demonstrate the contribution CSREES funding made toward the application of food processing technologies, product development, and food preservation through different funding mechanisms.

- Impact of NRI Competitive Grants: Major accomplishment was the development of a computer-aided method on food freezing that is being widely used by frozen food operators in the U.S. to improve their operations. The World Food Logistics Association (the Refrigerated Research and Education Foundation) that consists of most of the refrigerated warehouse operators in the U.S. has been distributing this program to its members. This program running on a desktop computer helps the processors to reduce energy (costs) and improve quality of frozen foods during freezing and frozen storage.

- Impact of NRI Competitive Grants: In this project, the investigators developed new information on heat transfer in beef patties when cooked in double-sided grills. Reliable information on heat transfer is critical for assuring that the process will provide a hamburger patty that is safe yet of high sensory quality. They worked with manufacturers of industrial-scale grills to identify changes in the design of the grill to improve its performance. They also worked with the frozen hamburger patty manufacturers to identify key parameters that are important in initial forming process that may have impact on cooking those patties in the grills. These studies conducted at the mechanistic level have provided new information for improving quality and enhancing safety of cooked hamburger patties.

- Impact of Hatch Multistate Research Grants: Research support which started in 1977 resulted in several notable achievements in improving thermal processing of food. For example, funding from this project allowed basic and applied research on the use of Time-Temperature-Indicators (TTIs) for use in food distribution and retail. The investigator developed the information on kinetics of quality change in a wide variety of foods and used that information to help design TTIs. Now these TTIs are being used by grocery chains for consumer products, e.g. Trader Joe chain is using these sensors on consumer packs of meats. US Army uses these for case packs on all food shipments. It is believed that these sensors can further improve the food chain to improve the quality of food delivered to the consumer. (See Exhibit 3 for many other achievements).

  Note: The investigators were able to leverage funding from state and other federal agencies.

- Impact of a Hatch Grant Supplemented by a Special Grant: Non-chemical methods for the postharvest disinfestation (insects) of fruits and nuts were developed by researchers at the University of California – Davis. This research resulted in a series of publications detailing the evaluation of a suite of technologies (e.g. thermal treatment, microwave radiation) that supported continued development of these technologies in the private as they move toward commercialization. This research is critical in replacing chemical treatments that have deleterious environmental and human health impacts.

- Impact of a Small Business Innovation Research (SBIR) Grant: A novel and effective food storage and preservation technology for home and commercial

preservation of fresh fruits and vegetables was developed by Silverbrook, Ltd., Federal Way, WA, supported by CSREES SBIR Phase I and Phase II funding. The technology is nearing commercial application.

- An Example of Extension Program at Land Grant University: The Food Science and Technology Extension program at the University of Nebraska is conducted through 2.5 to 3.0 FTE commitment of effort. The objectives are broad and encompass Agricultural Competitiveness and Profitability, Youth Development, and Food Safety. Food processing and product development is one of the most successful outreach programs in the country, partially due to the presence of nationally known Food Processing Center well connected with the food processing Industry. Outreach and educational programs are focused to achieve long-term behavior and attitude changes among consumers, food processors and food handlers, and producers. CSREES funded several activities of the Department in this area through Special Research grants and Competitive grants programs. The University has been able to successfully raise more than dollar-for dollar matching funds from private sources.

- An Example of the Impact of Education and Research at a Minority Institution: The Food Science and Technology curriculum had its beginnings in 1974 at Alabama A&M University, Normal Alabama, which is an 1890 Land Grant University. Shortly after receiving the Institute of Food Technologists (IFT) accreditation for this program, the university started an M.S. degree program in Food Science. Graduate students and their research were largely supported by the Evans-Allen funds from CSREES. As the amounts allocated from Evans-Allen funds grew, the research and education portfolio grew rapidly in the food science program and the State of Alabama approved a Ph.D. program in food science in early 1990s. The support form the capacity building grants from CSREES to the university were very crucial in generating more grants from other agencies such as NSF, NIH, DOD, and DOE for strengthening the Ph.D. program. Currently, alumni of this program are serving in the government, Industry and academia and a majority of them are African-Americans.

Funding

Funding for problem areas for problem areas (PAs) 501 and 502 for fiscal years 1998-2002 is shown in the Table 7 below (See the foot notes of the table for the explanation of 501 and 502 PAs). An examination of the table reveals that CSRRES administers about 3% of its total research dollars in PAs 501 and 502 (3rd column from right). The corresponding figure is less when expresses as percent of total agricultural research second column from the right). As was mentioned earlier in the Resources Section above, total Food Products Portfolio (PAs 501, 502, 503, and 504 which encompass almost all Food Science and Technology area except Food Safety (Table 8) is less than 0.1% of total federal R&D. Over all, for all areas, investment of federal dollars in R&D as % of gross domestic product (GDP) was 2.65 in 2002 (NSF). Calculations based on value addition ($500 billion) to raw agricultural and the resultant contribution to the GDP, it is

Table 7. Funding For Problem Areas (PA) 501 And 502*

	SOURCE ($ x 1,000,000)										
FY	ARS	CSREES	OTHER USDA (ERS etc)	OTHER FEDERAL	STATE	OTHER Non-Federal-	Total 501 and 502	Total Ag.	CREES 501 and 502 as % of CSREES Total	Total 501 and 502 % of Total Ag	CREES Total
1998	19.00	10.38	1.48	3.48	31.56	17.86	83.76	3,173.7	3.04	2.64	341.33
1999	19.87	9.92	1.63	3.85	31.06	19.89	86.21	3,351.6	2.79	2.57	355.98
2000	21.22	14.17	1.76	5.59	35.19	19.32	117.25	3,635.6	2.65	3.23	535.19
2001	21.52	21.29	2.73	6.21	28.38	19.09	109.22	3,936.0	3.33	2.77	640.06
2002	23.52	18.61	2.22	4.81	39.40	20.89	108.45	4,147.4	3.50	2.61	530.98

*501= New and Improved Food Processing Technologies; 502= New and Improved Food Products

Table 8. Funding For Food Science and Technology (PAs 501,502, 503, 504)*

FY	SOURCE ($ x 1.000.000)										
	ARS	CSREES	OTHER USDA	OTHER FEDERAL	STATE	OTHER Non-Federal	Total FST	Total Ag.	CSREES FST as % of CSREES	Total FST as % of Total Ag	CSREES Total
1998	37.78 [1]	13.65		3.86	42.98	22.80	123.12	3,173.7	4.0	3..9	341.33
1999	38.91	13.29 **	2.34	4.57	43.29	25.23	127.63	3,351.6	3.7	3.8	355.98
2000	41.18	20.44 **	(2.34)	6.78	48.19	24.49	143.60	3,635.6	3.8	3.9	535.19
2001	42.04	26.93 **	(3.32)	7.29	51.93	23.99	155.51	3,936.0	4.2	4.0	640.06
2002	44.10	22.90	(3.14)	5.33	50.55	25.90	151.92	4,147.4	4.3	3.7	530.98

** Jump from 99 to 2000 probably due to Integrated (401 funding)
Jump from 2000-2001 probably due to IFAFS (and special grants)
*501= New and Improved Food Processing Technologies; 502= New and Improved Food Products; 503=Quality maintenance in storing and marketing food products; 504= Home and commercial food service
Data from CRIS [1]

estimated that the public R&D investment in Food Science and Technology (152 million in 2002) as percent of its GDP contribution is 0.3%. Clearly, there is potential for higher rates of value addition, if more R&D resources are invested in this area.

New Direction and Emphasis

Role of Food Science and Technology in Obesity Prevention: In the continuum of food systems, product development, processing, packaging, and marketing are critical links between farm and the consumer. At any given time, a typical grocery store in the U.S. displays thousands of SKU (Stock Keeping Unit) food items. Besides grocery store, foods consumed outside home also present a wide choice to the consumer. According to the latest data from Economic Research service (ERS, 2002), 46% of the food dollars are spent on eating away from home. While consumers have a wide choice of foods and their behavior has significant influence on what they consume, the behavior is within the domain of available foods. This segment of food systems not only adds close to a trillion dollars to the raw agricultural products (ERS, 2002), but also has a strong history of responding to prevention of diseases. Notable examples are prevention of pellagra, rickets and neural tube defects, notwithstanding successful introduction of several lines of cholesterol reducing and low glycemic index products. Thus, the discipline of food science and technology is well poised to contributing to the prevention of obesity. But many entities have to collaborate to bring synergy within the discipline.

Potential Variables**:** One of the issues within food science discipline is to identify variables that are outside the domain of consumer, and therefore do not influence their behavior. The identification of these variables is clearly a researchable item. The following few are potential examples.

- Proper balance of macro and micronutrients, especially in convenience foods (ex: type of carbohydrate, ratio of carbohydrates to proteins, role of soluble and insoluble dietary fibers, calcium, and levels bioactive components such as CLA. See CDC, MMWR Feb 6, 2004 for increasing trends in energy and macronutrient intake).
- Proper balance between dietary guidelines and foods prepared
- Clarity in food labeling
- Serving size
- Prepared foods for home and institutional use (restaurants, schools etc).
- Food prices, poverty and obesity. (See Drewnosky, AJCN, January 2004).

The other issue is balancing the already low profit margins in food processing against the consumer demands. The food industry has to come up with innovations that will benefit consumers while keeping the competitive edge.

The above few examples point out the need for collaborations among government, food processing industry, food service industry, land-grant and other universities, FDA and other federal agencies.

New Program in Food Engineering and Processing Technologies: Value Addition to the Harvest was one of the seven key challenges identified by NASULGC in 2001 document entitled "A Science Roadmap for Agriculture." Adding value to various food commodities is an integral part of overall agriculture strategy to sustain the global competitiveness of US. Value addition to the harvest not only expands the nation's agricultural economy, but also it is critical to improve human health and safety, and to support rural community resilience issues (CSREES White Papers). Novel processing technologies and their engineering designs are crucial to process foods with added economic, esthetic, nutritional and health-promoting values. Public funding for R&D in food engineering and processing technologies is scanty (e.g. Food irradiation supported by DOD, Aseptic Processing Center supported by NSF and some basic research supported by NRI). Food Technologies are receiving greater emphasis internationally, particularly in Europe, Pacific Rim Countries and Japan**,** eroding our global competitive edge in food technology. The proposed program represents a unique opportunity for USDA to enhance the value of the harvest by significant proportions. This program could be coordinated with the Rural Development, USDA Value Added Program and also DOD Army Natick Solider Sustainability Research Program, as well as NSF and NASA programs. A few examples of innovative technologies that potentially have enormous economic and social implications are hydrostatic high pressure processing, pulsed electric field processing, ohmic heating, nonthermal plasma, electrolyzed water and ultrasonic treatments, better membrane materials for separation process, advanced computational techniques for process simulation and product design, new packaging materials and system design, rapid and noninvasive detection of pathogenic microorganisms and physical property characterization methods. It is obvious that food engineering and processing is a cross-cutting issue encompassing global competitiveness, food safety, consumer issues and rural development. It is proposed that basic and mission-oriented components of this new program be included in the NRI and an applied aspect be included in the Integrated Programs.

Bioactive components in Foods: It is well documented in medical archives that mankind has always looked up to foods in preventing, mitigating and treating diseases. With the advent of modern medical and surgical advances, the role of foods in health has remained folklore. However, in the past couple of decades, foods have been shown to contain many bioactive and possibly health promoting components. Meanwhile, consumer demand for the 'health foods' surged ahead of the science and became a significant market of the food chain. The estimated sales of the bioactive components (Nutraceuticals) and health foods (functional foods) in the U.S. in year 2002 is $ 21 billion (Nutrition Business J. 2003. Functional Foods Overview, March/April: 1-11) and is growing at the double digit rate. Several Federal Agencies (CSREES/ARS, ODS/NIH, NCI/NIH, FDA, and DOD) have been supporting research to provide scientific basis for the efficacy and safety of the bioactive components in botanicals and to some extent in foods. CSREES has supported in a large way a program entitled "functional foods" in fiscal years 2001 and 2002 under the Initiative for Future for Agriculture and Food Systems (IFAFS) which was authorized by specific legislation. Most of the work supported was in the area of nutrition and Metabolism. However, the monies were not appropriated for the following fiscal years

and IFAFS is non existent. Thus, CSREES does not have a defined portfolio in this important area as it relates to agricultural products. We are participating in an interagency initiative being coordinated by the National Institute of Health.

Home and Commercial Food Service (PA 504)

Overview

Problem Area Definition

Awardees have received the following guidance concerning RPA 504:

Guidelines are necessary to ensure the wholesomeness, nutritional value, taste, and appearance of commercially and home prepared foods. Methods for improved preparation and storage of food that reduce waste and assure quality of food are needed to increase consumer appeal. Areas of research include:

- Factors affecting quality of food prepared at home or commercially.
- Improving methods of preparing, holding, and serving food, including automation and/or computerization.
- Development of methods to provide effective, efficient management in institutional and commercial food services.
- Product labeling to improve consumer information about product quality, preparation and storage, nutritional values, and unit cost of foods for home and commercial use.

Excluded areas of research include:

- Nutrient composition and function in foods (RPA 701 and 702)
- Safety of commercially and home prepared foods. (RPA 711 and 712)

After comparing their projects' objective, 13 projects cited RPA 504 as relevant to their projects' aims.

Situation

CSREES programs that focus on the home and foods tend to treat the subject from nutrition (food selection) and safety (preventing acute disease) perspectives. This RPA includes the more subtle technique and quality approaches. CSREES programs involving food technology, although not without important implications for commercial and institutional food vendors, focus on the production of these foods, rather than the preparation just prior to consumption.

A search in CRIS for projects mentioning home or commercial or institutional food preparation (these terms appearing in close proximity) yielded two projects that one could classify as related to RPA 504 but the project teams did not. One, with a strong nutrition emphasis, concerned the psychology of food consumption choices at home and away from home. The second, with a strong storage emphasis, sought to commercialize fruit and vegetable preservation appliances.

Pure extension programs have not used CRIS to record their reports. However, the Expanded Food and Nutrition Extension Program (EFNEP) has taught home food preparation skills while teaching the importance of selecting the right foods for good nutrition. Assessing the impacts of these collateral efforts poses a challenge.

Performance Indicators

Relevance

Morgan Spurlock's recent documentary, "Super Size Me," illustrates the need for RPA 504. In this film, Mr. Spurlock spends an entire month consuming nothing that he could not buy at a particular fast food restaurant chain. The filmmaker contends that although food items themselves (hamburger patties, French-cut potatoes, cut salad greens, etc.) do not contribute to poor health, often the preparation and the portion size do. As Washington Post writer Robin Givhan described the transformation: "At the end of his experiment the once-healthy Spurlock waddled out of the last McDonald's with a splotchy face, a reduced libido and 25 extra pounds. He had been transformed into a pudgy young man with dangerously high cholesterol, chest pains and a liver that was overwhelmed by the fat in his system" (Sunday, May 2, 2004; Page N01).

Provision of high quality food products does not suffice. Prior to ingestion, these food products must be prepared into meals, usually in home, commercial, or institutional settings. This last step can affect the appeal, value, and quality of the food and make the difference between an appetizing, safe, profitable, and optimally nutritious meal and one that could increase the likelihood of the consumer developing acute or long term illnesses or yield poor revenues or inefficiently use a household's limited funds.

Whereas RPA's concerning food safety, nutrition, obesity, and economics address the primary concerns, this RPA concerns a path toward a solution. Emerging issues include developing novel means to minimize the decisions consumers and food purveyors need to make that influence the appeal, value, and quality of their meals. Doing so requires organizing the vast amounts of information already collected concerning food safety, nutrition, obesity, and economics to help food product vendors, food preparation guidance industry, and food preparation appliance manufacturers add value to their products.

Quality

The findings and outputs have the most significance for RPA's in other portfolios not receiving assessment at this point. No projects citing RPA 504 have significant application to the processing or storage of food products.

Performance

Six of the projects contributed all 49 publications identified in the CRIS reports for RPA 504.

Funding:

Between 1998 and 2002, 13 projects cited RPA 504. Of these, Hatch formula funds supported eight, the Section 406 Integrated Food Safety program supported four, and the community foods program supported one. RPA 504 comprised about 0.6% of the portfolio, on either the basis of CSREES funding only or all funding sources reported. CSREES five year investment totaled to $1,138,000 while the non-CSREES contributions to these same projects totaled to $3,590,000 (about $3.00 non-CSREES to every CSREES $1.00). The data available does not point to any cogent funding trends.

Accomplishments/Outcomes

Impacts Include:

- More efficient methods for sensory testing, based on increased knowledge of how the brain processes information.
- Verifying that digital images of food products yield comparatively good data to spectrophotomers and colorimeters but avoid challenges posed by these devices.
- Better informed consumers about how to use instant-read thermometers with smaller cuts of meat, particularly ground beef patties.
- Better informed home delivered meal providers for older citizens with respect to food preparation, business budgeting, and equipment decisions.
- Training 68 school foodservice directors to train others in their states in the use of safe food preparation educational materials used by extension nutrition educators, FNS, USDA, and the National Food Service Management Institute.
- Teaching dinning service employees in NE, KS, and MO how to improve their customer service skills.
- A gleaning cooperative has provided fresh fruits and vegetables, freeing funds in needy consumers' tight budgets.
- Food allergy research leading to the National Restaurant Association including food allergy component in their "Serve Safe" training.

Nonfood Products, Processes, and Storage (511/512)

Overview

Nonfood uses of agricultural and forestry materials offer the best opportunities to realize the full economic potential which agriculture and forestry can play, beyond the traditional food and fiber markets. Research and development in nonfood products can have a positive impact in many ways: 1) value-added products from new uses of conventional crops, forestry materials and wastes, 2) diversified agriculture through new crop development and expanded growing areas with modified crops, 3) new business opportunities, 4) economic development in rural areas through new farming and processing opportunities, and 5) development of sustainable, renewable resources for the U.S. industrial base. Even though increased profitability and rural economic development are the major incentives for new products research, current research is also driven by society's need for products that are more environmentally acceptable than traditional counterparts. Two problem areas in the CSREES portfolio address new nonfood products development. Problem Area 511 (PA 511) "New and Improved Non-Food Products and Processes" is broad and encompasses products and energy, product characterization and functionality, product performance and environmental impacts, and improved processing. Problem Area 512 (PA 512) "Quality Maintenance in Storing and Marketing Non-Food Products" focuses on quality maintenance of feeds, seeds, and other nonfood agricultural and forest products during handling, storage and marketing. For the purposes of this review, PA 511 and 512 will be considered as a single PA, rather than separately. Note: Even though the budget and related Current Research Information System (CRIS) information provided for this report cover 1998-2002, much of the discussion covers activities through 2004.

Situation

Need

The objectives of the Nonfood Products portfolio are to advance knowledge and technologies to generate new or improved high quality products and processes to expand markets for the agricultural sector. New products, new uses, and value-added processes must have consumer acceptance to be commercially successful. Secretary Veneman's focus on consumer driven agriculture resulted in the preparation of an agency white paper that broadly encompassed food, nonfood and social issues (copy is included in evidentiary materials). Regarding nonfood issues, relevance is addressed from various perspectives. From a consumer perspective, new products and technologies have a reduced negative impact on human health and the environment. From the farm community perspective, nonfood uses of agricultural materials offer tremendous opportunities to expand agricultural markets. From a national security perspective, agriculture will play a significantly larger role in providing industrial raw materials, products and energy. From the CSREES perspective, the land grant system can support research, engage extension to demonstrate and accomplish technology transfer of this research, and can educate a future workforce with not only technical expertise but also with the ability to apply that expertise in a comprehensive and integrated framework that meets consumer demand for quality, low cost, and pollution prevention.

Products and technologies are emerging from a number of successful programs in academia that encompass basic molecular biology to process engineering to applied economics. Agricultural raw materials and wastes are being converted into products such as liquid fuels, power, industrial lubricants, and polymers. Forests continue to be the major source of raw material for wood and paper products, however numerous other opportunities exist. Forest resources and wood processing waste are a source of botanicals and aromatics, pharmaceuticals, composites, and electricity, among many other uses.

In the last five years, Congress has recognized the need for research to expand the development of nonfood products from renewable agricultural resources. In the Agricultural Research, Extension, and Education Reform Act of 1998, two of eight delineated priorities for agricultural research were to: 1) enhance the competitiveness of the United State agriculture and food industry in an increasingly competitive world environment, and 2) develop new uses and new products for agricultural commodities, and to develop new crops. The 2002 Farm Bill further expanded opportunities for non-food product development with the Energy Title that includes sections to promote research and development, demonstrations, outreach, and establishes a preferred procurement program for nonfood products, now defined as biobased products, to be purchased by Federal agencies, thereby creating a market pull, which in turn will stimulate research and development to meet the growing market. CSREES partners also recognized the need for expanded research in the 2001 National Association of State Universities and Land Grant Colleges (NASULGC) document entitled "A Science Road Map of Agriculture." The roadmap identifies new nonfood uses from crop and animal production systems as one of the seven challenges to meeting the nation's agricultural goals.

Implementation

CSREES promotes research and development for nonfood biobased industrial products and bioenergy primarily through the National Research Initiative, Small Business Innovation Research Program and the Agricultural Materials Program:

1) The National Research Initiative (NRI) is a competitive grants program utilizing a peer review process to award grants to US researchers in the field of agriculture. Funding opportunities within the NRI are unique in the fact that each project must have a direct impact on US agriculture. NRI has two programs which primarily focus on research related to value added non-food products from biomass: Improved Utilization of Wood and Wood Fiber Program and Biobased Products and Bioenergy Production Program. Both programs seek to advance knowledge on pretreatment, conversion, and product recovery steps that limit technical and economic efficiency of the production of non-food products from biomass. Research is encouraged in two general areas: 1) to increase understanding of the physical, chemical, and biological properties of raw agricultural materials and products that are important for quantifying, predicting, protecting, and controlling their quality, value and processing characteristics and 2) to develop innovative products and processes for better utilization and more efficient conversion of agricultural materials and co-products to value-added non-food products. Activities include development of nutraceuticals, biobased composites, surfactants, fuels, polymers, adhesives, lubricants and other biobased materials. Examples of current research projects include the production of bioplastics and composites

from linseed oil, the production of recombinant procollagen in transgenic barley and the development of cellulosic based corrosion resistant coatings.

2) The Small Business Innovation Research (SBIR) Program provides competitive research funding to small businesses developing products, processes and services for the diverse communities served by the USDA. These communities are represented in the CSREES 1.3 Portfolio through the following Topic Areas: Forests and Related Resources; Food Science and Nutrition; Rural and Community Development; and Industrial Applications; and Animal Waste Management (new). Phase I feasibility studies funded up to $80,000 for eight months may be followed by Phase II research and development projects for up to $325,000 for 24 months. The participation of university and public sector (e.g. national laboratories, USDA research facilities) researchers, acting as Co-Project Directors, collaborators, contractors, or consultants is encouraged. The USDA-SBIR Program provides opportunity to transfer technology from the pubic sector to the private sector for commercialization.

Objectives of the Small Business Innovation Research (SBIR) program include stimulating technological innovation in the private sector, strengthening the role of small businesses in meeting Federal research and development needs, increasing private sector commercialization of innovations derived from USDA-supported research and development efforts, and fostering and encouraging participation by women-owned and socially and economically disadvantaged small business firms in technological innovation.

3) The Agricultural Materials Program provides funding primary to academia for new crop development to encourage crop diversity, and for new uses of conventional agricultural materials to stimulate market expansion. Non-competitive funding through formula funding and special research grants supports a range of basic and applied research topics including plant breeding and genetics, crop production, materials processing, and product development. Products include lubricants, energy, fibers, polymers, chemicals and utilization of agricultural waste. Competitive funding is provided through the Initiative for Future Agriculture and Food Systems. This initiative was supported in 2000 and 2001 for applied and developmental research that integrates research, education, and extension activities to address key issues of national and regional importance, including new and alternative uses and production of agricultural commodities and products. Awards made in 2000 and 2001address optimizing technologies for converting biomass to ethanol, developing formulations for functional fluids and greases from corn, soybeans, castor and lesquerella, producing hypoallergenic latex rubber from guayule and genetically modified sunflower, and producing energy and products from animal waste.

Program Leadership and Management

CSREES National Program Leaders support PA 511/512 through management of formula funds, special research grants and other earmarked authorities, and through competitive programs. Leadership is reflected in new requests for applications that target emerging issues as described above, workshops to create opportunities and to develop new ideas, facilitating collaborations between government and private sectors, and serving as champions for the CSREES partnership with land grant institutions.

Performance Criteria

The foundation for economic, technological and market advancement is timely science-based research, education, and extension that lead to inventions and practices leading to new products in the marketplace. Activities that are judged to be of high quality must:

- Create and disseminate alternative uses and markets for non-food products from existing and new agricultural products
- Expand the commercial use of scientific knowledge pertaining to efficient bioenergy and biomass conversion and utilization
- Establish new integrated agricultural research and extension programs to increase the commercial application of scientific knowledge in the development, production and use of new nonfood products.
- Establish multidisciplinary graduate education training programs

Performance Indicators

- expanded knowledge pertaining to bioenergy, biomass conversion and related topics
- creation of alternative uses and markets for nonfood products from existing crops and from new crops
- increased knowledge through the establishment of new integrated research and extension programs
- increased knowledge through the establishment of multidisciplinary graduate education training programs

Specific examples of projects that serve as performance indicators are described as follows:

- Researchers at the University of Florida, have successfully genetically engineered bacteria to produce enzymes necessary for the utilization of cellulose as a feedstock for fuel ethanol. Recombinant *E. coli KO11* converts sugar compounds that traditional yeast-based technologies cannot utilize. The patented technology is currently being piloted in Japan for commercial conversion of deconstruction wood waste to ethanol. Research to optimize biocatalysts has received sustained funding from NRI and from IFAFS and is a good example of what can be accomplished to add value to crop residues.

- Another example of NRI funded research in biomass conversion technologies includes researchers at the University of Wisconsin who seek to produce cellulose in transgenic barley for the purpose of biomass conversion for the production of biofuel.

- The University of Northern Iowa Ag-Based Industrial Lubricants Program conducts research and technology transfer of environmentally friendly industrial lubricants and greases. The program has developed a number of products based on soybean oil. Commercial success has been most prominent in the trucking and rail markets. CSREES support has been provided through the Special Research Grant Authority and IFAFS. As a result of IFAFS funding for an on-farm demonstration of grease production, the participating soybean farmer now has funding from USDA's Rural

Development Value-Added Development Grants Program to initiate commercial production. The rail curve grease performs 20% better than conventional greases and is currently being used by more than 24 rail lines. 2.5 million pounds of grease were used in 2003, capturing about 25% of the market.

- The University of Southern Mississippi Polymer Institute has developed novel vegetable oil additives from castor, soybean, and linseed oils and has successfully copolymerized them into emulsions with commercial formulations resulting in paints and coatings free of organic emissions and with very little odor. Castor oil acrylate monomer used in indoor architectural paint formulations is commercially available and has been used in Pentagon renovations. Soybean oil acrylate monomer is being used by a Mississippi-based company in a permanent press treatment for use on U. S. Marine military uniforms. This textile treatment company has submitted 7,500 uniforms treated with the soybean derived polymer and is awaiting for certification by the U.S. Air Force. The Polymer Institute has received sustained support from CSREES under the Critical Agricultural Material Act.

- Silverbrook, Ltd., Federal Way, WA is a good example of how a small business has used SBIR research funds to evaluate a concept and create value-added products. Silverbrook used Phase I and Phase II SBIR funds, $340,000 total, to evaluate the development of a wood-based mulch for erosion control using low-value small diameter timber and wood waste from traditional logging operations. They developed a patented mobile processing technology that could be used by rural communities and small businesses to create local sources for the wood mulch, WoodStrawTM. Tests of the resulting product demonstrated that the material was highly effective and cost competitive with more traditional mulches. They partnered with King County (Seattle-Tacoma), WA on the testing of the material and now have several lucrative large-scale contracts being negotiated in the southeast and northwest.

- The United Soybean Board received IFAFS funding for market development of biobased solvents formulated to specific requirements. De-inking printing presses and architectural paint stripping operations have demonstrated the environmental benefits of using blends of soy methyl ester and ethyl lactate. Savings in disposal costs were realized during the renovation of the U.S. Army Walter Reed Hospital in Washington, DC.

Education projects include:

- The Cornell Multidisciplinary Graduate Education Training program was funded through IFAFS. The goal of the project is to create a cadre of engineers and scientists who can bring critical and creative thinking to the task of designing sustainable industrial activities that range from nanobiotechnology to industrial ecology. Students are provided with fundamental training in science and engineering, and work in multidisciplinary teams of basic and applied researchers.

- In 2003, Tennessee State University was awarded an 1890 Capacity Building Grant entitled “Development of an Internet-Based Education for Biobased Product

Information: Preparing Student for Careers in Agriculture. The goal of the project is serve as an innovative tool for teaching information technology in the context of biobased products. The project will result in 2 0r 3 courses and/or supplements to current course being taught at TSU. A website will be constructed to offer interactive learning opportunities regarding biobased products at TSU and other universities.

Funding

CSREES supports a portfolio of projects with various funding mechanisms that encompass all phases of the research and development continuum from basic through pre-commercialization. NRI supports basic and early applied research, formula funds support basic and applied research, special research grants and other earmarks support applied and developmental research, and SBIR supports pre-commercialization activities. During 2000 and 2001, IFAFS focused on applied and developmental R&D. Examples of projects that have successfully utilized one or more available mechanisms to move R&D to commercialization are described in the Performance Indicators section.

Funding for PA 511/512 for fiscal years 1998-2002 is shown in the table below. A major strength of CSREES programs is leveraging, and the table shows other Federal and Non-Federal dollars over the five year time period. The increase of the CSREES contribution in 2000 and 2001 is due to IFAFS.

Table 9. Funding for Nonfood Products, Process and Storage (PAs 511 and 512)

SOURCE ($ x 1,000,000)					
FY	**CSREES**	**OTHER FEDERAL**	**OTHER NON-FEDERAL**	**TOTAL 511/512**	**CSREES AS % OF TOTAL**
1988	10.5	5.06	32.9	48.49	21.6
1999	10.37	4.93	35.8	51.06	20.3
2000	16.3	6.61	34.71	57.63	28.3
2001	22.3	7.63	36.72	66.65	33.5
2002	11.5	7.61	36.14	55.25	20.1

Other Agencies across USDA provide funding for programs relevant to nonfood products. Activities include research that is complementary to CSREES, financial assistance for scale-up and other incentives, and procurement. For example, budget estimates for 2001 included: Agricultural Research Service ($48.9M), Forest Service ($12.5M), Natural Resources Conservation Service ($6.3M), Office of the Chief Economist ($612K), Office of Procurement Policy ($61K), and the Farm Services Agency bioenergy incentives payments ($150M).

New Directions and Emphasis

Agricultural research is providing new strategies to address environmental and economic issues. Biomass feedstocks have almost a net zero net effect on greenhouse gases during their life cycles when compared to petroleum feedstocks. Alternative, value-added uses for

wastes generated from agriculture and forest management turn liabilities into assets. But as promising as these new strategies are, the CSREES research portfolio continues to focus on production agriculture. Historically, the objectives of cutting edge technologies in genomics, integrated pest management, and other sustainable agricultural practices are to increase yields and reduce costs, but do not necessarily add post harvest value.

The challenge is to streamline research, development and production systems and to resolve technical bottlenecks to bring the research discoveries to full commercialization with products that are cost effective and environmentally preferable. Currently, technical gaps in product R&D include developing or optimizing designer organisms, feedstock harvesting, management and transportation, biomass pretreatment, bioconversion, and separation techniques.

Examples of new directions include:

- The Initiative for Future Agricultural and Food Systems (IFAFS) - was a competitive grants program funded in 2000 and 2001, and it offered a new approach to accomplish near-term outcomes relevant to the mission of CSREES. The purpose of the initiative was to bring the agricultural knowledge system to bear on issues facing small and mid-sized producers and land managers, thus enabling improvement in quality of life and community. IFAFS was distinct from other CSREES programs because of its priority on integration of research, education and extension, and its support for relatively large projects with a multidisciplinary, as well as multi-functional approach. "New and Alternative Uses and Production of Agricultural Commodities and Products" was one of 5 major topic areas supported under this initiative.

- NRI has typically supported single-investigator projects focused on basic and early applied research. Because of the successful outcomes from integrated projects, as evidenced by IFAFS, NRI is authorized to fund integrated projects (research, education, extension). Funding for integrated projects can be up to 20% of the NRI budget.

- Future trends for SBIR supported research look toward addressing the continuing issues of developing value-added products to improve the commercial potential of bio-based products derived from forestry and agriculture. The recent devastating wildfires experienced throughout the western United Sates have highlighted the need to reduce fuel loads by thinning small-diameter timber. Although some work has been supported in this area, the need to develop a suite of value-added products to make thinning economically attractive is compelling. Projects in this area may find potential support in the SBIR Forest and related Resources topic area. In 2003, the SBIR RFA was rewritten to include examples of value-added wood utilization technologies to attract more proposals to this important area of research.

  Similarly, the bio-energy industry would also benefit from continued development of value-added products from the by-products produced by processing of biomass.

Projects in this area may find potential support in the SBIR Industrial Applications topic area.

As social and environmental pressure mounts; it is incumbent upon the animal production and dairy industries to develop more efficient and economical methods for controlling managing animal waste, including by-products, such as manure and carcasses. The economics of animal waste management may be increased by turning animal waste into value-added products, such as fuel or fertilizer. The 2005 SBIR RFA has added a completely new topic area, Animal Waste Management, to be co-managed in 2005 by Drs. William Goldner, and Richard Hegg. The new topic area will help small businesses focus on the development of value-added products from the animal waste stream, as well as other aspects of the management of animal waste and its consequences.

- Multistate Committees – Two relatively new committees address biobased products and bioenergy exclusively: S-1007 "The Science and Engineering for a Biobased Industry and Economy," and SR-DC-303 "Production, Harvest, Storage, Delivery of Herbaceous Energy Crops for Fuels and Chemicals." A third committee focuses on forest products, NCA010 "Forestry and Forestry Products." S-1007 has been tasked with conducting site reviews of projects funded by USDA in 2003 under the Biomass Research and Development Initiative (administered by NRCS). This committee will provide the expertise needed to determine if project objectives are being met and will provide information for NRCS accountability.

Other programs not included in CRIS reporting for PA 511/512 but are relevant to the topic area of nonfood products:

- The Biodiesel Fuel Education Program was new in 2003 and is an example of a program that focuses exclusively on outreach and marketing of a new nonfood product. CSREES can point to many examples of agency support in biodiesel research over the past decade, resulting in a commercially available product that is ready to meet the alternative fuels market. The Biodiesel Education Program will engage the Extension system in outreach activities.

- The Biomass Research and Development Initiative is a section of the Biomass Research and Development Act of 2000. The Act designates USDA and DOE as lead agencies for implementation. Section 9008 in the Energy Title of the Farm Bill makes available $14M a year 2003 through 2007 to support agricultural production, conversion, and product development. This initiative is USDA's largest competitive program focused on research and development of biobased products and bioenergy. USDA's Natural Resources Conservation Service administers the biomass initiative, and CSREES provides support with RFA development and proposal reviews, post award reviews.

CONCLUSION

Working under strict constraints, the F&NFPP unit strived to provide the Panel with broad descriptions of the Problem Areas under their leadership and management. In spite of the effort that went into its development, the report remains incomplete, with issues unaddressed and questions unanswered.

The F&NFP hopes that the Panel will review the report, note questions to ask for clarifications, and examine evidentially materials and other documents available to them at meetings in Washington, DC. The report, along with presentations by the NPLs at the meeting and other materials, are the only evidence on which the Panel will assess the Plant Production Portfolio.

The scores that the Panel assigns to the Portfolio will serve as a basis for CSREES' report to OMB to fulfill the requirements of program assessment using the new Program Assessment Rating Tool (PART). This will partly fulfill OMB requirements of the Agency to have all portfolios of programs covered under CSREES Goal 1 to be assessed this Fiscal Year. The recommendations that the Panel makes to CSREES will assist the Agency and the NPLs to improve the ways program portfolios are managed.

The F&NFP unit thanks the Panel for the time and effort invested in evaluating the portfolio and recommending ways to improve the performance.