

**THE
PEANUT COLLABORATIVE RESEARCH SUPPORT PROGRAM
2007-2012
A USAID-Funded Program**

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**EXTERNAL EVALUATION TEAM REPORT
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Prepared at the Request of the Peanut CRSP Advisory Board

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Abbreviations and Acronyms

AF-ALB	Aflatoxin Albumin
AFB1	Aflatoxin B1
AFB Lysine	Aflatoxin B Lysine
AF-M1	Aflatoxin Exposure Biomarker
AGRA	Alliance for a Green Revolution in Africa
ANAPO	Asociacion Productores de Oleaginosas y Trigo
APRES	American Peanut Research and Education Society
ASPRODEB	Association pour la Promotion du Developpement a la Base
AUB	Auburn University
BBC	British Broadcasting Corporation
BMGF	Bill and Melinda Gates Foundation
CAADP	Comprehensive African Agricultural Development Program
CBR	Cylindrocladium Black Rot disease
CDC	Center for Disease Control
CD4 count	Cluster of differentiation cells/type of white blood cells that fight infection and their count indicates stage of HIV or AIDS in a patient
CFC	Common Fund for Commodities
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Research Center for Tropical Agriculture
CIP	International Potato Center
CODEX	Alimentarius Commission (System for Approval of Food Additives)
COR	Cornell University
CRSP	Collaborative Research Support Programs
CRI	Crops Research Institute/Ghana
EET	External Evaluation Team
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuaria (Brazilian Enterprise for Agricultural Research)
FARA	Forum for Agricultural Research in Africa
FB1	Fumonisin Exposure Biomarker
FDA	United States Food and Drug Agency
FHI	Food for the Hungry International
FN	Fumonisin
FRI	Food Research Institute/Ghana
FtF	Feed the Future
FTIR-ATR	Fourier Transformational Infrared-Attenuated Total Reflection Spectroscopy
FTIR-PAS	Fourier Transformational Infrared-Photo Acoustic Spectroscopy
GHEKIO	The Haitian Group for the Study of Kaposi's Sarcoma and Opportunistic Infections
GIS	Geographic Information System
GM	Genetically Modified
GMP	Good Management Practices
GPC	Georgia Peanut Commission

Acronyms

GRD	Groundnut (or Peanut) Rosette Disease
HACCP	Hazard Analysis of Critical Control Points
HB/HC	Hepatitis B, Hepatitis B viruses
HC	Host Country/ies
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HPLC	High Pressure Liquid Chromatography
HSCAS	Hydrated Sodium Calcium Aluminosilicate clay
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IEC	Information, Education, and Communication
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
IPM	Integrated Pest Management
ISNAR	International Service for National Agricultural Research
ITTU	Intermediate Technology Transfer Unit/Ghana
KARI	Kenya Agricultural Research Institute
KNUST	Kwame Nkrumah University of Science and Technology
LDC	Less Developed Country
LLC	Limited Liability Corporation
ME	Management Entity
MFK	Meds and Foods for Kids
MLs	Maximum Limits
MOA	Ministry of Agriculture
MS/MSc	Master of Science Degree
NARI	National Agricultural Research Institute/Uganda
NARO	National Agricultural Research Organization/Uganda
NAWOU	National Association of Women's Organizations in Uganda
NCS	North Carolina State University
NC/VA	North Carolina Virginia peanut growing area
NGO	Non-Government Organization
NMS	New Mexico State University
NS	NovaSil Clay
PBMC	Peripheral Blood Mononuclear Cell
PCARRD	Philippine Council for Agriculture and Resources Research and Development
PCRSP	Peanut Collaborative Research Support Program
PEPFAR	Presidents Emergency Program For Aids Relief
PhD	Doctor of Philosophy
PI	Principal Investigator/s
PIIM	Peanut Industry Incubator Model
PINS	Peanut Information Network System
PUR	Purdue University
PVCA	Peanut Value Chain Analysis
R&D	Research and Development
RJR Nabisco	RJ Reynolds Nabisco/a food manufacturing company
RNAi	Ribonucleic Acid Interference

Acronyms

RUTF	Ready-to-Eat Therapeutic Foods
SADC	Southern Africa Development Community
S-SOS	Society for Sustainable Operational Strategies
SSA	Sub-Saharan Africa
TAM	Texas A&M University
UAB	University of Alabama at Birmingham
UCN	University of Connecticut
UF	University of Florida
UN	United Nations
WGS	Women and Gender Studies/Makerere University, Uganda
UIRI	Uganda Industrial Research Institute
UGA	University of Georgia
UGAGP3M Team	– University of Georgia Global Peanut Product Processing Marketing Team
UGARF	University of Georgia Research Foundation
UNBS	Uganda National Bureau of Standards
USAID	United States Agency for International Development
UPSN	Uniform Particle Size NovaSil
USD	United States Dollar
USDA	United States Department of Agriculture
USDA/ARS	United States Department of Agriculture/Agricultural Research Service
US/USA	United States of America
VT	Virginia Technological University
WHO	World Health Organization

Acronyms

Executive Summary

The Peanut Collaborative Research Support Programme phase 2007-2012 is composed of a series of projects addressing production, processing, and consumer values with expectations of capacity development, outreach and gender equity activities from all projects. Projects have a peanut- or aflatoxin component, and most projects continued from previous activities, and build upon the historic achievements of the program. Also continued in the current phase of the Peanut CRSP are activities initiated in the previous special purpose award in 2002 (Preventing Human Aflatoxicosis) under the Peanut CRSP.

The Peanut CRSP and its 21 component projects were all the result of open competition. The majority of projects were initiated in early 2008, but three projects in the processing sector only received funding in 2009, and an impact assessment project was initiated in 2010 when funds became available. The portfolio of projects is still technically relevant to the goals of USAID under the new Feed the Future (FtF) initiative, although some of the locations where the Peanut CRSP is active are no longer priorities for USAID. The major hubs for Peanut CRSP activities (Ghana and Uganda) are FtF focus countries, and the strong emphases on nutrition and food security reinforce the relevance of the Peanut CRSP to the FtF.

Technical Achievements and Impacts

The program has supported a range of projects from different areas of the basic-applied-adaptive research continuum. Outputs anticipated from the project selection range from knowledge to influence policy decision to technologies to change production and markets that are needed to address the major problems of the peanut sector.

The projects focused on the consumer values of nutrition and public health, through preventing human aflatoxicosis, have been very successful in demonstrating the consequences of uncontrolled human exposure to aflatoxin. Through outreach activities this initiative has been a major (if not the dominant) research effort alerting governments and institutions in developing countries of the need to reduce human exposure to aflatoxins and other mycotoxins. The hypothesis that aflatoxin is a critical factor in public health was supported by research results related to HIV, tuberculosis, and pregnancy/birth outcomes.

Aflatoxin has now been officially recognized as an issue for the African Union and its agricultural programs, and USAID and other development agencies have invested in addressing this problem. The discovery that maize consumption is strongly correlated with HIV transmission, and the conclusion that the mycotoxin, fumonisin, was the most likely causal agent was a landmark discovery with great potential importance to the future management of HIV. Following up on this finding, the use of Novasil as an intervention against this toxin was evaluated and proven effective in human trials. This result supports

the need to deploy this intervention for human use in situations where the standard paradigm of regulation is failing to protect humans from exposure.

A significant development in the regulatory environment was the approval of binding agents as an intervention to recover aflatoxin contaminated grains for animal use by the European Union and by the State of Texas. The momentum of this aspect of the Peanut CRSP is very significant and the EET urges the USAID's agriculture and health programs to join in accelerating this very important area where the Peanut CRSP has established world leadership. in exploiting Novasil to reduce human aflatoxicosis.

Nutrition projects are exploring the use of peanuts to address both issues of obesity, blood pressure and diabetes; and under nutrition have made good progress towards the dual goal of expanding the use of peanuts for nutritional purposes and improving public health. Progress has been made toward RUTF (Ready to Use Therapeutic Foods), which are aflatoxin safe, nutritious, and near liquid and easy to eat by malnourished children and adults. This research assumed increased relevance with the recognition of the World Health Organization (WHO) and the United Nations (UN) of non-communicable diseases as a worldwide epidemic.

Due to the delayed start-up of the projects aimed at expanding demand for peanuts by industries, the achievements in this area are limited by mid-term. Project sites and partners have been identified and the research activities have started. The research teams are strong with good experience in the topic and are deploying proven models to expand processor and consumer demand for peanuts.

Research progress was sustained and consistent for the projects focused on increasing the value of peanuts to farmers. The efforts in this sector have mostly focused on the improvement of varieties, and the deployment of improved varieties with the ability to withstand constraints in the environment. Reflecting the earlier investments by the Peanut CRSP in this area, an impressive number of new varieties have been released, or are being readied for release, and brought to fruition by the sustained funding over this limited time span. In Guyana, the school lunch program continues to expand to more villages in terms of both peanut product supply and economic impacts.

In Africa, the breeding programs are mostly mature and have materials advancing in through the breeding process. The improvement of human, institutional capacity and facilities has been particularly rewarding in Uganda. The improved varieties in Uganda are being shared with neighboring countries and Peanut CRSP has essentially established a regional breeding program. The emphasis on seed system issues of seed multiplication and distribution has been justified in Senegal, with progress in developing the ability to popularize improved varieties. In Ghana, the earlier rapid development of the IPM and crop improvement technologies went through a difficult period of slower transfer and extension as the scientists and institutions adjusted to the changes in fiscal management required by the new award.

The production projects located within government institutions (as opposed to universities) have suffered particularly from difficulties in the fiscal process that were created by changes in the award by USAID, and in the Peanut CRSP by the University of Georgia (UGA). These changes, although intending to achieve improvement in administration, made the process more cumbersome and difficult, particularly for partner institutions in developing countries.

The mandated benefits returning to the U.S.A. have been consistent, particularly in the areas of nutritional consequences of consuming peanut; partnerships to develop and produce RUTF; development of improved varieties; and maintenance of institutional capacity to conduct peanut production research.

Capacity development has shifted emphasis relative to historic programs, with more attention to extension and short-term training than to graduate degree training. Outreach and the creation of partnerships to achieve impact have been expanded, particularly in the areas of aflatoxin and nutrition. The first scientific papers resulting from research under this phase of the Peanut CRSP are being published in refereed journals, and are potentially very important to the objectives of the USAID in the areas of HIV, TB, maternal and child welfare, mortality, legacy effects associated with the critical first '1000 days'.

Administrative Issues

The technical program was constrained by a number of administrative factors that were outside the control of the Director and Management Office.

1. Variable and uncertain funding made planning and implementation difficult.
2. Projects were changed during the third year of implementation introducing a different set of indicators and changed expectations.
3. Award mechanisms relating to accounting greatly increased the burden of accounting, particularly for developing country partner institutions.
4. Changes adopted by UGA had the unintended consequence of compounding the problems of accounting at national institutions.

Recommendations

The EET recommends that the Peanut CRSP be extended for the full design period up to 2017. To justify this recommendation we note the following:

1. The Peanut CRSP addresses priority issues for the peanut sector in FtF focus countries.
2. Peanut is the most important legume in African agriculture and is particularly important for women who produce, process, market and utilize the commodity but usually in in the informal economy.

3. The importance of the aflatoxin component of this program extends well beyond the peanut commodity since it is addressing mycotoxin policy and management issues that are common to all commodities. The importance of this program to USAID's health mandates and efforts justifies a recommendation that USAID expand funding to the program utilizing the PEPFAR resources.
4. The scientists participating in the program are prominent in their own disciplines and in the peanut sectors of the countries where the Peanut CRSP is being implemented. Program achievements and impact, particularly in the consumer values area, are such that the Peanut CRSP is a world leader.
5. The program has also established a network that allows the modest funding to achieve disproportionate results in economic development, nutrition and impact the quality-of-life for a large number of people in developing countries.

USAID, UGA and the Management Entity (ME) at UGA should implement solutions to the administrative problems identified before the implementation of the extension phase that the EET is recommending.

I. Introduction

The Peanut Research Collaborative Support Program (Peanut CRSP), one of a number of CRSPs, funded by the U.S. Congress through the United States Agency for International Development (USAID), contributes to the goal of preventing famine and establishing freedom from hunger through U.S. land-grant universities being involved in international development. The current phase of the Peanut CRSP is supported by USAID Cooperative Agreement No ECG-A-00-07-00001-00 to the University of Georgia, as the coordinating institution, in 2007-2012. The Program is structured for a 10-year period, with adjustments based on the recommendations of the current mid-term review and approval by USAID, for an extension to 2017.

The mission of the Peanut CRSP is the “achievement of sustainable economic and social development through research and capacity development using peanut and related expertise in developing countries and the USA.” There are five goals including:

1. Greater incomes for participants in the peanut sector (producers and processors);
2. Greater value of, and demand for, peanuts in the market place;
3. Improved public health through enhanced nutrition and quality, including reduced human aflatoxicosis;
4. A sustainable value chain (produce, processor/market and consumer values) for peanut systems; and
5. Improved capacity of participants to support future development of the peanut sector.

The Peanut CRSP has three expected products: (1) knowledge and technology; (2) capacity development; and (3) changed quality of life through technology transfer and impacts.

The 21 projects under the program group around three sectors of the whole-value chain: Production Values, Processor Values and Consumer Values, the latter including Food Safety (Aflatoxins) and Nutrition. A fourth sector is of Cross-cutting projects which communicate technology and assess impact. In the communication and in management activities advanced web-based programs are in place with many participating institutions worldwide to enable ongoing communication of peanut research, training programs and technology transfer to users. Fiscal management is cost effective and accountable.

This External Evaluation Team (EET) report reviews the Program's progress over the first three years (2007-2010), the plans for the remaining two years and projections of activities for the next five years. The review was prepared using Annual Reports and a Principal Investigator (PI) survey.

There presently are 21 projects led by Project Investigators (PIs) located in 11 U.S. universities and nine Host Country (HC) universities and eight HC ministry institutions representing West Central Africa, West Africa, East Africa, Latin America and the Caribbean (summary in Appendix 1). Implementation progress, including achievements, in terms of outputs, outcomes and impact of the Peanut CRSP projects are summarized in this EET Report. This review report

Introduction and Background

includes summaries of individual projects showing EET's findings relating to achievements, strengths, weaknesses and recommendations for each project, from which this EET Report is drawn.

The External Evaluation Team (EET)

The EET consists of nine experts representing various fields in the key areas addressed in the Peanut CRSP program sectors. They represent a wide range of institutions including U.S. universities, international and national research institutes and authorities, development agencies and private sector companies. They also represent the various regions where on-going projects are located and where there are active research teams working on Peanut CRSP-supported projects. The list of the EET members and their brief resumes is in Appendix 4. The review process followed by the EET in their evaluation of the progress and achievements of individual project progress and the overall Peanut CRSP outputs, outcomes and impact is described in Appendix 3.

II. Background of Peanut CRSP

The present fourth phase of the Peanut CRSP began in 2007; with a ten-year design horizon (to 2017) funded until 2012, with extension provisional on a satisfactory mid-term review, relevance to USAID and availability of funds. It was designed around a whole-value chain concept involving peanuts and peanut related expertise in the mycotoxin area. This latter component being a continuation of the "Preventing Human Aflatoxicosis" initiative that opened to the Peanut CRSP research to demonstrate the importance of aflatoxin to public health in developing countries.

Earlier phases of the PCRSP in 1982-1996 involved Southeast Asia, West Africa, and the Caribbean and emphasized breeding and crop management, but included an investment in aflatoxin management and food technology. Consumer and market issues were important research needs for the expansion of the peanut crop in developing countries to contribute to food security, health and economic growth. The Peanut CRSP contributed to peanut production in all location of Peanut CRSP activity, and resulted in the expansion of integrated pest or disease management (IPM or IDM). In the U.S. and Philippines, a highly insect resistant germplasm line (from collections with naturally occurring genetic variability) was identified and exploited. Working with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), virus resistant varieties were developed and released in W Africa. The development of hand sorting for aflatoxin control and food processing developments for cottage and small-scale processors resulted in strengthening small-scale peanut industries. A commercial bentonite, NovaSil (NS) that had high affinity for aflatoxin in the digestive tract was discovered from this earlier work.

By 2010, it was reported that Peanut CRSP involved peanut varieties (or cultivars resulting in crossing germplasm lines or advanced lines that have desired characteristics for yield, pest resistance, disease resistance, etc.) developed in Senegal occupied 400,000 acres in that West Africa country; rosette virus resistant varieties and other varieties developed in Nigeria cover

Introduction and Background

70% of the peanut acreage; and rosette resistant varieties developed in Uganda covered over 60% of the peanut area. NovaSil (NS) used as a feed additive was making a major contribution to world food supplies in that 60% of world commercial livestock feed included NS as a toxin-binding agent to protect livestock from exposure. However, only in Southeast Asia was significant progress being made at protecting people from dietary aflatoxin.

During the 1996-2007 phases, the scope of the Peanut CRSP was expanded to give greater emphasis to nutrition, post-harvest issues, human aflatoxicosis and provided increased focus on the whole peanut value chain. Research studies continued to develop technologies that relieved production constraints like IPM in Ghana. New rosette-resistant cultivars were introduced to Malawi and Uganda and these varieties now cover about 60% of the production areas in Uganda. The full value chain (producer, processor and consumer) was expanded through a peanut butter-based school lunch program in Guyana that established cottage industries producing peanut butter.

Reflecting the failure in Africa to have technologies that manage aflatoxin adopted, a change in aflatoxin research focus was effected. Consumer value projects directed toward aflatoxin contamination problems as they affect human health and immune systems, and efficient and effective control measures including NS clay research to extend its use to human use were added to the portfolio. Studies on the nutritional value of peanuts provided the U.S. Food and Drug Agency (FDA) with information for labeling peanuts along with tree nuts as "Heart Healthy."

Peanut sales in the USA have increased by \$500 million per year because of these research results. In the Philippines and Thailand a market based approach to peanut product development led to a Peanut Industry Incubator Model to identify consumer product-needs and acceptability, develop the indicated products in concert with interested processors, and introduce the products through markets to the consumer. The process was successful to enhance nutrition, demand for peanuts in the market, food supply, and for economic growth.

The current phase for 2007-2012 (with a ten-year outlook until 2017) builds on the progress made in the earlier work with strong recognition that development across the whole peanut value chain was important for the production phase of the chain (a market pull concept). Strong focus was made on preventing human aflatoxicosis and on exploiting the high nutritional value of this commodity. The result is a program that contributed to the food supply and economic growth of Less Developed Countries (LDC), while providing feedback to the U.S. peanut sector.

This EET Review Report includes an evaluation of the research progress, technology developments and impacts at mid-term of the implementation (2007-2010).

III. Technical Achievements: Outputs, Outcomes and Impacts

Overall, a wide ranging and exciting portfolio of Peanut CRSP projects have been funded with most showing some successes and in some instances potential for having very high impact. One advantage of Peanut CRSP is that it has supported long term research programs allowing them to evolve and build on advances established by past work. For example, breeding studies are long term and require time to produce newly developed cultivars with impact. Moreover, additional time is necessary to gain approval to newly release cultivars, conduct planting seed production and gain the acceptance of farmers who want assurances that replacement of present crops will allow them to maintain or improve their profits.

Technology transfer of successful results is another achievement of Peanut CRSP. Continuation of the successful approaches developed in Southeast Asia that commercialized processing technologies for new locally adapted peanut products through multiple media has been a major benefit. The results of all these advances are now expanding throughout the Peanut CRSP family. The following is a summary of the successes to date of each of the 21 Peanut CRSP projects in this phase. The detailed results of the evaluation of individual projects are in a separate volume which could be accessed by the Principal Investigators (PIs), the research teams and their partners in developing countries. Individual evaluation reports are also available in the Peanut CRSP website (www.peanutcrsp.org).

A. Production Values (Resource Efficient Production)

Production projects focus mostly on ongoing challenges from the environment, such as water stress and climate warming, diseases, especially rosette viruses, leaf spot, rootworm and rust and increasing yields by managing these factors. The strategies include developing better varieties and farming practices to conserve soil fertility, to reduce the use of costly herbicides, pesticides and fungicides, and assuring quality peanuts for consumer acceptance and market expansion. **All these projects have a history that goes beyond the start of this phase so they have materials and results at all stages of the continuum of production research.**

High yields, drought tolerance and reduced diseases would improve competitiveness of peanuts relative to other crops. Sustained breeding programs to enhance drought and disease resistance along with increasing yields are major tools used in these endeavors. This includes increasing use of wild relatives and early-developed strains based on a wealth of germplasm for the needed crossover of favorable genes into cultivated varieties. Training in breeding techniques, implementing integrated pest management technologies and incorporating good cultural or farming practices through multi-disciplinary collaborating research efforts to end users is the primary focus of the production projects in Peanut CRSP.

The measureable impacts from this program area include: (1) technologies allowing increased returns to identified production resources; (2) adoption of more sustainable production technologies; and (3) knowledge applied to improve or maintain profitability of peanut operations.

Achievements

There are eight projects focused on Producer Values located in East Africa (UCN139, UGA136, NMS172): West Africa (TAM137, NCSI31, UF150) and Latin America/Caribbean (UF155, UF157).

Research on production values led to the development of improved peanut technologies and good production practices such as new early-maturing and high yielding varieties with resistances to major peanut pests and diseases, high oleic traits and good agronomic characteristics, improved pest and disease management practices, and good harvest practices using mechanical tools. These technologies led to yield/production increases in many HCs where farmers have been trained and have adopted them. Key achievements of Peanut CRSP are improved varieties and potential germplasm that have gone into the breeding programs in the HCs. PCRSP has also contributed to the International Peanut Genome Project through which future crop improvement will become more efficient.

Basic Research Activities

Utilization of Bolivian land races (tetraploid species), and collection and preservation of wild species has contributed to conservation and exploitation of valuable peanut genetic materials, which have the potential to result in commercial cultivars with improved disease resistance. An expanded range of peanut germplasm has been identified and developed through crossing, and some derivatives show considerable potential for resistance to rust and leaf spot. Two potential lines showed resistance to both pathogens and are being used as parents in crosses. Intra-specific crossing has progressed well and progenies now require chromosome doubling.

In Uganda and New Mexico a wide range of Valencia peanut accessions have been evaluated. A number of these were shown to perform better than the check entry Valencia-C. A total of 114 accessions were characterized and relationships between accessions from different geographical regions are now better understood. This information could be useful in breeding Valencia peanuts for improved yield and resistance to major constraints.

In developing molecular techniques to enhance the ability to utilize specific characteristics of peanut germplasm in a shorter time, a high-density oligonucleotide microarray suitable for transcript profiling has been designed for the Valencia type peanut. The array represents the majority of publicly available peanut EST's (Expressed Sequence Tags), and can be used as a tool for expression profiling studies in diverse tissues.

Applied Improvement Activities/Impacts

Development and deployment of improved varieties has accelerated and six new varieties have been released in Senegal. Although somewhat delayed, there is potential for variety release in Burkina Faso. Seed multiplication is progressing well in Senegal with training in this technology being initiated. Stronger support of government extension services is needed for training of farmers. There is also interest in molecular breeding in Senegal that needs support.

Achievements

In the U.S., early maturing varieties with high oleic traits (which significantly extend shelf-life of peanuts and peanut products) and drought resistance are due to be released in Texas.

In Uganda, two new lines with high resistance to Groundnut Rosette Disease (GRD) were released in 2010 as Serenut 5R and Serenut 6T. At least 2 more lines having GRD resistance and/or leaf spot resistance were field tested in 2010 and are awaiting approval for release in 2011. Improved versions of Ugandan landraces/germplasm are in process and should be released in due course. GRD resistant lines have been transferred to other countries in the region including Ethiopia, Sudan, Western Kenya, Democratic Republic of the Congo, and Rwanda. Six transgenic lines have been generated using RNAi technology and other lines are in various stages of testing.

In the U.S., excellent results have been achieved in North Carolina on IPM practices that have been profitable to growers in the North Carolina and Virginia peanut growing region. In Ghana, IPM practices developed in the earlier phase are being implemented and scaled-up by the Ministry of Agriculture. Cropping systems research is refining and extending to farmers the production of peanut with irrigation in the dry season, the present market benefits of this system are that farmers market their peanuts at the time of highest prices.

In Bolivia, a new variety has been released and seed is being multiplied. In Guyana a Peanut Field Production Guide was completed based on the results of the research and on-farm demonstration in the Rupununi Region and have been distributed widely to farmers; and translated to Creole for a Haiti version. Virtual extension services by University of Georgia scientists have provided farmers in Haiti field days access to the best possible knowledge. This service has been done using wireless internet and video conferencing capabilities.

B. Processing, Value-Addition and Market Development Sector

Research advances in the development of quality aflatoxin-free peanuts as a food along with growing economies has induced the need for farmers and agribusinesses to know what food products are in high demand by consumers. Studies have shown peanuts and peanut products are highly nutritious, having several benefits to human health and wellbeing beyond basic nutrition. Consumer-driven, market pull approaches to develop safe, quality peanuts, and peanut products such as processing technologies are being developed by Peanut CRSP.

Consumer and market surveys have been carried out to identify consumer priorities for selected peanut foods. The information from the peanut value chain have identified peanut product preferences, selected peanut products, and training is being provided on appropriate processing technologies with small and large industries. Products produced will be fit to local consumer/market preferences and economic conditions, while refining safety, sensory and functional properties through food science.

The measurable impacts from this program sector include: (1) increased processing of peanuts through value added activities; (2) companies, cooperatives and entrepreneurs producing value added peanut products; (3) increased presence or maintained value of peanut products in the market place; and (4) greater trade of peanuts and its products. There are three projects specifically focused on the Processor Values program sector (UGA127, UGA165 and UGA166).

Achievements

Projects with major emphasis in other sectors also contribute to this sector. For instance, UF 155 has also utilized the value chain approach to sustain production expansion and COR158 has addressed aflatoxin which has resulted in added processor and nutritional results. These projects have built on the capacity and experiences achieved during the earlier phases of Peanut CRSP.

The suite of three specifically processing projects (UGA127, UGA165 and UGA166) was established **in 2010¹** by the PIs at the University of Georgia as the University of Georgia Global Peanut Product, Processing and Marketing Team (UGAGP3MTeam). Partners in these projects included the collaborating HC PIs in Ghana and Uganda. The Team established a seamless communication mechanism <uga_gp3mt@gmail.com>, which has vastly enhanced the progress of the collaborative work. The research is building a market-pull emphasis based on food manufacturers informed by consumer preferences and desires to increase production and utilization of peanuts and peanut products (a transfer of the Peanut Industry Incubator Model – PIIM developed in the Philippines and Thailand).

Three nutritionally enhanced foods, Vitamin A fortified stabilized peanut butter, stabilized peanut butter and chocolate-peanut spread, were selected (based on surveys in Ghana and Uganda) for development and production. These products were the basis of previously successful Peanut CRSP-funded projects and are documented in Peanut CRSP Monographs and other scientific journals. Identification of potential marketing opportunities for peanut-based products is continuing in Ghana and Uganda with survey instruments, including questionnaires to find out what peanut foods are of most interest to the consumers, and link the Host Country investigators with interested processors to develop, process and market these new products. In addition to these three foods noted above, this effort has identified nutritious peanut cookies and fiber-enhanced peanut butter and peanut soup.

The surveys involved more than 1000 households in both Ghana and Uganda to directly identify market opportunities for new and modified peanut products. The importance of these studies is building a baseline of knowledge to support future investments and a market-pull emphasis of consumer desires working with food manufacturers to increase production and utilization of peanuts and peanut products (a transfer of the Peanut Industry Incubator Model – PIIM developed in the Philippines and Thailand).

In another project (UF155) in Guyana, Peanut CRSP has linked peanut producers, processors and consumers around school-feeding. The cottage industries in seven villages established in the earlier phase have expanded to 43 villages and provide consistent market demand and steady income by marketing peanut butter through the school feeding program and local sales. The cottage industries also contribute to the development of the private sector with over 50% of the income they generated in Aranaputa village coming from private sales. There are now cottage industries capable of producing 25 kg or more of peanut butter per day. Over 1400 snacks were produced per day and they generate \$75 million Guyana dollar in the region per year. A state-of-the-art peanut processing and storage facility was built in Aranaputa in collaboration with the NGO partner, Society for Sustainable Operational Strategies (S-SOS). A satellite program was

¹ The restricted funding levels defined over the first 2 years of the project delayed these projects.

Achievements

set up to supply peanut butter and provided training to processors in 26 new villages in collaboration with S-SOS.

C. Consumer and Social Values

In this sector of the Peanut CRSP projects address gender issues, nutrition and the food-safety; the later being focused on aflatoxin and public health through the prevention of aflatoxicosis. In the previous phase a major change in emphasis occurred to focus PCRSP on documenting the overlooked health consequences of neglecting aflatoxin in the diet, and demonstrating an alternate paradigm for the prevention of human aflatoxicosis in food insecure situations. Gender is an important factor in peanut production, marketing and exploitation; in many Peanut CRSP locations this is primarily a women's crop. Women produce, process and market the majority of peanuts through informal channels: as such the importance of the crop is likely to be overlooked since it is seldom well documented as a feature of national economies.

Key achievements were reported from most of the projects in the Consumer Values sector.

(a) Food Safety/Aflatoxicosis

Because of the priority accorded to this topic a major fraction of the resource was invested to address food safety. Three areas of activity occurred addressing: 1) management of contamination (COR158, AUB163, UGA145, VT134, UF155 and UGA122); 2) consequences of exposure (UAB14), and 3) prevention of human exposure (TAM149, UGA145). In addition the nutrition project (UGA 122) and food processing projects (UGA127, UGA165, and UGA166) described above extend the management of this problem to provide safe foods in the market place.

The measurable impacts from this program sector include: (1) technologies to decrease exposure to aflatoxin contamination; (2) health and food policy changes relating to Aflatoxin-modulated health risks; (3) increased social awareness for aflatoxin risks; and (4) increased gender equity. There are eight projects focused on food safety/aflatoxicosis (COR158, UAB148, UAB163, TAM149, UGA145, VT134, UF155 and UGA122), the last two being associated projects.

Management of Contamination

Aflatoxin contamination of peanuts during the on-farm production and post-harvest handling - storage, processing and marketing chain is a worldwide, especially in developing countries, financial and/or health risk. Financially, the problem is quality loss and waste of produce; and for health issues, findings include nutritional and immunological effects and the associated modulation of infectious diseases, including HIV. Through this effort Peanut CRSP has elevated aflatoxin to an international development issue. USAID, the African Union and major development interests now are addressing aflatoxin as a priority. The Peanut CRSP goal is to minimize aflatoxin contamination in the food chain that would impact health and market economics. The Peanut CRSP is progressing well in the health aspects due to some breakthroughs achieved by food safety projects.

Achievements

Capacity for estimation of food based aflatoxin exposure was established in Uganda, Kenya, Haiti and Ghana. With this capacity, aflatoxin contamination data were generated for peanuts and peanut butter in these countries. Previously, the aflatoxin contamination data and peanut consumption data determined in Uganda were utilized by the Uganda National Bureau of Standards (UNBS) to set maximum limits (MLs) for aflatoxins in peanut and peanut based products. Also in this country, Hazard Analysis of Critical Control Points (HACCP) plans for reduction of aflatoxins in peanut-based food and Information, Education and Communication (IEC) materials on management of aflatoxins in peanuts were developed and communicated to stakeholders. This effort was continued during this phase and has resulted in improving quality of many marketed foods in Uganda.

Projects established aflatoxin management strategies and evaluated them for their effectiveness. In Ghana, there was increased awareness among project participants in the peanut marketing chain on effects of aflatoxin contamination on peanut profitability. This led to farmers increasing adoption and use of improved storage facilities along with disinfecting them after each use. In Guyana, Grainpro™ storage systems (airtight durable storage bags to prevent moisture accumulation and insect damage) are being supplied to selected villages to ensure reduction in aflatoxin contamination and improved profitability.

Prevention of Exposure

Two main options are available to prevent exposure of people to aflatoxin. Peanut CRSP has worked both to improve the regulatory approach and to address the protection of consumers where the regulatory approach is not a viable option. The standard approach to preventing exposure is the regulatory paradigm. In Uganda, the CRSP has continued to work with the Bureau of Standards to define and improve the enforcement of sanitary standards. Part of this has been achieved through the development of rapid, non-destructive measurement of aflatoxin in peanuts using Fourier-Transformed Infra-red Reflectance; and in part by training processing companies in Kampala in the HACCP needed for aflatoxin.

Where food security is not assured people consume aflatoxin contaminated foods despite the risk of exposure. Studies on exposure generally demonstrate that the majority of people in Africa are exposed and for this situation the Peanut CRSP has worked to provide a mechanism to protect people despite uncontrollable contamination. The basis of this has been the decision to transfer to human use the sorption technologies so effective in the animal-feed industry. This initiative is unique to the Peanut CRSP and is on track to be exploited as countries recognize the need for immediately available interventions.

A really important discovery by the Peanut CRSP has been that NS is also effective and provides protection for animals and humans against a second mycotoxin (fumonisin), which is predominantly found in maize and has been connected by the Peanut CRSP with the transmission of HIV in Africa.

Achievements

Consequences of Exposure

Association was found between aflatoxin exposure and health status. In Ghana, a research team established the association between aflatoxin B1 exposure levels in pregnant women and birth outcomes, and anemia. It was found that 100% of the women had aflatoxins - albumin (AF-ALB) in their blood. With regard to birth outcomes, pregnant women with aflatoxin levels in the highest quartile were twice as likely to have low birth weight infants when compared to women in the lowest quartile. There was a trend of increasing risk for low birth weight with increasing aflatoxin levels. This association remained after adjusting for known confounders, including malaria parasitemia, anemia and worm infections. Aflatoxin also increased the odds of pregnant women developing anemia in pregnancy, with an 85% increase from the lowest to very high category, which suggests that the prevalence of anemia among these pregnant women is associated with AF-ALB levels in their blood.

Results suggested that HIV-infected individuals exposed to aflatoxins in the diet may experience faster progression to AIDS. The intensive, multifaceted studies at clinical and immunological levels along with disease progression over time are proving extremely important in understanding these relationships and should allow development of appropriate and targeted strategies to decrease the rate of progression of HIV disease in infected people.

All projects in the Consumer Values program sector have a capacity development component to ensure sustainability of the Program. One project developed a short-term biomarker of aflatoxins exposure (AFM1) and fumonisin exposure (FB1) in urine. Early career researchers from the HCs are being trained in the use of this technology in a M.Sc. degree program.

(b) Nutrition

Nutritional issues for the developing world are evolving and becoming bi-modal. As important as the problem of under-nutrition is in developing countries, it is also apparent now that peanut has a powerful role/opportunity in the emerging epidemic in these countries associated with poor-quality/over-nutrition (non-communicable diseases and obesity) just recognized by the UN.

Peanut is an important nutritional and health-giving food grown over much of the developing world, but research to make this evidence-based and exploit this potential has been neglected. Documentation of the positive nutritional aspects of peanuts remains an important priority for Peanut CRSP to promote increased consumption of peanut and peanut products, thereby promoting public health, the market demand for, and profitability of this crop for farmers.

Nutrition research in an earlier phase documented that peanuts are a heart-healthy food, and because of a satiety factor do not promote weight gain, important for developing countries where these nutritionally modulated health risks have become as important as under- and mal-nutrition. In addition, research has been supported to produce and test new types of nutritional and aflatoxin-free RUTF (Ready to Use Therapeutic Foods) for other vulnerable groups, successfully feeding high risk populations of malnourished adults, young children and infants.

Achievements

The measurable impact in this area are: (1) increased knowledge and value attached to peanuts for their health properties, (2) use of local nutrition sources to address nutritional needs of vulnerable populations and (3) research is also expected to improve gender equity. There are two projects focused on the nutrition aspects of peanuts (UGA122 and PUR151).

In Brazil, nutrition studies by PUR151 show that inclusion of peanut butter with breakfast helps control appetite and blood sugar in obese women. Data documenting the mechanisms that account for these findings are helping to reinforce the role peanut ingredients play. Also evidence shows peanuts consumed in moderation do not pose a threat to weight gain allowing the recommendation to consume, in moderation, peanuts and/or peanut products. The improvement of the market perception of the healthiness of peanuts is key to expanding their consumption in the U.S. and worldwide. Preliminary analyses show in U.S. and Brazil studies that peanut consumption was associated with marked reduction in blood pressure. Cardiovascular disease is a pressing health problem globally. If this work is confirmed, this will create a strong demand for peanuts and peanut products globally and would be a key contribution of Peanut CRSP research studies.

UGA122 is seeking to improve nutrition, expand economic activities and expand the demand for peanut by developing low viscosity drinkable RUTFs). Use of RUTFs is presently limited by the cost and dependence on expensive, imported ingredients. These highly nutritious and easily digestible, formulations have been developed in Ghana and Uganda. In Ghana, the formulation is made with peanuts, cowpeas and rice ingredients, major crops in this country. In Uganda, a number of crops, peanuts, amaranth, orange-fleshed potatoes, cowpeas, sesame, corn millet, sorghum and bananas are included. The nutrient-rich and microbial safe, stable-long shelf life foods are fortified with vitamins A, C, and zinc and iron. The physical (functional), chemical (including essential amino acids), energy and sensory properties of the formulations meet international food and nutrition standards for special groups (HIV, pregnant/lactating women, etc.).

Addition of probiotic cultures and NS clay to remove aflatoxin contamination is being studied for additional nutritional quality. Under the direction of a nutritionist, test-feeding studies of the RUTF formulations are underway. Projected outcomes are to help resolve malnutrition issues affecting adults, children and infants due to food shortages, food insecurity, conflicts, and infectious diseases including HIV/AIDS.

D. Capacity Development

The second product of Peanut CRSP is capacity development. A wide range of activities have been included from Ph.D. and M.Sc. degree programs for both U.S. and HC participants, institutional development for research and technology transfer and development of partnerships, especially with the private sector and non-government and civil society organizations such as women's groups. The Peanut CRSP continues to build the capacities of its continuing partners that were improved during the earlier phases of the Program. If funds were increased for capacity development, these achievements could be expanded. The focus in this current phase is the development of the capacity of researchers and practitioners on processing, value addition and market access and in reducing health risks such as aflatoxin contamination and improvement of

Achievements

human nutrition, especially among children and infants. The report collects the data for the first three years where recruitment of students was happening, and where uncertain funding discouraged the projects from making commitments to long-term students.

(a) Human Resource Development

Long-term Degree Programs

The long-term advanced degree program remains an important component of capacity building for researchers and scientists in the Peanut CRSP; 18 or 75% are coming from partner HC institutions. At this mid-term period of the project, 24 students (80% of the planned total scholars) are pursuing their degree programs in the U.S. and HC universities. Seventeen students, (71%) are pursuing their M.Sc. degrees while 7 (29%) are pursuing Ph.D. degrees. The majority (71%) of the students are pursuing specialized topics related to Consumer and Social Values (health, nutrition, social and gender), which is a dominant focus of the current phase of the Peanut CRSP. Because of the difficulty of foreign students to obtain student visas to the U.S., many scholarship slots for degree training have been converted to HC universities.

Short-term Non-Degree Training

As in the past, many technicians, laboratory assistants, researchers, extension and health workers and others have undergone short-term training both in the U.S. and HC universities. As of mid-term, about 41 staff had been trained by the Program on laboratory analytical techniques, research methodology, extension methods, and other areas related to the projects.

Training of Practitioners

The main focus of the training of practitioners are the collaborating farmers (422 were men and 201 were women) on various topics related to the technologies being transferred resulting from the various projects completed. Training of processors, traders, marketers, consumers and other people in the peanut value chain have also been completed. Focus was also given to the publication of media materials such as farmers' brochures, researchers' technical guides, training materials, and to support radio and TV programs. Some examples include:

In VT134:

- Extensive training of women on aflatoxin hazards in foods in Uganda.
- Held a HACCP workshop in 2010 in cooperation with Kenya Bureau of Standards for 19 traders and processors from Nairobi on food safety of peanut products.
- Distributed 1500 PCRSP calendars and 2000 booklets to farmers and extension agents in four districts in Uganda that made them aware of practical activities for aflatoxin management

In NCS131:

- Trained 91 farmers in production practices in 2008 using farmer field school methodology;
- Trained 40 farmers (15 women and 25 men) in IPM practices in 2009;.

Achievements

- Trained men in the fabrication of a sheller to relieve farmers of labor from increased production in four villages in 2010, which is 50 fold more efficient than hand shelling; and
- Trained 30 farmers (6 women and 24 men) on IPM in 2010.

In NMS 172 & UGA 136:

- Trained 63 farmers on Valencia peanut production using FFS in Uganda;
- Held radio talk show extension events 8 times;
- Trained 6 farmers groups trained on rosette virus management; and
- Set up demonstration plots of improved varieties at Source of The Nile Agricultural Show.

(b) Institutional Capacity Development

Transportation provided for our partners to visit farm sites was critical to the program in Burkina Faso, Ghana and Uganda. Upgrades of buildings and lab equipment were supported in Haiti, Guyana (together with the USAID Mission), NASARRI, Ouagadougou University, Noguchi Memorial Valencia peanut proMedical Research Institute, and Makerere. The provision of equipment and building infrastructure has been limited, but where it occurred it was important to the achievement of the objectives in several projects. Through another NGO in Guyana (Full Belly Project), UF155 provided threshers, shellers and sorting machines for demonstration and use by the local growers and traders for preparing marketable peanuts. COR158 also provided some upgraded equipment at ILRI in Kenya for aflatoxin analysis.

E. Cross-Cutting, Analytical and Information Aspects

Across the Peanut CRSP, information transfer is achieved through multiple media and venues. A factor contributing to the success of Peanut CRSP has been the proactive information transfer of its ongoing program developments. The Management Entity (ME) has always been forward reaching in supporting work to use the Internet for worldwide communication among project PIs and their collaborators and partners. This includes Annual Reports, peanut journal publications, meeting presentations, training and news links, etc. In addition to the scientific community, users include industries, policymakers and the consumers.

As part of advancing communication technologies to strengthen the outcomes of Peanut CRSP goals, efforts are supporting the analyses of not only the scientific impact but the impact of these studies on social benefits, especially helping vulnerable groups. This will encourage project designs that work with in the whole value chain for production, processing and marketing of quality, safe and nutritious peanut and peanut products, and showing how the lives of people are improved both health wise and economically.

There are two cross-cutting projects (UGA124 and UGA128). The measurable impacts from this program include: (1) knowledge developed and applied to peanut development and problems; (2) networks of peanut researchers/practitioners supported or created around the world; (3) impacts assessed; (4) knowledge relevant to policies generated through analysis and published; (5) policy changes recommended; and (6) policy changes adopted.

Achievements

A worldwide web-based Peanut Information Network System (PINS), <worldpeanutinfo.com>, was initiated in 2007 to share ongoing information developed worldwide by the Peanut CRSP on peanut organizations, publications, training programs, production practices, peanut-based foods, results of meetings and workshops and related news links. Matching funds have been received from donors to support the PINS (including from the Georgia Peanut Commission for the Hot Topics workshop). The PINS has about 18,000 visits and over 47,000 hits annually from people all over the world. .

The achievements of Peanut CRSP continually generate social benefits and impacts positively on vulnerable groups including poor households and female family members. A new effort was initiated in 2010 to specifically document the impact of ongoing research three in selected HCs, (Bolivia, Ghana, and Uganda). Some studies initiated are household surveys in Ghana and Uganda to determine the benefits received by the poor, medium and rich farmers and women-headed households from the Program. This opportunity allows participating PIs to include in the outcome of their research not only the science but also the impact on the lives of the people involved in the peanut value chain. This will include influencing the interests of policymakers. This project holds the key to determining if Peanut CRSP projects are successful in meeting the objectives for which they were funded.

The ME also has an information and analytical role. Analysis by the ME focused on the socio-economic impacts of the Guyana peanut value chain project and on the role of mycotoxins on public health. In a widely reported (BBC, Reuters) publication the connection between maize consumption and HIV transmission in Africa was discovered, providing a new potential intervention in the HIV epidemic. This was an unplanned result emerging from analysis seeking to document the connection between infectious diseases and aflatoxin-prone commodities.

IV. Partnership Development and Contributions

The collaboration between U.S. universities and their partner HC universities and research institutions remains strong and successful. Added to this core was an expanded network of links to other development players and stakeholders, without which the Peanut CRSP would not have the impact that it has achieved.

Partnership with Universities and Ministry Institutes

The base of the current phase of the Peanut CRSP consists of 11 collaborating U.S. universities that lead projects and cost share in financial support. There are nine participating HC universities and eight ministry institutes in Central Africa, East Africa, West Africa, Latin America and the Caribbean. In the past, other universities and institutes in Asia, Central Asia and Eastern Europe also participated in the Program.

Partnerships with Research Institutions

The partnership with ICRISAT, an international research institute with a center in Malawi and UGA136 resulted in the sharing and testing of germplasm with rosette virus resistance. The collaboration of VT134 with ICRISAT/Kenya supported the aflatoxin work in Kenya. The linkages with ICRISAT and the KARI have resulted in the identification of breeding materials with potential resistance to diseases. The ME has collaborated with FARA, CAADP, IFPRI and the Gates Foundation to determine their involvement and approach to the aflatoxin issue.

Partnership with Governments, Ministries and Bureaus

The Peanut CRSP ME has worked to inform Governments of the importance of aflatoxin. Some of the key partners of the Peanut CRSP in the HCs are government Ministry of Agriculture, Ministry of Health, and government research and support institutions. They are in the dissemination of information and technologies resulting from the research carried out by the various projects and in the training of farmers and other users. VT134 works with the Ugandan National Bureau of Standards (UNBS) for establishment of aflatoxin standards in peanuts and peanut-based products, and HACCP (Hazard Analysis of Critical Control Points) plan and accreditation of processors and traders. The HACCP adoption effort in Kenya has had the cooperation of KARI (Kenya Agricultural Research Institute) and Kenya Bureau of Standards.

Partnerships with U.S. Private Sector

The Private Sector Peanut Commissions in the states of Georgia, Florida, North Carolina and Texas have consistently supported Peanut CRSP in the past and continues to leverage funding to support research and product development. They provide feedback on the Peanut CRSP technologies and promote these to producers, processors and consumers. Peanut CRSP also has close relationships with the Peanut Foundation, Peanut Institute and the American Peanut Council. A further partnership developed by the Peanut CRSP has been with GrainPro who

Partnerships

produce and market drying and storage systems. Peanut CRSP projects have had systems donated by GrainPro to test their ability to control storage issues. CRSP literature has been used by GrainPro to promote the need for improved storage and drying.

Partnership with NGOs

Peanut CRSP projects have been encouraged to achieve impact thorough partnerships with local NGOs. This partnership is natural since these development partners are seeking technologies to extend while the Peanut CRSP generates technologies and new knowledge.

V. Comment on the Administrative Environment

The EET team did not evaluate the Administration of the Peanut CRSP. This section is a narrative written by the Management Entity to establish the administrative and funding background to the technical program which was the focus of the review. A significant aspect of the achievements of the program has been the process and policies implemented by USAID, the ME and how participating individuals and institutions have responded. The feedback of PIs to the ME is discussed in Appendix 5.

The RFA for the Peanut CRSP released by USAID defined a number of adjustments to the traditional operation of the CRSP. The program also responded to recommendations included in the External Evaluation report from the previous phase in the application the UGA submitted. Some of these changes have proven difficult and detrimental and these aspects should to be modified in an extension to allow more efficient management of technical activities.

Background

The Peanut CRSP administrative unit is composed of a Director, supported by an associate director, administrative assistant, a web programmer/information management agent, and an accounting staff. The associate director was added after 18 months of this phase. The past/retired Director is rehired on a part-time basis for special activities.

The RFA was released by USAID at a time when the Administration and Congress were not in agreement about the need for and funding of agricultural programs. BIFAD and Congress were urging increased resources in this area (both were urging CRSPs be funded at \$3 million annually, while USAID planned this at \$1.6 million annually). At the time of the award, Congress forced the issue with a directive to fund the CRSPs at the higher level by authorizing a line item budget for the CRSPs. The UGA application was designed about a target of \$3 million per year with a second set of budgetary numbers at the \$1.6 million level.

Changed Conditions, Policies and Procedures, and their Consequence

As a result of changes by USAID and the RFA the following changes occurred:

- The award was made as a Leader with Associates (LWA) Cooperative Agreement (CA), as opposed to a grant, which was the previous agreement model.
- UGA reacted to the CA by increasing the number of decisions referred to USAID. USAID has often not been responsive to these requests for approval and administrative transactions and decisions have been slow or not happened.
- As part of the Award agreement, the fiscal management was to be on a cost reimbursable basis. This change precluded the possibility of managing research activities at host

Constraints

country institutions through the USAID preferred process of fixed price contracts for research deliverables.

This change greatly increased the burden of accounting on HC institutions, and where multiple projects were located at a single accounting office this has hampered accounting and prevented activities since the processing of funds was not happening on a timely basis. This also had a knock on effect in that the pipeline seemed always excessive and commonly needed explanation.

In the ME's response to the RFA and as instructed no provision for external assessment and impact was initially planned. An external technical advisory panel was planned to evaluate project proposals and if needed to evaluate performance of projects.

Funds for external advisory services were inadequate; the Peanut CRSP Board recommended that the ME undertake this review because it was not clear that USAID would undertake an evaluation of the program in a timely manner to allow the question of an extension to be based on some review.

After two years, in response to the Congressional mandate, USAID required that the program be revised to include activities to justify the increased ceiling. Included in this revision was an instruction to adopt a standard set of indicators.

The introduction of a second set of performance indicators has increased the burden on the ME and PIs. Over performance against estimated performance for the new indicators triggered a data quality audit that consumed ME resources. Achieving clarity on these indicators on the part of USAID and the PIs was also a challenge and consumed the ME for months.

As a result of the external evaluation conducted at the end of the last phase the following changes were added to the UGA application for assistance:

- UGA would manage awards to host country institutions according to the INTSORMIL model where a leading Institution in major hubs of activity managed the distribution of funds to local participants. A large single award is made to the institution with instructions as to its distribution to the individuals participating. This model had been used by the Peanut CRSP historically where large awards to U.S. universities were distributed to the participants but increased the time for funds to reach HC institutions.
- UGA partially implemented the model that they undertook to manage the financial distributions to all host country institutions, which decreased in theory the time for funds to be awarded and incremented to the partners of the Peanut CRSP. However, the consolidation of the awards to a single award made to leading institutions in HCs was not agreed to so the ME ended up administering a very large number of small awards, often with multiple distinct awards to a single accounting office. This added to the burden inside those offices, but assured UGA that the accounting was accurate, all be it very burdensome. Change in the approach and implementation is clearly needed and should be requested as a modification of the extension document.

VI. Budgeting and Financial Management

Budget Allocations

The Peanut CRSP award was initially based on USD 8.2 million over 5 years of implementation. However, the fund released in the first year was USD 2.8 million and USD \$2.1 million for the second year (see table below). These numbers were consistent with the Congressional Budget directive, but were described by USAID as forward-funding. If spent at the higher incremental funding rate established over the first two years, the program risked exhausting the funding when the ceiling was reached.

This resulted in the program having a great deal of fiscal uncertainty, and projects intended to be initiated in the second wave, after exploratory meetings with scientists in the new project sites for processor values sector, were suspended until the situation was clarified with USAID and the intent of Congress realized. Eventually, after a revision of the Program, the total budget was increased to near the design level of USD 15.0 million for five years. All the proposed projects were retained, but USAID imposed additional indicators for achievements which were not appropriate for a research program.

Comparison of planned allocation and fund released for Peanut CRSP, 2007-2012

Years	Planned Allocation (USD)	Actual Amount Released (USD)
1 (2007-8)	1,640,000	2,760,000
2 (2008-9)	1,640,000	2,105,000
3 (2009-10)	3,000,000	3,058,096
4 (2010-11)	3,000,000	3,000,000
5 (2011-12)	2,941,904	2,550,000
Total		13,473,096

Program Budgets

The total budget awarded by USAID to UGA for the first three years of Peanut CRSP (2007-2010) implementation was USD 10,451,268.66 (Appendix 2). The initial funding provided by USAID for Year 2007-2008 amounting to USD 2.7 million was close to the US Congress' Directive to fund CRSPs at a level that could provide the Program with USD 3.0 million each year. The budget is divided into the program sectors: (1) Producer Values – USD 2,965,229.72 (28.37%); (2) Processor Values – USD 639,989.58 (6.12%); (3) Consumer Values – USD 4,070,659.25 (38.95%); Cross-cutting, Impact and Information – USD 371,215.33 (3.55%); and Management Entity and Program Support – USD 2,404,174.78. The main budget items are to support projects on Producer Values (8 projects) and Consumer Values (8 projects). The support for Processor Values program sector was minimal, and not commensurate to the importance of the sector in the peanut value chain. Due to uncertainty of funding the start-up of these projects was delayed.

Budgets

After three years, a total of USD 7,780,066.15 had been spent with USD 2,671,202.51 remaining balance, part of which was already spent or committed but not yet reported by October 1, 2011.

Financial Management

The ME which is located at the University of Georgia (Athens campus) provides overall financial management at the program level. The ME is also responsible for program management. It is headed by a Program Director and supported an Assistant Director and a Management Team. Individual PIs, through their universities carry out financial management at the project level through their College and Department Financial Offices. The PIs ensure that their institutions submit the required financial of their projects to the ME. In turn, the ME prepares consolidated financial reports for submission to USAID, which are the basis for confirming the next year's budget allocation. When Peanut CRSP funds are released to a partner institution, the collaborating PI is responsible for project management and for the submission of the required financial reports through its Accounting Office.

In the past, the ME was responsible for initiating award documents using a UGARF approved template and had established a tracking system both a the ME office in UGA and the partner institutions. Some problems in accounting of expenditures resulted to major lapses in awards and modification processes. A number of implementing and partner institutions met some problems especially associated with changes in project personnel.

The ME office maintains staff responsible for accounting and financial reporting. Because of the problems met, an Associate Director was recruited in February 2010 and an additional temporary accounting officer was also recruited for 18 months.

VII. Constraints and Solutions

The implementation of the Peanut CRSP happened in circumstances that affected operations, decisions and results. The Constraints section summarizes selected problems that were identified as occurring during the 2007-2010-review phase. The EET suggests some solutions so implementation could move forward more smoothly in the remaining period.

Project Design and Expectations

Constraints:

- The expectation of impact in a three-year period is unrealistic for most projects.
- USAID-mandated indicators are not realistic for a program with a wide range of geographies and technical products. For instance breeding studies are long-term endeavors and require time to produce results with impact.
- A number of projects have too many objectives. Ambitious plans are difficult to implement, maintain progress and report impacts.

Solutions:

- An impact assessment project for Peanut CRSP should have been started at the beginning of the program so proper benchmark information are collected based on agreed sets of impact indicators.
- Project proposals should include clear and realistic key indicators and ways to collect and analyze the necessary data during implementation.
- Long-term projects, such as breeding for new varieties, should specify mid-implementation expectations.
- During proposal preparation and initial project evaluation, a rigorous review of the objectives should be made and integrate them to focus only on key areas and those that are attainable.

Research Approach

Constraints:

- High cost of clinical trials necessary to demonstrate the importance of preventing human aflatoxicosis limits the rate at which Peanut CRSP can advance towards the important goals established in this area.
- Need international approval for use (safety, efficacy) of NovaSil (NS) clay as a food additive to sequester aflatoxin is not within the *Codex Alimentarius* Commission system.
- Breeding programs to produce new varieties with specific characteristics would take time to attain results and may be beyond the timeframe of a project.

Solutions:

- Peanut CRSP has to address policy issues to get the enterosorbent approach deployed in developing countries before its application can occur. One way to address this issue is through the FAO's *Codex Alimentarius*.
- There are new breeding techniques with shortened time frames to attain the desired genetic properties in cultivated varieties. Doing these studies in HCs where the diseases

Constraints and Recommendations

under study are prevalent is an advantage in finding solutions in the field before they become an issue in the U.S.

Technology Transfer

Constraints:

- Technology transfer is the responsibility of collaborating HC institutions with Peanut CRSP providing technologies and support, hence its effectiveness depends upon the commitment of these institutions. The result is that there more technology transfer activities, hence impacts, in some HC countries compared to others.
- The capacity of local institutions and extension/health workers in HCs are not commensurate with the levels needed to implement and transfer the technologies developed from the research program, especially if it involves complex industry and socioeconomic models.

Solutions:

- Some projects are focusing more on the technology transfer aspects of the Peanut CRSP. Where there are already technologies ready for dissemination, such a focus would be relevant and should be funded by the program.
- More support should be provided by Peanut CRSP for training of trainers from HC institutions responsible for technology transfer such as the Ministry of Agriculture, Ministry of Health, etc. This should include the production of multi-media and information materials to support the new technologies.

Degree and Short-term Training

Constraints:

- Difficulty of identifying qualified and committed researchers to undergo degree programs (Ph.D. and M.Sc.) and short-term technical training.
- Limited funding from Peanut CRSP to support long-term degree programs.
- Candidates have difficulty to obtain visas to enter the U.S. for training; USAID requirements and process takes long so training programs are delayed.
- Delays in the release of funds have affected the students on training in U.S. universities.
- Uncertainty of funding limited the number of graduate students recruited for the projects. This slows development of expertise and timely continuation of interest in future advances for breakthroughs to solve the assigned problems.

Solutions:

- Increase the allocation especially for long-term degree training by agreeing on cost-sharing mechanism with partner institutions (universities, private foundations, governments) to leverage Peanut CRSP funding in the next phase.
- Identify the training candidates early to give them time to prepare the requirements including the long timeframe for obtaining U.S. visas.
- Some Principal Investigators have arranged with their own universities to provide funding for their scholars through the university's own programs.

Financial/Funding Issues

Constraints and Recommendations

Constraints:

- Uncertainty of funding and problems with transfer of funds from the U.S. to Host Country institutions slowed down project implementation process.
- Unanticipated turnover of interested collaborators in HCs, sometimes caused by lack of sufficient funding, can hamper the desired level of progress. Insufficient levels of expertise in selected areas of collaborating projects can limit progress of research assignments.
- Delays of the transfer of funds from the PIs to the HC institutions, due to imposed changes by USAID and UGA on proven systems, affecting the HC's accounting systems to deal with the new requirements.

Solutions:

- PIs exercise more diligence in identifying and selecting HC collaborators who have support and backing of their agencies and institute management teams.
- PIs and ME financial officer monitor more closely the status of submission of financial reports from HC institutions to facilitate clearing the backlog of processing financial documents.

Administrative Issues

Constraints:

- Variable and uncertain funding made planning and implementation difficult.
- Projects were changed during the third year of implementation introducing a different set of indicators and changed expectations.
- Award mechanisms relating to accounting greatly increased the burden of accounting, particularly for developing country partner institutions.
- Changes adopted by UGA had the unintended consequence of compounding the problems of accounting at national institutions.

Solutions:

- Processes and award mechanisms has to be agreed by the donor (USAID), the implementing institution (UGA) and the Management Entity at the start of implementation.
- Simpler accounting and financial systems have to be put in place before the start of the next phase. All PIs and HC collaborating institutions have to be trained on how to use these systems.

Natural Disasters/Situations:

- Negative outcomes of the 2010 earthquake in Port au Prince slowed progress of project activities in Haiti.
 - Unexpected low level of disease infection had affected variety trials for resistance to certain key diseases in the U.S. and in some HCs.
 - Flooding delayed the implementation of some activities.
- NOTE: David, can you indicate the places in the US and countries affected by natural disasters?

Constraints and Recommendations

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VII. Endorsement and Recommendations

The EET recommends that USAID extends the implementation of Peanut CRSP for the next five years (2012-2017) as per its original design. Although designed to respond to the goals of the IEHA, the program does respond strongly to FtF and has a wide range of activities where the full impact and contribution to FtF will only be achieved with the additional time available through an extension of the award. While the program has relevance to FtF, the results also have relevance to the majority of developing countries because of the aflatoxin work undertaken from the peanut platform which is relevant to any source of exposure.

This includes our recommendation for USAID to support the program with adequate funding to maximize return on investments through working on the full value chain, This holistic approach will realize the benefits of research leading to increased production and economic activity, improved nutrition and gender equity, and improved public health through reduced human aflatoxicosis.

We find that the Peanut CRSP aligns well with the expressed development objectives of the U.S. and USAID Feed the Future (FtF) program initiative. The results being gleaned from the Peanut CRSP projects provide contributions to the realization of the short-term FtF program initiative goals. Support for outreach activities and future plans that address ending hunger and improving health among underfed/malnourished populations is well justified. The outcomes being obtained or likely to result from the Peanut CRSP include developing and extending technologies to small and large farmers, commodity handlers, food manufacturers and marketers to process and market quality, safe, and nutritious foods responding to consumer preferences. Policy recommendations relating to the problem of aflatoxicosis have been realized, BUT much still has to be achieved to fully capture the benefits of these investments. In this area a disruption of the program would be particularly harmful to momentum that has been established.

The program has experienced problems associated with the fiscal/accounting conditions established for the award. The EET recommends that USAID modify the recommended extension such that a performance-based payment model, that is the recommended mode for USAID awards, replaces the present cost re-imbursement paradigm (as suggested in the ME commentary and the PI Surveys). Host Country Institutions have found this process and requirement difficult to follow and this has affected the technical achievement, particularly in Uganda and Ghana, where multiple projects are being implemented.

The EET analyzed the program relative to the Feed the Future (FtF) initiative of USAID and believe that Peanut CRSP can be further refined to correspond to FtF with relatively minor adjustments. The strong emphasis on nutrition and food security through addressing the aflatoxin in the whole diet make the Peanut CRSP and the accomplishments to date mesh well with the FtF goals.

The Peanut CRSP is compatible with the FtF research theme II (increasing food supply) by:

Recommendations

- Advancing the Productivity Frontier - cropping systems to increase productivity, expanding yield potential of crops, technology adoption by farmers through farmer training and other cooperative efforts with the Host Country collaborators, partnering with NGOs;
- Transforming Key Production Systems – models to identify production constraints, IPM systems to efficiently control diseases and insects, disease and pest resistance varieties, information transferred to farmers with many peanut farmers being women:
- Enhancing Food Safety and Nutrition – strong focus and accomplishments on aflatoxins and its effect on health/immune systems/communicable diseases, means to reduce or prevent agricultural and food safety threats from aflatoxin, at the household level making women aware of the hazards of aflatoxin in the food supply, processing systems to produce healthy peanuts will contribute to both health and income since peanut is the most readily marketable of crops.

The Peanut CRSP also responds to Part III of the FtF document that addresses Gender Equity. In addition to commonly being a crop produced, processed and marketed by women in the informal economy the Peanut CRSP also is proving highly relevant to gender-biased health concerns: by documenting how aflatoxin impacts on pregnant women, is related to low birth weights of babies and anemia in the mothers, concerted efforts to inform policy makers and women of aflatoxin hazards to health are a need for the future activities of the CRSP.

Part IV of the FtF strategic document identifies the need for ‘Accountability and Impact’. The Peanut CRSP broadly is progressing in accord with key indicators developed in the documents for the 2007-2012 phase. Examples of impacts, such as the deployment of the rosette virus resistant varieties released in Uganda and their rapid spread to growers, which is bringing back production lost to the devastating disease, are documented.

The Peanut CRSP is working to better document the high order impacts needed for FtF but it should be noted that the intensive monitoring required on an annual bases leaves of a number of impacts undocumented.

Project Specific Impacts and Observations

The preceding programmatic sectors have illustrated some of the key achievements of the 2007-2010 timeframe of the Peanut CRSP in an integrated thematic fashion. This section, Section 1, describes individual project references and achievements that have particular value to the Host Countries and across regions. Section 2 describes achievements that have special value to the United States. As already mentioned, detailed evaluation reports of individual projects are included in a separate volume as part of this EET Report (Annex 3). The evaluation reports are also available in the Peanut CRSP website (www/peanutcrsp.org). In addition, the Annual Reports of individual projects, which were submitted to the EET, are also available at the Peanut CRSP ME office (Annex 1).

Section 1. Host Country Values

Production Values

TAM 137: Overcoming Abiotic and Biotic Constraints to Yield and Production of Quality Peanuts in West Africa and Texas

Overcoming multiple constraints and transferring these new technologies on yield and production of high quality peanuts in West Africa and Texas have been the objectives of this project, which is a continuation from earlier phases of the Peanut CRSP. Materials with field measures of improved drought tolerance were found in Texas and crosses are underway to introduce drought tolerance into cultivars from Africa. Early maturing, high-oleic runner peanuts are set to be released for the Texas market and progress is now being made in germplasm improvement in Senegal, Burkina Faso and Ghana.

Crosses to transfer high oleic traits from wild species have been successful. The results are hybrids with alleles closer to cultivated peanuts. Six accessions from previous evaluations were selected and increased for new underway regional trials of leaf spot-resistant materials with improved yields. Seed multiplication is a primary objective of the Senegal peanut breeding program. The Peanut CRSP, ISRA and the NGO –ASPRODEB are cooperating to improve seed multiplication and distribution to farmers of both new and formerly released cultivars, which include seven cultivars developed in Senegal with Peanut CRSP assistance that now occupy about 400,000 ha of production. Seed multiplication for farmers is basic to the growth and profitability of the peanut sector.

UGA136: Strategies for Controlling Groundnut Rosette Disease in Sub-Saharan

Africa Groundnut rosette disease (GRD) causes the greatest yield losses of the peanut viral diseases in Sub-Saharan Africa, including Uganda. This affects economic status of small holder farmers and food manufacturers, and in turn the nutritional needs of the populations. The breeding program has developed and released two new cultivars in 2010 that have farmer, processor, and consumer acceptance. The cultivars are Serenut 5R and Serenut 6T with resistance to GRD, early leaf spot disease and drought tolerance. Seed increase programs of the desirable cultivars are underway and seeds are being disseminated to farmers. These cultivars

Project Specific Observations

will help reach a more full adoption of GRD resistant cultivars grown in the country, and will complement the release in the earlier phase of the three GRD resistant cultivars.

An impact study shows the three earlier cultivars occupy over 60% of the production area and when fully adopted will add \$47 million per year to the economy. Demonstration plots, field days, seed fairs and participation in agricultural shows, exhibitions, radio talk shows, workshops and seminars throughout Uganda are educating the farmers in the agricultural practices needed for production of these new cultivars. Seed of rosette resistant cultivars for multiplication and use by farmers are being shared with Ethiopia, Sudan, Rwanda and other East and Central Africa countries.

UF150: Breeding Peanut for Disease Resistance Valuable to Latin America, the Caribbean and the United States

This project used wild peanut relatives in breeding programs producing rust and leaf spot resistant peanut germplasm and cultivars. The gene pool of wild species is strong in resistance to many plant diseases. This team of scientists has been successful in bringing these genes into cultivated plants, which is a major step forward in breeding programs working with wild species. The result is two lines displaying little or no rust and very little leaf spot diseases. If confirmed in field test studies in Bolivia where a history of these diseases exist the results will significantly accelerate development of resistant cultivars and greatly improved peanut production.

NMS172: Global Valencia Peanut Niche Market Development Program

Valencia peanuts are a niche, in-shell, market crop growing three or more peanuts per pod and having a sweet attribute, and were a preferred type in Uganda, but diminished in production because of susceptibility to groundnut rosette disease and other diseases. The project has a goal to reintroduce and expand Valencia production. Genetic diversity was shown in the molecular characterization of 114 Valencia peanuts (78 accessions from the U.S. Valencia core and 35 accessions from global mini-core and one control cultivar from ICRISAT) representing various geographical regions of the world. This genetic diversity is being used in breeding Valencia cultivars for higher yields, drought resistance and reduced diseases. A study growing 80 plant introductions from the U.S. Valencia core collection using full and limited irrigation showed eight that performed better under limited irrigation conditions, a major development.

UF157: Systems Approaches to Enhance Peanut Production Under-Resource Limitation

In Burkina Faso and Ghana, systems approaches to enhance peanut production include use of new herbicides and fungicides, optimizing use of hand-weeding relative to herbicides use and using enhanced spraying equipment. Multi-location peanut cultivar trials under Peanut CRSP sponsorship show that fungicide use results in 70% pod yield increases and improve labor productivity even without herbicide use because production is a higher value.

UF155: The Development of the Peanut Sector for Guyana and Selected Caribbean Countries

Protocols were established in Guyana for on-farm packaging, inventory, insect control and aflatoxin assessment to ensure that peanut quality is maintained during handling and storage to processing of peanut butter, including the construction of state-of-the-art storage and processing facilities that address these parameters. A technical manual, with working protocols for the

Project Specific Observations

processing equipment and facilities was developed, including training of the cottage industry personnel to control aflatoxin contamination in peanuts through to manufacture of peanut butter. The outcome is the growth of the cottage industry from seven to 43 villages selling high quality nutritious peanut butter in school lunch programs and also in local sales to a consumer driven market, which brings 75 million Guyana dollars annually into the local economy. Production research to maintain a flow of produce to the market is a component of the project but has been hampered by weather and other factors. In Haiti, work was initiated to improve farming practices, and reduce aflatoxin contamination in peanuts. A production guide developed, produced and distributed in Guyana was translated into Creole and distributed in Haiti.

UCN 139: Improving Livelihoods of Farm Households in Peanut-Based Farming Systems in East Africa

The objective of this project is to improve the likelihood that households will be successful in using the technologies of peanut-based farming systems in East Africa, Uganda and Kenya. The challenges include instituting ways to bring research developments, via training and technology transfer, for better farming practices to conserve soil fertility, promoting advances for increased yields, adding value by improving quality to enhance market expansion, and in doing so, raising peanut output because of increased demand and strengthening participation by women in agricultural programs to the farming communities. Training workshops and application of surveys to gather baseline data on farm practices are underway. The U.S. and HC PI's have gained greater insight into working with colleagues/teams and communities in both Kenya and Uganda. There have been lessons learned on the implementation of peanut farming systems in both locations which will benefit expanding efforts in Uganda and Kenya and other geographical locations.

NCS 131: Improved West African Peanut Production for Enhanced Health and Socio-Economic Status through the Delivery of Research-Based Production Systems in Ghana

Pests decrease yield, quality and safety of peanuts for farmers and consumers. The work of this project is identifying, documenting and strategizing ways to minimize their impact, especially in regards to aflatoxin contamination in the field during harvesting, handling and storage. Via multidisciplinary research efforts, some U.S. information is transferred to Ghana, has ameliorated the effects of diseases and insects. IPM practices impact production systems and produce effective, efficient and minimal pesticide use, including application practices that protect workers, the environment and food supply. Two new cultivars should be released in Ghana in 2011, which have greater drought tolerance, and are more competitive against weeds, produce higher yields and are less susceptible to leaf spot and rust. They also produce a consistent level of yield under varying environmental conditions. The result is control of *Aspergilli* fungi (source of aflatoxin) contamination due to soil pest damage of developing pegs, pods and seeds inside pods.

The introduction of the NGO-Full Belly Project peanut sheller has relieved the burden of hand shelling which should result in increased production through increased planting acreage and better timing of marketing. The quality of peanut in the market is greatly improved with less damage and aflatoxin contamination. The use of planting in rows, germination testing, leaf spot control and timely harvesting are four technologies adding to production, processing and

Project Specific Observations

marketing vastly improving Ghana's peanut industry, and have been extended to farmers through Farmers Field Schools. Recent socioeconomic studies and a current study document the economic impact of increased cost effective peanut production in Ghana.

Project Specific Observations

Processor Values

Due to the fiscal uncertainty over the first 30 months of this agreement release of projects in this area was delayed until clarity was achieved and the program was assured expanded funding. Thus these projects have only just been initiated and their achievements need to be considered within the context of that late start.

UGA127: Enhancing the Peanut Value Chain, from Processing to Marketing of Peanuts and Peanut Products-Processing, UGA165: Enhancing Peanut Value Chain, from Processing to Marketing of Peanuts and Peanut Products-Economics, and UGA166: Enhancing the Peanut Value Chain, from Processing to Marketing of Peanuts and Peanut Products-Product Development

A suite of three projects (UGA 127, UGA 165 and UGA 166) was established by the University of Georgia PIs as a University of Georgia Global Peanut Product, Processing and Marketing Team (UGAGP3MTeam). The Team established a seamless communication web-site uga_gp3mt@gmail.com. The goal is to transfer their Peanut Industry Incubator Model (PIIM), a successfully developed Peanut CRSP funded project in Southeast Asia (in the Philippines and Thailand), to East and West Africa, Uganda and Ghana. The Southeast Asia work included proven successful handling, storage and sorting methods, farm to market, resulting in new and existing aflatoxin-free peanut foods processed by both small and large food manufacturers.

The HC collaborating PIs in Ghana and Uganda were identified. Based on questionnaires plans were made to develop three nutritionally enhanced foods, vitamin A fortified and stabilized peanut butter, stabilized peanut butter and chocolate - peanut butter spread. Information from the Southeast Asia program and published in Peanut CRSP Monographs and in scientific journals will be used. Identification of potential marketing opportunities for these peanut - based products is continuing with survey instruments, including questionnaires to find out what peanut foods are of most interest to the consumers. In addition, the project has identified nutritious peanut cookies and fiber-enhanced peanut butter and peanut soup. The importance of the surveys is building a baseline, a market-pull emphasis of consumer desires, working with the food manufacturers. The surveys involve more than 1000 households in both Ghana and Uganda directly identifying market opportunities for new and modified peanut products.

Consumer Values

(a) Aflatoxin

COR158: Innovative Procedures to Protect Therapeutic Foods from Aflatoxin in Developing Nations

In Haiti, Peanut CRSP supported development of specialized equipped laboratories, trained technicians and implemented farm to market processes in a special coordinated effort to sort and monitor from field to processing removal of damaged -- high aflatoxin contaminated peanuts. Aflatoxin levels of peanut acquisitions were studied for 24 months. Blood samples taken from a clinic indicated that adults were ingesting aflatoxins. The results of the aflatoxin training produced high quality peanuts with aflatoxin profiles at reduced levels to below U.S. and European standards (5ppb) in peanuts and peanut products. The process enabled the NGO-Meds and Foods for Kids to reduce in like manner the aflatoxin content in their peanut-based RUTF (Ready to Use Therapeutic Foods), Medica Mambo. The results are reversing childhood malnutrition in thousands of children with a product that does not suppress immunity, interfere with nutrient absorption, and cause liver cancer.

The process began of contacting manufacturers to offer advice on product improvement. A compliant manufacturer in Cap Haitien used acquisition and sorting techniques learned at our collaborating RUTF manufacturer, a small indication that techniques are and will be transferable. Work delayed by the earthquake will continue to determine the extent of aflatoxicosis in pregnant women seeking testing in AIDS clinics, which suggests a nutritional approach to HIV intervention. Although also delayed by the January 2010 earthquake, urine samples have been taken from children to study aflatoxin levels in malnourished children.

UAB148: Association of Aflatoxin Biomarker Levels with Health Status and HIV Disease

Association was found between aflatoxin exposure and poor health status. In Ghana, the research team established the association between high and low aflatoxin B1 albumin (AF-ALB) levels in pregnant women, birth outcomes and anemia. It was found that 100% of the women had AF-ALB in their blood. With regard to birth outcomes, pregnant women with aflatoxin levels in the highest quartile were twice as likely to have low birth weight infants when compared to women in the lowest quartile. There was a trend of increasing risk for low birth weight with increasing aflatoxin levels. This association remained after adjusting for known confounders, including malaria parasitemia, anemia and worm infections. Aflatoxin also increased the odds of pregnant women developing anemia in pregnancy, with an 85% increase from the lowest to very high category, which suggest that the prevalence of anemia among these pregnant women is associated with AF-ALB levels in their blood.

Results suggested that HIV infected individuals exposed to aflatoxins in the diet experienced faster progression to AIDS. The intensive, multifaceted studies at clinical and immunological levels along with disease progression over time are proving extremely valuable in understanding these relationships and allowing development of appropriate and targeted strategies to decrease the rate of progression of HIV disease in infected people. A short-term biomarker of aflatoxin exposure (AFM1) and fumonisins exposure (FB1) in urine was developed with cooperation of

Project Specific Observations

AUB 163: Aflatoxin Financial and Health Risks Along the Peanut Marketing Chain in Ghana

In Ghana, aflatoxin management strategies for peanuts during storage were implemented and evaluated for their effectiveness. The findings showed there was increased awareness among project participants in the importance of quality peanuts in the marketing chain, i.e., the effects of aflatoxin contamination on peanut profitability. Interest was generated only with the assurance of improving profits. This led to an increased adoption and use of improved storage facilities and many farmers disinfecting their storage facilities. These findings also sent out important signals to policy makers and agricultural officers on policy formulation to encourage fabrication of efficient and affordable storage structures and to adopt improved storage techniques to reduce aflatoxin contamination in peanuts.

TAM 149: Entrosorbent Intervention Therapies for Population at Risk for Aflatoxin-Related Diseases

To evaluate aflatoxins management strategies, investigators used both animal and human feeding trials to evaluate the safety, effectiveness and acceptability of a refined Novasil (NS) product for reduction of aflatoxin exposure in the diet. The investigators first compared effectiveness of edible clays available in Ghana with those from the U.S. and found that U.S. clay is the best binder of aflatoxins. Studies demonstrated that Uniform Particle Size (< 45 μm) NS (UPSN) is more desirable and safer for use in three month human and animal intervention feeding studies of aflatoxin exposure than NS. It was found that UPSN contains lower levels of dioxins and furans, and can be delivered successfully in common food, and was decreasing the bioavailability of aflatoxins. Both animal and human feeding studies indicated that dietary inclusion of UPSN at levels as high as 2% (w/w) does not result in overt toxicity. Dietary studies on long term digestion are ongoing and should further confirm these results.

UGA 145: Development of Methods of Establishing a Global Network for Aflatoxin Exposure

The biomarker analysis technology previously developed used to determine aflatoxin biomarker levels in blood serum from subjects in West African countries, Burkina Faso and Ghana. The technology is a highly sensitive, non - antibody, non - radioactive and non - mass spectrometry based analytical method for rapidly measuring, at low cost, serum and urine aflatoxin B1 (AFB1) - lysine (AFB-LYS) and fumonsin (FN) biomarkers using HPLC technologies. One of the novel achievements of the project is the establishment of the capacity for estimation in food, as well as biomarker based, aflatoxin and fumonisin exposure at the Noguchi Medical Research Laboratory, in Accra, Ghana.

VT 134: Improving the Health and Livelihood of People in East Africa by Addressing Aflatoxin and Gender-related Constraints in Peanut Production, Processing and Marketing

Capacity for estimation of food- based aspergilli fungi growth and aflatoxin contamination were established in Uganda and Kenya. With this capacity, aflatoxin contamination data were generated for peanuts and peanut butter products on farm, and at the processor and market place in these countries. The aflatoxin contamination data and peanut consumption data determined in Uganda were utilized by the Uganda government agency responsible for standards (UNBS) to set maximum limits (MLs) for management and control of aflatoxins in peanut and peanut products.

Project Specific Observations

In both countries, training processors and traders on Hazard Analysis Critical Control Points (HACCP) was conducted through workshops and the technology implemented for reduction of aflatoxins in peanut based foods. Information, Education and Communication (IEC) materials on management of aflatoxins in peanuts were developed and presented to stakeholders through farmer meetings and distribution of informational materials with the assistance of a key women's organization. Large numbers of people were made aware and trained in aflatoxin associated problems and management each year of the project in both countries.

UF 155 (Associated Project): See above

In Guyana, Peanut CRSP funds have assisted U.S. and Host Country (HC) PI's and their collaborators to establish on - farm packaging, inventorying, insect control and aflatoxin assessment programs to assure peanut quality is maintained during handling, storage and processing of peanut butter; this includes construction of state-of-the art storage and processing facilities that address these parameters. A technical manual, with working protocols for the processing equipment and facilities was developed, including training of the cottage industry and entrepreneurs for controlling aflatoxin contamination in peanuts through to manufacture of peanut butter. As a result, the cottage industry has expanded from seven to 43 villages in Guyana providing peanut butter for school feeding program, and because of strong market pull from the consumer has resulted in commercial sales in the villages, which create a steady income, thereby enhancing economic growth in Guyana. Over 1400 snacks were produced per day and they generate \$75 million Guyana dollars in the region per year.

(b) Nutrition

UGA 122: See above

Low viscosity drinkable pre-enzyme digested RUTF, highly nutritious and easily digestible, formulations have been developed in Ghana and Uganda. In Ghana, the formulation is made with peanuts, cowpeas and rice ingredients, major crops in this country. In Uganda, a number of crops, peanuts, amaranth, orange-fleshed potatoes, cowpeas, sesame, corn millet, sorghum and bananas are included. The nutrient-rich and microbial safe, stable-long shelf life foods are fortified with vitamins A, C, and zinc. The physical (functional) chemical (including essential amino acids), energy and sensory properties of the formulations meet international food and nutrition standards for human use. The addition of probiotic cultures and HSCAS clay (NovaSil) to remove aflatoxin contamination are planned for additional nutritional quality. Under the direction of a nutritionist, test feeding studies of the RUTF formulations are underway. Projected outcomes are to help resolve malnutrition issues affecting adults, children and infants due to food shortages, food insecurity, conflicts, and infectious diseases including HIV/AIDS.

PUR 151: Peanut Consumption and Human Weight Management

In Brazil, studies show that inclusion of peanut butter with breakfast helps control appetite and blood sugar in obese women. Data documenting the mechanisms that account for these findings are helping to reinforce the role peanut ingredients play. Also evidence shows peanuts consumed in moderation do not pose a threat to weight gain allowing the recommendation to consume, in moderation, peanuts and/or peanut products. Improving the market perception of the healthiness of peanuts is key to expanding their consumption in the U.S. and worldwide. Preliminary analyses show in U.S. and Brazil studies that peanut consumption was

Project Specific Observations

associated with marked reduction in blood pressure. Cardiovascular disease is a pressing health problem globally. If this work is confirmed, this will create a strong demand for peanuts and peanut products.

Crosscutting values- Information and Impact Analyses

UGA124: A Peanut Information Network and Train-the-Trainer Program

A worldwide web-based Peanut Information Network System (PINS), <worldpeanutinfo.com>, was initiated to share ongoing information developed worldwide by the Peanut CRSP on peanut organizations, publications, training programs, production practices, peanut -based foods, meetings, workshops and related news and links. Key are links to the Peanut CRSP research and publication sections of the Georgia Peanut Commissions (GPC), American Peanut Research and Education Society (APRES) journal, International Crop Research Institute for Semi-Arid Tropics journal, the Annual Hot Topics on Peanuts workshop, peanut - specific farming and processing equipment and manufacturers and the USDA germplasm database. Dr. S. K. Sefa-Dedah, HC, Co-PI, Ghana has been named to coordinate input from the African countries.

This project has received matching funds (\$2000) from GPC on the Hot Topics workshop and a grant (\$7500) from the National Peanut Board through the Southeastern Peanut Research Initiative on "Functionality of Peanut Ingredients in Production of Peanut Pancake Instant Mix," showing the support for this program by the peanut industry. The PINS, during one year had a total of nearly 18,000 visits and over 47,000 hits with an average 49 visits and 130 hits/day. A needs survey is underway to develop an annual Train-the-Trainer program to address peanut production, harvesting and storage practices and constraints. Because of the peanut butter recall from the Peanut Corporation of America, the focus of the speaker presentations on the Hot Topics workshop presented on PINS was on food safety, a topic of worldwide importance.

UGA128: Economic Assessment Test

The achievements of Peanut CRSP continually generate social benefits and impacts positively on vulnerable groups including poor households and female family members. The project's objectives, newly underway in 2010, collaborates with PIs to specifically document the impact of their ongoing research studies in selected HCs, Bolivia, Ghana, and Uganda. Studies initiated are household surveys in Ghana and Uganda to determine the ongoing benefits of the assigned projects to the poor, medium and rich farmers and female-headed households. This opportunity allows participating PIs to include in the outcome of their work not only the science, but also how it is impacting on the lives of the people. Their efforts will include influencing the interests of policy makers.

The research team of this project is expected to provide valuable advice to participating PIs and their collaborators on how to collect and analyze impact datasets, including the use of already available data from past projects/phases. The emphasis includes the three Peanut CRSP focus areas, production values, processor values, including aflatoxins and nutrition, and consumer values in the U.S. and selected HCs. This project holds the key to determining if Peanut CRSP projects are successful in meeting the objectives for which they were funded.

Section 2. Project Specific Achievements Benefiting the USA

This Section describes a select number of Achievements in Projects that have particular interest to the United States producers, processors, and consumers. Title XII states that CRSP research should provide results important to developing countries and at the same time provide feedback to the U.S.

In PUR 151, research being conducted show that inclusion of peanut butter with breakfast helps control appetite and blood sugar in obese women. Also evidence shows peanuts consumed in moderation do not pose a threat to weight gain allowing the recommendation to consume, in moderation, peanuts and/or peanut products. Preliminary analyses of new studies show that peanut consumption was associated with marked reduction in blood pressure. Cardiovascular disease is a pressing health problem globally, and if this work is confirmed, this will improve the market perception of healthiness and create a strong demand and expansion of the market for peanuts and peanut products. The negative sense of the high fat peanut is difficult to overcome, but with more research to support the effectiveness of peanuts as a means to improve satiety without weight gain is extremely important. Dissemination of the results of this work in more commercial media will help even more.

In TAM 137 materials with field measures of improved drought tolerance were found in Texas. Early maturing, high-oleic runner peanuts are set to be released for the Texas market, which is of high processor and consumer interest for increasing shelf-life of products. Crosses to transfer high oleic traits from wild species have been successful. The results are hybrids with alleles closer to cultivated peanuts. Six accessions from previous evaluations were selected and increased for new underway regional trials of leafspot-resistant materials with improved yields. Funds from the Peanut CRSP is critical to accelerating the important discoveries of markers for drought, early maturity, and some of the primary peanut diseases, because of the increasingly limited funds available from public and private sources in Texas.

In UF 150, the development of disease resistant cultivars is important to Florida and the adjoining Georgia and Alabama area where production conditions are similar and information is shared. A strong germplasm base is available including wild species (that have a different chromosome number and require special breeding techniques to introduce the desired resistance characteristic into new cultivars), which will contribute to the cultivar improvement. Contributions from a molecular geneticist would speed up the breeding program.

Improvements that are being made in the clay technology for aflatoxin adsorption in the digestive tracts in TAM 149, such as a more refined UPSN will advance the use of the clay. In Texas, the clay in feeds is very important in reducing aflatoxin in milk.

NCS 131 in has provided the technology for a highly efficient and productive IPM program in North Carolina to reduce the insect and disease impact on the peanut crop. New efforts are directed toward new insecticides to replace a standard one that has been suddenly taken off the market. Tomato spotted wilt virus, leafspot and Scherotina blight, and *Cylindrocladium* black rot are important diseases to the farmers. Advisory systems developed to alert farmers to IPM problems have produced documented increased in peanut yields. Also, the work is developing IPM practices for new areas of peanut production in North Carolina.

Project Specific Observations

NMS 172 is focused on the improvement of Valencia type peanut with a particular niche market of roasted-inshell peanuts. Most Valencia peanuts in the U.S. are produced in New Mexico. The project is utilizing molecular marker techniques to speed up the development of improved cultivars with higher yield potentials, and insect and disease resistance.

UGA 136 is directed toward virus resistance in peanuts, a problem in Georgia and U.S. peanut production. Contributions are being made by this project in transgenic technology to improve the ability to breed virus resistance cultivars.

UF 157 uses production models to identify constraints to production (i.e. yield potential of varieties, losses to diseases and insects, drought stress, etc.), and to develop recommendations for overcoming these constraints. Reduced costs and time for field studies to provide the recommendations should occur.

Overall in the development of new cultivars, there is the need to develop cultivars with drought tolerance and significant resistance to the diseases sclerotinia, CBR (*Cylindrocladium black rot*), early leaf spot, and white mold, and for resistance to aflatoxin contamination. If a coordinated effort continues to be made by the Peanut CRSP to focus these programs, they can also make even more substantial contributions to the US peanut industry.

Project Specific Observations

Appendices and List of Annexes: