Research Proposal: Improved West African peanut production for enhanced health and socioeconomic status through the delivery of research-based production systems in Ghana

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Geographical Locations

Burkina Faso, Ghana

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Focus

Domain - Production Values Region - West Africa

Background

These goals and objectives focus on obtaining additional biological information on the production constraints defined in phase 1 in both the U.S. and Ghana. The objectives directly focus on problem solving in both the long and short term. Short term research delivers technology that allows growers to immediately improved production efficacy such as the use of local soap for leaf spot management. Long term research such as germplasm evaluation provides cost effective production benefits in future years. Similarly, strategies

designed to manage herbicide resistance provide long term benefits for peanut growers in the U.S. Refinement of risk indices will continue to provide immediate guidance for pest management decisions.

Non-technical constraints include a lack of appreciation by many farmers in southern Ghana for the potential of peanut production.

Environmental issues include the use of legumes in a crop rotation system, the benefit of nitrogen fixation, the value of the hay to reduce overgrazing.

The institutional capacity of both the Crops Research Institute and the Savanna Agricultural Research Institute are excellent as are the quality of the scientists and the appropriate expertise is present. Research station facilities and land are more than adequate. Resources at N. C. State are appropriate for peanut research.

Women provide much of the labor in groundnut production. Increased production lends itself to increased labor, but potentially increased revenue. Improved production systems, particularly in the area of weed management, can dramatically reduce labor (weeding is the most significant labor input), and the purchase of shelling machines can keep labor to a minimum even with increased yields.

Enhanced production strategies with improved pest management and storage will reduce aflatoxin incidence which has significant health implications. Increased peanut consumption has many health benefits in West Africa including vitamin uptake.

Technical Review

Research in North Carolina has focused on major pests such as tomato spotted wilt, weed biotypes expressing resistance to herbicides, southern corn rootworm, and foliar disease. Production practices that affect yield and quality including variety evaluations, tillage and cropping systems, and harvesting principles have also been addressed in this project. Relevancy of these studies within appropriate science disciplines is verified in the peer-reviewed publication record presented in this document. However, efforts to identify additional production constraints, develop effective pest management strategies in sustainable and profitable cropping systems, identification and promotion of superior cultivars, and involvement of farmers in additional regions of West Africa is needed. Prior to the initiation of NCS19 in Ghana during 1996, pest management surveys, germplasm evaluations, documentation of aflatoxin incidence, and evaluations of other production factors from a wide range of institutes and countries in West Africa have been documented (Wightman and Wightman 1994). Additional efforts assessed impact of IPM on production issues including strategies to reduce incidence of aflatoxin (Lynch et al. 1991). While there has been significant research conducted over the past two decades, less research has been conducted in the coastal countries such as Ghana, Togo, and Benin. Their unique environments

require localized research. Additionally, to effectively address the production constraints and farmer frustrations (many farmers had abandoned peanuts in southern Ghana and have only recently returned to production based on new research findings) a multidisciplinary approach provided by a team of scientists is necessary. The strength of the program in Ghana through the two research institutes has been the multidisciplinary teams that have surveyed, assessed, and responded to the overall production constraints rather than individually. From a scientific perspective, this has resulted in contributions to the scientific literature and has elevated technical expertise associated with production systems in West Africa. Baseline data associated with occurrence and yield loss assessments associated with insect, disease, and weed pests; agronomic production system dynamics; seed quality, seeding rate, and row patterns; land preparation and planting dates; foliar disease management; and harvest principles. This information allows more rapid advances in pest management, greater efficiency in production and storage, and improved transfer of principles and recommendations to farmers. Our findings as documented in the publication by Dankyii (2005) from the previous project indicate the IPM program developed form this research are effective and can be modified to other geographic areas.

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Problem Statement

Pests frequently decrease yield, quality, and safety of groundnut for farmers and consumers. Identifying pests, documenting loss associated with pests, and developing strategies to minimize pest impact is critical in sustaining yield and market potential for high quality groundnut. Protecting groundnut yield and minimize pest damage in stored products, including aflatoxin is desperately needed in West Africa. Extending technology developed through multidisciplinary research efforts associated with peanut science to end users is the primary focus of this.

The funding of the Peanut CRSP project NCS19 over the past 11 years has driven successful research programming, significant scientific findings, and dramatic increases in production efficiency. The success and impact of the Peanut CRSP collaboration between the Departments of Entomology and Crop Science at North Carolina State University and the Crop Research Institute (CRI) in Kumasi, Ghana and the Savanna Agricultural Research Institute (SARI) in Tamale, Ghana have been well documented through publications (more than 20 since 1996), extension programming and outreach, economic benefits, and high ratings by the EEP. Current programs used to ameliorate the impact of diseases such as tomato spotted wilt virus, leafspot, and Sclerotinia blight, as well as advisories for rootworm management and tillage practices are all the result of Peanut CRSP sponsored research at North Carolina State University. Documented increases in production acreage as well as increased yields by growers in Ghana are also the result of Peanut CRSP sponsored research and extension programs. Additional research and extension efforts are needed in the U.S. to address new challenges including concerns over impacts of production and pest management practices on sensitive watersheds, efficiency of production systems, relatively high usage of pesticides and exposure to workers, the environment and food supply, viability of alternative-market type cultivars, and production strategies appropriate for shifts in production regions. In Ghana, it is essential that the highly successful technology transfer programs proven effective in villages be expanded, evaluated, and modified to fit local environments in new locations.

Vision and Approach

Goals

The funding of the Peanut CRSP project NC-19 Improved Production Efficiency Through Standardized, Integrated, and Enhanced Research and Technology has provided considerable economic impact and scientific merit to farmers, scientists and the peanut industry in Ghana and the U.S. The economic impact of the Peanut CRSP in Ghana as documented in an article by Dankyi et al. (2005). A model was established in a village in Ejura to involve 30 farmers in the research and technology transfer of new Peanut CRSP research findings. These farmers met with Crop Research Institute researchers bimonthly at the research plots for training, observations and dialogue relative to the various production methods. These efforts have resulted in a dramatic increase in production, a doubling of yield, and a significant impact on individual and village finances. Biodiversity has also increased with the inclusion of peanut into farming systems where nitrogen fertilizer is virtually non-existent for maize and other grain crops.

The overall goal is more efficient peanut production. In the U.S. this equates to maintaining yields while reducing inputs. This has been attained in recent years through risk indices and pest forecasting which has permitted more efficient use of pesticides, fertilizer, and water as well as reductions in primary and secondary tillage. Enhancing understanding of production systems associated with the development of herbicide resistant biotypes, newly emerging pest problems, and volatility in marketing is important. In Ghana and other host countries the goal is to remove production constraints through adoption of improved germplasm, management of pests and addressing labor issues such as weeding, seed storage and general educational limitations. Certain production constraints can be reduced or eliminated simply through effective field testing of current technology and successful transfer. However, additional detailed research is necessary to develop improved production and management strategies. The final goal is to effectively transfer technology and knowledge to farmers through their involvement with on farm testing, observations, and training.

Objectives

1. Continue the development and enhancement of advisories and risk indices and other pest management decision-making tools for U.S. peanut growers. These concepts have been readily embraced by growers and documented. After a record year of tomato spotted wilt virus in 2002, the implementation and grower acceptance of the tomato spotted wilt virus index resulted in levels of virus in 2003, 2004, and 2005 that were half that observed in 2002. These indices require continued refinement and are currently being expanded to include additional disease, weed, and insect pest profiles as well as incorporating agronomic practices. This will be the responsibility of the U.S. PI's and will be measured by the number of farmers using these programs and

the lack of serious pest outbreaks.

2. Continue to evaluate germplasm for pest resistance and agronomic traits to improve production efficiency and yield potential. The development of high-yielding, pest resistant cultivars is central to the mission of developing economically and environmentally-sound peanut production strategies
3. Develop a strong database on the impact of emerging soil pest problems. During the past two year there has been a noticeable increase in the incidence and impact of wireworms and late season rootworms in North Carolina peanut production. This has occurred in many fields despite the use of broad-spectrum soil insecticides. The presence of emerging wireworms problems in other crops such as sweet potatoes indicates a need to assess the impact of wireworms under current peanut production practices. Additionally, it appears the increased cotton acreage in many areas is contributing to late season corn rootworm infestation in peanuts. There are indications that the adult rootworms beetles are feeding on cotton flowers and contributing to these late season infestations that do not appear to be controlled by the typical rootworm insecticide treatment. Reduced tillage production of peanut in North Carolina doubled during the period 1999 to 2005. In some instances, burrower bug caused damage when peanut was planted in a reduced tillage system under dry conditions. Although insecticides can be applied to control burrower bug, these products often flare secondary pest outbreaks such as spider mites. Developing a comprehensive strategy to manage burrower bug will increase in importance as reduced tillage production increases.
4. Efficient weed management strategies continue to be important in .US. production. The need to develop cost effective strategies continues to be a key focus of this project. More recently, biotypes expressing resistance to acetolactate-synthase inhibiting herbicides have greatly reduced ability of farmers to manage difficult-to-control weeds like Palmer amaranth and other pigweeds. Equally as troubling is the development of biotypes of Palmer amaranth that are resistant to glyphosate, a herbicide used extensively in crops often rotated with peanut. There is also concern that some of these biotypes are resistant to both glyphosate and acetolactate synthase-inhibiting herbicides. Imazethapyr, imazapic, and diclosulam are herbicides that have been effective in managing broadleaf weeds in peanut but are now of marginal effectiveness in many fields because of resistance. However, biotypes of horseweed, a weed found in many sandy fields in North Carolina, is often controlled in reduced tillage fields prior to planting with glyphosate. Biotypes expressing resistance to glyphosate have been reported in most Coastal Plain counties in North Carolina where peanut are grown. Over the coming year’s research and education programs will be critical in minimizing the deleterious effects of these and other resistant weeds and developing strategies that minimize further development and spread of resistant populations in the region. Compatibility of pesticides and other agrichemicals continues to be one

of the most important issues raised by growers during the middle and latter half of the growing season. With new registration of pesticides and the need to make fewer trips across fields due to higher fuel prices, defining interactions more clearly will continue to be important in helping growers develop efficient pest management strategies.

5. Changes in Federal farm legislation have resulted in movement of peanut production to several new regions of North Carolina. Additionally, growers continue to seek alternative crops to tobacco in North Carolina. In doing so more growers are growing non- traditional row crops such as sage, fresh beans, vegetables, and potatoes in rotation with peanut. Historically, cotton, corn, tobacco, and soybean have been the dominant rotation crops with peanut, and the impact of these crops on peanut has been relatively well understood. However, information on the impact of peanut on yield of other crops is less well understood. Research will be conducted to better define cropping systems that include vegetable and other crops that have not been traditionally planted in peanut-based cropping systems. Rotation crops will also include those with potential as biofuels (sunflower, canola, etc.).
6. Train a current Ghanaian scientist involved with the Peanut CRSP program in a Master's program at N. C. State in an associated discipline of either Agronomy, Entomology, Plant Pathology, or Weed Science to then return to his/her institute in Ghana following completion of degree.
7. Evaluations of germplasm from North Carolina State University and ICRISAT have shown considerable promise in both northern and southern Ghana and seed multiplication is currently underway. Utilize seed multiplication plots to provide seed to farmers in selected locations for their own seed multiplication program and incorporation into production fields. Continue to evaluate new germplasm on research stations and in grower villages. Cooperation with peanut breeder, Dr. Mark Burrows, Texas A&M University will work to provide germplasm to both research centers in Ghana as well as expanding evaluations into Burkina Faso and Mali. A peanut breeder will be placed at SARI in late 2008/early 2009 who will coordinate evaluations and breeding in these three countries. INTENDED OUTCOME: New promising varieties.
8. Continue the development and refinement of IPM and production strategies and programs for cost-effective peanut production in Ghana and use research findings to produce a West African groundnut pest management manual. Previous research as a component of the Peanut CRSP has found that seed quality and selection, planting in rows, weed management, pest management, maturity monitoring and timely harvest all contribute significantly to improved yields. This information will be included in the manual and is a consistent component of all farmer training activities. This will also include validation and refinement of IPM programming in various locations throughout the country. Successful components of the IPM program in Ghana will be shared with scientists in Mali (IER) and Burkina Faso (INERA) once those relationships are established.
9. Evaluate the impact of IPM practices on the incidence of aflatoxin in

harvested and stored peanut.

10. Recent research in the Peanut CRSP has demonstrated that improvements in optimal harvest date assessment can dramatically improve yield and quality and will undoubtedly impact aflatoxin levels.
11. Conduct baseline economic studies of current peanut production in villages and then continue studies in selected sites as IPM programming is evaluated and customized for local conditions and growers are educated on these strategies.
12. Conduct regional training for scientists involved with peanut research in Burkina Faso and Mali.

Research Approach:

U.S. - North Carolina: The current southern corn rootworm, tomato spotted wilt, and tillage advisories will be enhanced by research that will focus on utilizing the newest cultivars, pesticides, and a refined data base on pest occurrence through trapping and monitoring to improve the reliability of the advisory programs. Germplasm from the peanut-breeding program at N. C. State University through the multi-state Peanut Variety and Quality and Evaluation program (PVQE), will be evaluated against the pest complex found in N.C. as well as for agronomic and market characteristics. Rootworms and wireworm populations and pest ecology dynamics will also be monitored. These experiments will be conducted at numerous on-farm sites and research stations.

Experiments will be conducted on university research stations and with Cooperative Extension agents to address the occurrence and management of weed resistance in peanut. Initially, the scope of resistance will be defined and appropriate management practices developed and extended to end users to minimize the impact of resistant ecotypes on peanut. Defining interactions and determining compatibility of pesticides will be evaluated with respect to weed, disease, and insect control.

Cropping systems experiments will be initiated at the Peanut Belt Research Station at Lewiston, North Carolina to determine the impact of type and duration of rotation on disease development and yield of peanut and rotation crops. Rotation crops will include Irish and sweet potatoes, fresh beans, and other traditional rotation crops such as perennial grasses.

Ghana: New germplasm will be added to the current collection and evaluated in at least 4 locations including: Kumasi (southern Ghana), Ejura (central Ghana), Tamale (northern Ghana), and Bagurugui (extreme north Ghana). Germplasm will be further evaluated for agronomic traits and yield as well as pest resistance, particularly leaf spot. Farmers will begin multiplying the seed and incorporating new varieties and management strategies into their production programs. Economic studies will monitor the impact of improved varieties as well as other management programming. Significant progress has been made, but harvest date, rosette, and leaf spot remain limiting factors in production and continue to demand additional studies. Additional studies will

continue to focus on the evaluation of production practices that provide sustainability and yield. This includes optimal row spacing, seed population, pest management practices, the use of degree days to monitor maturity, and timely harvest. These studies will be conducted at the two research institutes (CRI and SARI) and in village locations. Research will continue in village sites (Ejura and Bagurugui) to further enhance current production programs, but also to bring in leading growers from other surrounding villages to begin the process of technology transfer to those village farmers. Additional villages in new areas (districts) will be selected for initial research that will evaluate previous research findings. Local farmers will be involved in a manner similar to the successful model that was used in Ejura.

Plots will be established at the two research stations and in villages to monitor the impact of production practices, IPM programs, and harvest date on the level of aflatoxin in harvested peanuts. Degree-day accumulations will be monitored at 5 sites with microloggers placed at each field that allows data to be downloaded onto a laptop computer. Plots will be replicated over a range of cultivars and production practices and samples taken at various harvest dates and analyzed for Aspergillus flavus. Research on storage techniques and technology will be conducted at on-farm locations and at the research institutes. Surveys will be conducted to determine limiting factors in storage. This will be closely linked with in field pest management and maturity at harvest studies.

Socio-economic data will be collected at all sites through surveys of local farmers and combined with yield data from research plots to document the impact and benefit of the research and technology transfer programs. These surveys and studies will also include changes and benefits in marketing from local villages to larger urban areas. Regional training will be conducted in two programs. One program will take advantage of the extensive research plots in Ghana to use them as a backdrop for site visits by scientists from surrounding countries. These sites visits will be conducted in August when there will be an opportunity to see the impact of the various research treatments. Visiting scientists will be able to observe research procedures and field operations, see the effect these research variables, and discuss methodologies with Ghanaian scientists. A one-day peanut conference will be hosted at the same time at which all peanut researchers will present their recent research findings and discuss their outreach and extension programs. This program will allow planning for the upcoming field research season, exchange of germplasm and technology, and allows scientists to learn from their counterparts in surrounding countries.

Training & Capacity Development Approach

There is a strong need for additional advanced degree training of scientists in Ghana and there is a need for additional problem solving research expertise in Ghana. These needs can be most readily developed through training at appropriate U.S. universities. We propose training a current scientist with a MS degree in a Ph.D. program at N.C. State in an appropriate discipline.

Several current research team members at Crops Research Institute and Savanna Agricultural Research Institute have Masters Degrees and some degrees were earned at U.S. or European institutions. We would provide an opportunity for these scientists to apply for a Ph.D. program and assistantship at N.C. State and our selection would be based upon the candidate's credentials, guidance from senior research team members who already have their Ph.D., and upper administration within the CSIR system. It is possible that the student could take course work at N. C. State University and conduct their research in Ghana and this might allow two students to be trained if funding allowed.

We also propose annual visits for at least two host country scientists to attend the American Peanut Research and Education Society meeting each July in the U.S. This would not only allow participation and presentations at this scientific meeting, but would also provide an opportunity to visit N.C. State University and spend time with U.S. scientists in pertinent areas of expertise.

Additionally, we also propose including training of scientists in nearby West African countries by host country scientists. This would involve annual visits by scientists to Ghana to observe research plots, exchange scientific research information, and develop plans for germplasm exchanges.

Intended Benefits & Impact Responsiveness

Development Benefits

Many stakeholders will benefit in the host countries. The host country scientists benefit through the cooperative research effort and information exchange they receive. Scientists in Ghana will experience professional development through the association with the U.S. scientists and opportunities for travel and participation in professional society meetings and publication in scientific journals. They will also grow professionally through the enhanced interaction with other West African scientists will also improve capacity of scientists in Ghana and the other countries. Emphasis on continued technology transfer will keep scientists grounded in problem solving research. International peanut researchers will continue to benefit from the publication of scientific research articles.

The farmers throughout Ghana will benefit through the development of improved production and storage of peanuts. The research output of the past project in Ghana has had a significant on pest management, production practices, harvest, weed control, variety selection and this has resulted in increased production, yield and profit. Continued research will further refine production and storage practices, and new locations for evaluation will allow for technology transfer into additional areas. The local economy has the potential to benefit if marketing strategies can be successfully developed.

The children of Ghana will benefit through improved health (better diet and vitamin uptake and reduced aflatoxin consumption) and an improved

economic picture in local villages.

US Benefits

Several groups in the U.S. will benefit from the proposed project. The most obvious are U.S. peanut farmers through the applied research programming that seeks answers to the most significant production constraints. In addition, the responsibilities of the PIs include extension and technology transfer so there is a mechanism in place to ensure that research findings are deployed and implemented in current farming systems. The proposed research seeks environmentally sound approaches to more cost effective peanut production methods by which to lead farmers into a more sustainable production system that maintains peanut profitability under current market climates. Additionally, the allied industries such as shellers, equipment dealers, agribusiness, peanut processors, and businesses in the small rural farming communities also benefit through maintaining peanuts as a strong and profitable component of our farming systems.

Land grant universities in the U.S. also benefit through the support of research, not only on peanut, but the entire agro-ecosystem. The Peanut CRSP funding is an integral component for maintaining a critical mass of graduate students and support staff addressing issues associated with peanut-based cropping systems.

Tomato spotted wilt (TSW), caused by a Tospovirus vectored by thrips (Frankliniella sp.), began becoming more prevalent in North Carolina in the late 1990s but was considered sporadic and not yield limiting. However, in 2002 conservative yield loss estimates from Cooperative Extension field faculty due to TSW was around 5% of total production in the state. This amount of yield loss was due in part to an increase in prevalence of virus in the population of thrips and the extreme dry weather that exacerbates injury and subsequent yield loss of infected plants. Additionally, North Carolina State University released the cultivar Perry, a variety that expresses partial resistance to Cylindrocladium black rot (CBR) and Sclerotinia blight (SB), but is very susceptible to TSW. General production practices in North Carolina up to 2002 generally centered on early planting to ensure optimum pod maturation, use of aldicarb in-furrow, planting at modest seeding rates due to the expense of seed, and planting in conventional tillage systems. These production practices, in absence of TSW, were generally effective in optimizing yield and quality of peanut. Cultivars selection was also based on CBR and SB resistance levels and not based on potential for TSW.

The conservative yield loss estimate of 5% in 2002 resulted in an economic loss of approximately $5,625,000 (125,000 acres/North Carolina X 0.05 X $600/US ton X 1.5 US ton average yield/acre.) Research in North Carolina supported through USAID Peanut CRSP, the North Carolina Peanut Growers Association, and the National Peanut Board prior to 2002 supported development of recommendations for the region to manage TSW. The TSW index for North Carolina (and Virginia) was based on the University of Georgia

index and was modified to include categories of planting date, seeding rate, cultivar, in-furrow insecticide, and tillage system. The index was released in late 2002/early 2003 and was discussed at county production meetings and was distributed widely among peanut growers and their advisors.

Many growers incorporated two or three components of the index to minimize risk of TSW in the 2003 crop, and yield loss estimates were less than 1% from TSW (estimated at 0.5%) resulting in a 10-fold savings of savings of $5,062,500 (loss of 0.5% equaling $562,500.) Additionally, there was considerable concern over the future of the very popular multi-resistant cultivar Perry, especially following the dismal start for this variety due to severe damage from TSW in the release year. Concern that the positive benefits of CBR and SB resistance/tolerance would be overshadowed by the damage from TSW existed. Approximately $300,000 per year was most likely saved because growers using the TSW index could modify four other components, primarily planting date and plant population, thereby making the TSW susceptible variety Perry a viable option. Twenty-five percent of acreage (125,000 acres) was eventually planted in Perry, and on approximately 75% of that acreage Perry was planted as a replacement for fumigation of metam sodium ($23,438 acres were replaced with Perry for metam sodium). Therefore, approximately $703,140 was saved on an annual basis because this variety continued to be a viable alternative (125,000 acres X 0.25 X 0.75 X $30/acre).

Consequently, adoption of production practices associated with the TSW index, partially funded by USAID Peanut CRSP, was $5,765,625 (sum of $5,062,500 gained due to reduction in yield loss from TSW and $703,140 due to reductions in fumigation cost) when comparing the year with the highest incidence to a year with lower incidence (following adoption of the index).

Potential Impacts

Reducing yield loss, improving quality, and increasing safety through reductions in aflatoxin in the field and in stored product is the primary technical goal of this project. Improving infrastructure and developing human capital, continued development of scientific-based technology transfer appropriate for production regions, and expansion of this concept to additional villages throughout Ghana could lead to improved quality of life not only for farmers but entire villages. Ultimately, success of this project could positively impact human health by increasing accessibility to groundnut that is an excellent source of protein. Additionally, results from the proposed project could lead to increased food safety by reducing aflatoxin in groundnut. The impact of improved diets and increased food safety would improve lives of people in Ghana, especially young children that are vulnerable to health problems exacerbated by aflatoxin and are in critical development stages where a balanced diet with essential protein is desperately needed.

Success through this project could also lead to greater disposable income for farmers. Increasing yields, improving quality, and ensuring food safety has

the potential to increase markets for groundnut. Consequently, farmers could then use additional income to purchase essential items to increase and expand production of groundnut and other crops or to invest in other business.

Ultimately, all people in rural areas can benefit from improved diets, increased food safety, and greater income from marketing of groundnut. Developing scientifically-based recommendations to improve groundnut production systems and transferring information to farmers will be essential for the above-mentioned impacts to be realized.

Equipment

The only pertinent field equipment is the purchase and distribution of peanut sheller kits available through the Fully Belly project. These shellers can be assembled in villages and greatly improve shelling efficiency that enhances storage in a timely manner and has implications for aflatoxin incidence and improve marketing potential. The program at SARI is in serious need of a new vehicle (4X4). The program at CRI will soon be in need of a new vehicle due to the extensive travel they do throughout southern Ghana. Estimated cost for these vehicles is approximately $25,000 each.

Project Timeline:

The objectives of this research proposal become a moving target for establishing a timeline. This is due to the nature of the research in that it seeks to continue to enhance our knowledge and database of the farming ecosystem. In addition, the IPM and production programs are in a continual state of refinement as new information is produced, new varieties tested, and the production strategies evaluated in new areas. Therefore the objectives will continue to function over much of the five year period proposed in this Peanut CRSP. There is also a need for flexibility in the objectives as weather and growing conditions and pest pressure vary from year to year and in some years, little progress may be made on a particular objective. Objective 6 would be anticipated to be a 3 or 4 year commitment dependent upon the background of the student and the type of research program undertaken. The regional training would not be initiated until 2008 and would continue for the life of the project. Objective 11 is a key component for measuring the progress and success and while this objective will be ongoing during the life of the project, annual findings will be used to document progress and used in annual reports and impact statements.

USAID Mandate Responsiveness:

MDGs

Poverty/Hunger: Improved Health: Raised Rural Incomes: Sustainable Development

Foreign Assistance Framework

Governance: Human Capacity: Economic Structure: Persistent Dire Poverty: Global Issues (HIV and Infectious Diseases, climate change, biodiversity)

IEHA

Science and Tech Applications: Increased demand for peanuts: Market Access: Increased Trade

USAID Focal Areas

Greater incomes: Greater value and market demand: Public Health: Food Security: Sustainable Value Chain: Improved Human Capacity