Research Proposal: Improving the health and livelihood of people of East Africa by addressing aflatoxin and gender-related constraints in peanut production, processing and marketing

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Geographic Locations

Kenya, Uganda

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Focus

Domain - Aflatoxin Region - E and C Africa

Background

a) Non-technical constraints: Inadequate awareness of the AF problem by

farmers, traders, decision makers and consumers aggravates contamination and poisoning by the toxin. There is lack of funds from Governments of Uganda and Kenya to address AF problem or, if funds are available, AF does not feature in the budgets of the ministries concerned (MoH and MAAIF). There is no clear policy addressing aflatoxins in the region and existing control regulations are weak. Consequently, no AF standards have been established but, rather each of the countries depends on borrowed standards especially from EU. Unavailability of equipment and manpower to analyze AF in peanuts is a serious problem. Sustainability of AF research activities in the absence of donors is also a serious problem in the region.

b) Environmental issues Both Uganda and Kenya are located in tropical environment where rainfall and temperatures are suitable for growth and multiplication of Aspergillus flavus/parasiticus which produce AF. The weather does not allow fast drying of peanuts to safe storage moisture and contamination with these toxins is inevitable in these conditions without control measures. Stringent environmental protection measures exist in the region, thus care must be taken to assure proposed research activities do not lead to degradation of the environment.

c) Institutional capacity needs There is a serious lack of trained personnel to manage, and analyze AF. Many farmers, traders, service providers, policy makers and consumers are still unaware of the problem. The region lacks up-to-date labs for AF analysis. There is an urgent need for postgraduate training of scientists in AF control and management. At the same time, training scientists in Kenya and Uganda will contribute to the regional capacity to join global efforts to better understand and address related problems.

d) Gender Peanut is considered a labor intensive crop in the region, with women bearing much of the burden associated with peanut production and processing. Women are less likely to have access to training and information, as well as markets than men. Women are responsible for food preparation, family health care, and other household needs-all dependent on peanut in the regions, targeted by this proposal. They are observant of the link between food and health and can be educated to understand the role of AF in the diet, and take appropriate measures to prevent aflatoxicosis. Women farmer in the region are often dependent on their peanut crop (as opposed to that of the male head of household, when there is one) to solve their dietary and monetary household needs. They stand to benefit directly from adding value to their peanuts before marketing, as well as ensuring healthy peanuts in the home.

e) Health Peanuts are an important source of protein and oils to low-income farmers and consumers who cannot afford animal protein. However, they are contaminated with AF, potent mutagenic and carcinogenic substances affecting animals as well as humans. Prolonged dietary exposure has been linked to cancer, to kidney, liver, and immune-system diseases as well as to high infant mortality and morbidity rates. AF exposure is largely a developing country

phenomenon, with the FAO estimating that 25% of world's food is contaminated.

Technical Review

Peanuts are an important source of protein and oils in many African Countries to consumers who cannot afford animal protein. However, they are contaminated with aflatoxin (AF), potent mutagenic and carcinogenic substances affecting animals as well as humans. AF exposure is largely a developing country phenomenon, with the FAO estimating that 25% of world food is contaminated.

While in developed countries contamination is strictly regulated, in most of Sub-Saharan Africa regulation is ineffective and impractical, and at least 90% of people have chronic exposure and between 30 and 40% of breast milk samples show maternal exposure in the previous 24 hours. This exposure results in serious health and trade costs (Williams et al., 2004). Long-term chronic exposure can produce cumulative genetic damage leading to liver cancer. In addition, AF and Hepatitis B Virus are synergistic, with the risk of cancer when both are together twelve times greater than only with HBV. It also lowers levels of micronutrients (A, C, E, iron, zinc) and protein synthesis, resulting in increased malnutrition. HBV infected people have higher levels of AF and thus have greater nutritional interference and greater immune suppression.

Harvest and postharvest practices promote mold contamination and aflatoxin production. According to our research findings during the Peanut CRSP 03-07 phase in Uganda, aflatoxin contamination starts at the farm and increases along the chain with higher levels in peanut products like flour and paste (Kaaya et al., 2006). Farmers damage the pods and kernels during harvesting and shelling, creating avenues for molds to enter and produce aflatoxins. Drying is on bare ground using open sun drying method which allows molds to infect the nuts, sporulate and produce aflatoxins. Storage conditions do not protect the produce from further infection by molds. At the retail markets moldy and broken peanuts which are suspected to be contaminated with aflatoxins are processed into products moreover using locally fabricated equipment (Kaaya et al., 2006).

Recent developments in infrared spectroscopy has provided opportunities to investigate the efficacy of these systems for rapid non-destructive evaluation of toxins in food. Gordon et al., (1997) from the USDA Illinois Research Lab had developed a Fourier Transform Infrared photoacoustic method to evaluate aflatoxin in corn. Mirghania et al. (2001) used attenuated total reflection (FTIR-ATR) to detect aflatoxin in peanuts and peanut paste. These work show promising potential for developing this technology as a rapid non-destructive tool to control the aflatoxin contamination in peanuts.

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in corn. Int J Food Microbiol 35:179-186 (1997).

Kaaya, N. A, W. Eigel and C. Harris. 2006. Peanut Aflatoxin Levels on Farms and in Markets of Uganda. Peanut Sci 33: 68-75.

Mirghania, M.E.S., Che Mana, Y.B., Jinapb, S., Baharina, B.S., and Bakara, J. 2001. A New Method for Determining Aflatoxins in Groundnut and Groundnut Cake Using Fourier Transform Infrared Spectroscopy with Attenuated Total Reflectance. J AOCS 78: 985-992.

Williams, J. H., T. D. Phillips, P. Jolly, J. K. Styles, C. M. Jolly and D. Aggarwal. 2004. Human aflatoxicosis in developing countries: a review of toxicology, exposure, potential health consequences, and interventions. American J. Clinical Nutrition, Vol. 80, No. 5, 1106-1122.

Problem Statement

One in three people in Africa is undernourished, often due to insufficient and poor quality food. Hunger and disease are obstacles to development and, particularly in vulnerable states, threaten global stability and US national security. Peanut is a major crop in Uganda and Kenya. It is important to household consumption, complementing staples such as maize. Aflatoxin contamination limits its nutritional potential; it also prevents peanuts from accessing European markets, increases dependency on foreign food aid, and stifles economic opportunities. Reducing aflatoxin levels on peanuts can help fulfill the UN Millennium Development Goal of cutting in half the number of hungry people in Africa by 2015.

Recent cases of acute aflatoxin poisoning in Kenya have caught international attention, yet even low aflatoxin levels present a danger for public health. Chronic aflatoxicosis is linked to malnutrition and disease including cancer and AIDS. Limited data suggest that aflatoxin markers may be higher in women in regions where exposures are uniform in a population. More data are needed before strategies to combat and prevent aflatoxin can be integrated into the significant international effort to combat AIDS, other diseases and malnutrition.

In the case of AF assessment in peanut, the lack of non-destructive rapid assessment technology makes it difficult to address health and trade constraints. USAID has placed a high priority on technical options to reverse trends of hunger and poverty in Africa. Training programs presented here build host country capacity and serve US commercial interests with the ensuing demand for testing laboratory equipment and supplies.

Vision and Approach

Goals

This project links science directly to pressing development challenges. It increases food security and nutritional value for families producing one of

Africa's key crops, peanut. Building on previous PCRSP work and relationships in East Africa, it expands the regional focus in Uganda to include the war-torn North, developing on-the-ground research in Kenya, and further involves Tanzania and Rwanda in capacity-building efforts. The scope of research broadens with greater emphasis on health and nutrition aspects of aflatoxins, and on crop storage and food preparation in household space, while emphasizing value-added opportunities with small-scale peanut growers and processors. It brings agriculture and health scientists together for collaboration needed for effective resolution and impact. It empowers women to manage aflatoxins in peanuts in the household, increase their incomes through marketing of quality peanut products, and improve family nutrition and wellbeing.

The objectives below address the following overall goals: 1. Decreased levels of aflatoxicosis for rural families in peanut-growing areas and for peri-urban/urban families that consume peanuts through reduction of aflatoxin content; 2. Improved livelihoods for rural families through poverty reduction, increased market access and value addition for peanuts, and 3. Improved policy on aflatoxin content of peanut and peanut products in the region.

Objectives

1. Food Science/Risk assessment: Carry out aflatoxin risk assessment in the region in order to get exposure data and how hazardous aflatoxins are to local consumers.
2. HACCP and Certification: Evaluate aflatoxin contamination and physico-chemical composition of locally processed peanut products during storage and develop HACCP plan for small scale peanut processors and cottage industries.
3. IEC: Develop information Education and Communication (IEC) materials for aflatoxin awareness at grassroot and higher level as well as conduct training workshops to address the issue.
4. Build capacity to identify and address aflatoxin issues through training of students, researchers, processors, women's groups, farmers and government/extension personnel.
5. FTIR: Develop Non-destructive Rapid Deduction System to Test for AF in Peanuts and Peanut Products using Fourier Transformation Infrared spectroscopy with Attenuated Total Reflection (FTIR-ATR) or Photo Acoustic Spectroscopy (FTIR-PAS). Methods will be developed for both in-lab implementation and as well as in-field evaluation.
6. Ethnographic research: Qualitative, ethnographic research in selected households in urban and rural areas of Kenya and Uganda to document cooking practices involving peanuts, clay-eating practices, and identify opportunities for mitigating or reducing aflatoxins in diet
7. Identify clays in the region that can bind to AF and reduce its toxicity, building on prior Peanut CRSP research. Explore the feasibility of using locally available clays in Uganda as a product to supplement in animal feed and human diet for mitigating aflatoxin poison.

8. Gender and qualitative methodology course: Week-long course in gender and qualitative research methodology for students and faculty in Makerere, with students and faculty from Kenya.
9. Livelihoods: Working with women's organizations and cooperatives, develop livelihood strategies and models for reducing poverty and malnutrition in rural areas via value addition in peanut.

Research Approach

Strategies for Research Approach

Build capacity in the region to address, prevent and mitigate aflatoxin contamination in peanuts through training of students, scientists, farmers and processors, household managers, women's organizations

Strengthen the capacity of East African research and scientific institutions

Multiply training impact by facilitating farmer-to-farmer exchanges, train the trainer programs, and participation in scientific conferences regionally and internationally

Build on existing research, experience, and networks in Sub-Saharan Africa, including the extensive HIV/AIDS and other health and nutrition networks

Work with plumpynut and malnutrition rehabilitation centers (Lacor Hospital in the North and
Mulago hospital in Kampala) who use peanut-based foods to feed malnourished children
Increase linkages and synergy between health and agricultural scientists
Work with ministries of Health and Agriculture in both countries to implement awareness campaigns.

Build on momentum, government support and political environment conducive to taking action on aflatoxin issues in food, health and agriculture

Use the structure and experience of the Technical Committee on Mycotoxins formed in Uganda with support from PCRSP, and strengthen the Forum for Mycotoxin Management and Food Safety in Africa (FOMMFOSA) for regional coordination and dissemination of results. Work with scientists and policy-makers in Kenya, and later Tanzania and Rwanda to create a similar technical committees to inform regional policy initiatives and capacity building. Continue to work at policy level to support efforts already underway to address aflatoxins in the region; support FOMMFOSA by providing information to promote this and build a regional network of scientists.

Develop equipment to test aflatoxin that allows for non-destructive rapid analysis using Fourier Transform Infrared Spectrascopy-Attenuated Total Reflection mode; train scientists to use this. Leverage funds for acquisition of equipment for host countries.

Build on women's existing responsibilities and concern for family health and nutrition to involve them in participative research identifying opportunities for addressing aflatoxin contamination in home storage and food preparation and to develop guidelines and training materials for household use addressing aflatoxins in foods

Develop capacity of women's associations in Kenya and Uganda, working with them to approach and organize groups of women farmers to participate in project activities including assessment and value adding. In Uganda, work with NAWOU (National Association of Women of Uganda) and with other appropriate women's organizations in Kenya and Uganda

Increase gender equity and empower women with tools and information to address economic needs and improve family health, nutrition, and well-being

Training & Capacity Development Approach

Training the trainers, including service providers such as agricultural extension officers, district health educators, and community development officers.

Development of simple information and education materials in commonly used local languages. These will be in form of brochures, posters and also articles in local newspapers. Also, training materials and modules to be used by women's organizations working with women farmers in poor rural regions.

Developing information for media (local FM radios) at district level that can be used by district health educators.

Educate policy makers in region to dangers of aflatoxin and support efforts to introduce and enforce scientifically supported standards.

Train peanut processors in HACCP and producing safe and nutritious food products.

Acquisition of analytical equipment.

Provide short (3-day) course in Makerere in HCCP to scientists, industry and Bureau of
Standards representatives from East Africa.

Host 2 visiting scholars from Uganda and Kenya for 3 months each at Virginia Tech to train in development and utilization of non-destructive Rapid Deduction system to test for AF in peanut products.

Train one scientist from the region in methods for analyzing bentonite clays for AF-binding properties based on Texas A & M (TAMU) experience with Novasil. This training will take place at TAMU.

Offer a one-day workshop each in Kenya and Uganda on qualitative methodologies applied to peanut and AF research.

Train 10 Masters' students in the region to work with farmers and processors on agriculture and health aspects of aflatoxin contamination, and to provide ongoing support for assessing aflatoxin levels in peanut. Students include 4 working with clay objective, and 4 in Women and Gender Studies or other appropriate department working on ethnographic and livelihood objectives. Students will be funded only in part by Peanut CRSP (either field work, or stipend, or tuition, not all), with remainder of costs provided by home institution. Visiting scholars (above) may be
PhD, MSc students or professionals/scientists.

Train 2 PhD students at Virginia Tech, one in Bio-Systems Engineering to work with FTIR objective, one in Agricultural Economics to work with livelihoods objective. In both cases Virginia Tech will cost-share tuition and Peanut CRSP will cover stipend.

Intended Benefits & Impact Responsiveness

Development Benefits

In order to fulfill the UN Millennium Development Goal of cutting the number of hungry people in Africa in half by 2015, the project will address the role of aflatoxin (AF) in peanuts on malnutrition and health problems in the region. This will result in reduction in poverty and hunger, improved health and increase in rural income. The project will directly benefit women farmers, peanut growing communities, vulnerable groups including recently returned refugees in the northern Uganda region, widows, and most importantly malnourished infants.

The education (post-graduate education both in the host countries and the U.S.) and training (through workshops in the host countries) of scientists and technical personnel in host countries will result in capacity building to address challenges related to preventing and controlling contamination of the food supply. The technologies such as FTIR will provide opportunities to evaluate aflatoxin in all peanut products in a non-destructive rapid manner and manage aflatoxin contamination.

US Benefits

The US government has long recognized that world hunger and poverty present ethical challenges, and economic and political opportunities for this country. The Presidential Initiative to End Hunger in Africa (IEHA) targets Uganda and Kenya among other countries and aims to fulfill the UN Millennium Development Goal. American contributions to international efforts to combat the global AIDS epidemic mark the importance of this issue. This project will address this by investigating the link between AIDS and Aflatoxicosis, and opening avenues for value addition to contribute to rural livelihoods in East

Africa.

With the threats terrorism presents to the US, the importance of US scientists and institutions serving as good-will ambassadors in predominantly Muslim countries cannot be overestimated.

US trade interests will be served by opening markets in East Africa for peanut processing machinery, laboratory equipment, and supplies from American manufacturers.

Partnerships between US institutions with institutions in host countries enriches science, provides opportunities for US students, opportunities for US scientists to learn to make their research more relevant and apply their science within the context of real-life challenges in Africa. Virginia Tech as well as other universities from PCRSP benefit from collaboration with scientists in Uganda and Kenya, as well as the opportunity to conduct field research in the host countries. Besides research opportunities for students, the PCRSP program creates institutional relationships that pave the way for future international education exchanges. The benefit of current and future scientists gaining some understanding of the issues and complexities facing countries in the developing world cannot be underestimated.

Potential Impacts

Successful completion of this project will result in a better understanding of the link between AF contamination and health issues such as HBV, AIDS and malnutrition; it will provide data, training and technology to address these. This project will gauge AF levels in peanut and peanut products in select regions in Uganda and Kenya and offer strategies to mitigate health and economic impacts. It will help host countries, USAID, and development organizations plan appropriate preventive and control measures to reduce hunger and poverty, and improve health and rural livelihoods. Research will strengthen humanitarian efforts to supply nutritious food to vulnerable populations including internally displaced persons in northern Uganda. At the same time, it will allow local farmers and economies to benefit from such efforts by increasing markets for local peanuts. It will facilitate value-adding opportunities that empower women and increase household incomes for families. It brings the Presidential Initiative to End Hunger in Africa (IEHA) closer to meeting its goal.

Impact will be realized through implementation of control measures at the farm and market level by education, training and implementation of standards. Agricultural extension, local NGOs and women's organizations will be strengthened. Training of scientists and technical personnel in host countries will build capacity to address challenges related to preventing and controlling contamination of the food supply. Identification of local clays with ability to control aflatoxicosis could lead to important breakthroughs. Technologies such as FTIR will provide opportunities to evaluate all peanut products for AF contamination non-destructively and manage AF contamination. US trade

interests will be served by opening markets in East Africa for peanut processing machinery, laboratory equipment, and supplies from American manufacturers.

Equipment
None

Project Timeline
1. Epidemiological Studies - Year 1, Year 2, Year 3;
2. Aflatoxin risk assessment - Year 1, Year 2, Year 3, Year 5;
3. Identify local Clays - Year 2, Year 3, Year 4, Year 5;
4. FTIR deduction for AF - Year 2, Year 3;
5. HACCP, certification, storage - Year 1, Year 2, Year 3;
6. Ethnographic research - Year 1, Year 2, Year 3, Year 4;
7. Research methods workshop - Year 2;
8. Degree Training - Year 2, Year 3, Year 4;
9. Aflatoxin awareness and policy - Year 1, Year 2, Year 3, Year 4, Year 5;
10. Livelihood Strategies - Year 2, Year 3, Year 4, Year 5

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