# Research Proposal: Southern Africa Peanut Value Chain Interventions

## Description

Aflatoxin Management Interventions, Education, and Analysis at Various Steps within the Value Chain

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Zambia Agriculture Research Institute

## Partner Scientists and Colleagues

Dr. Tim Brenneman
Plant Pathology
University of Georgia
(provide pathology expertise)

Dr. J.W. Williams
Cropping Systems
University of Georgia
(provide systems expertise)

Dr. Greg MacDonald
Weed Science/IPM
University of Florida
(provide weed expertise)

Dr. Mike Deom
Virologist
University of Georgia
(provide virology expertise and germplasm)

Jim Goodman
Managing Director
Exagris Africa Ltd
Malawi
(coordinate test plots, seed multiplication, and farmer education)

Austin Ngwira
Agriculture Director
Clinton Development Initiative
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(coordinate test plots, seed multiplication, and farmer education)

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## Geographical Locations

Southern Africa including Malawi, Zambia and Mozambique

## Project Duration

October 1, 2013 –July 31, 2017

## Executive Summary

This project will address a wide range of production, post-harvest handling, and processing issues relative to peanut in Malawi, Zambia, and Mozambique that can impact aflatoxin contamination levels, yield, and profitability. The strength of this project is that interventions will be studied throughout the value chain and the cumulative effect of these efforts measured against traditional production and marketing practices. Through linkages with various partners, farmer education will be emphasized and extended linkages with various industries and marketing groups will help accelerate aflatoxin mitigation and market development.

Malawi has a strong history of research on peanut through ICRISAT, the Department of Agriculture Research at Chitedze Research Station, and Bunda College of Agriculture, but the ability of farmers to produce high yielding, high quality peanuts with low aflatoxin levels is still quite low. Additional agencies such as NASFAM (National Small Farmer Association of Malawi), the Ministry of Agriculture, Exagris, Afri-Nut, TWIN of the U.K., the Clinton Development Initiative and others are all engaged in further evaluation of production, processing, and marketing strategies as well as farmer education. Improved cultivars are available, but the lack of an effective seed program limits availability. Limited marketing due to high aflatoxin contamination levels exacerbates the problem by reducing farmer incentive to implement current production recommendations and limits commercial processing and marketing.

Our project with its multidisciplinary team takes a comprehensive approach to problem solving research and effective technology transfer through key partnerships with in country research counterparts and NGOs. The higher level of peanut research in Malawi will be expanded and emphasis placed on implementation and additional research efforts will be rapidly phased in to Zambia and Mozambique creating a regional project providing research data

with even wider scale application. Key components will include taking advantage of improved germplasm already available, in country aflatoxin testing equipment and technicians already in place, key production, processing, marketing, and technology transfer partners. Our project will address the challenges from production to processing including information transfer and aflatoxin awareness creation along the whole value chain. The project will use the unique and innovative approach known as PIIM (Peanut Industry incubator Model) to fast tracks the food process and product development cycle ensuring safe (aflatoxin free and microbiologically safe) and nutritious peanut based products. This model has been successfully implemented in other countries and requires early engagement in partnerships between research institutions and private seed and food industry partners (IP), and agreement during early stage of development work of research project through intensive interactions. In addition, this approach will include development of good manufacturing practices such as HACCP and facilitate the development of value added peanut based products that will increase the livelihood of farmers and industries. Moreover, the project will utilize the existing and new data bases from the surrounding market and nonmarket institutions to formulate and implement a strategy for the domestic peanut value chain capability for diversified and sustained supply of high quality and safe peanuts and peanut products.

## Project Description

### Goal

The goal of this project is to implement a broad, interdisciplinary research and technology program addressing aflatoxin contamination starting with cultivar selection and production through the entire value chain including post-harvest storage, processing, and marketing. This team will address a wide spectrum of technologies throughout the value chain and evaluate impacts to focus on those interventions that are viable in the southern Africa system and can elevate the potential for the production, processing, and marketing of low aflatoxin contaminated peanuts. One key to success of this project is a strong linkage to farmer education and technology transfer and collaboration with industries (seed and output markets).

### Relevance and Justification

Malawi has a long history of peanut production and for many decades was a consistent exporter of peanut to Europe. Peanut is also a popular crop in Mozambique and Zambia, providing food and income and reduced poverty for the smallholder farmers. Numerous events in the past twenty years have impacted production and trade including groundnut rosette disease and aflatoxin concerns in the EU. ICRISAT has a long history of peanut research

and significant contributions to the knowledge base regarding peanut production and alfatoxin mitigation. The challenges associated with peanut production in southern Africa are significant and while much progress has been made, there are still research areas that need further research. While groundnut production is still viable, reduced market incentives, aflatoxin and health issues, and concerns over climate change have created new challenges for producing high quality, profitable peanut. Current yields are relatively low, aflatoxin contamination is high, and organizations such as Afri-Nut and Valid Nutrition in Malawi struggle finding peanut sufficient for EU markets. While newer cultivars are used by some farmers, limited seed availability of improved varieties negatively impact yield, quality, and efficiency of production. Limited data on best production practices and pest management in the various production areas and lack of technology transfer result in farmer programs lacking a scientific basis for positive change are especially profound in Zambia and Mozambique. The major constraints in peanut value chain in the target countries include lack of:

1. post- harvest storage protecting and handling assuring peanut suitability and safety for value-adding activities,
2. knowledge and use of good manufacturing practices
3. wide availability of aflatoxin-free peanut-based products in the market place
4. high levels of plant stress in the field
5. poor harvest timing and techniques
6. further development and deployment of well adapted cutivars
7. limited rotations and other necessary cultural and agronomic practices and
8. challenges associated with technology transfer and effective farmer education
9. low efficiency in production to market processes.

Effective methods to minimize peanut aflatoxin contamination, starting with production and continuing through harvest, storage, and processing are critical. Humid conditions in these less industrialized nations, lack of storage facilities, low processing capacity and paucity of market information exacerbate the problem. Implicit is the assurance of safety of the products from aflatoxin, through training workshops on aflatoxin elimination, to provide compliance with international regulatory standards and thereby gain access to commercial distribution channels nationally and internationally. Thus, small industries, without capital resources for research, are able to bring to market peanut products that require research on its processing, and optimization based on consumer preferences.

The initial project's focus is Malawi building on the experience from previous projects implemented primarily by ICRISAT scientists. The necessary human capital is present in various national and international research labs, NGOs, and private companies in southern Africa to aggressively address the issue of research and technology gaps and farmer training relative to aflatoxin reduction. Addressing these constraints will increase the profitability of the peanut value chain and improve the health of producers and consumers of peanuts in Malawi, Mozambique and Zambia. While more work has been done in Malawi, this project will expand to Mozambique and Zambia and will utilize the knowledge gained in Malawi. Despite its high potential, the productivity of peanut in Mozambique remains low, limiting any serious engagement with export markets. Weak institutional arrangements and limited capacity to ensure quality also affect the peanut sector. Our phased approach in Mozambique will focus heavily on productivity enhancement and integrate aflatoxin mitigation from the beginning. Building on lessons learned in Malawi and recent efforts in Zambia, it is clear that the momentum already generated in Zambia can be leveraged to enhance productivity, promote aflatoxin mitigation strategies, and build capacity to test and promote quality and health standards. In these countries, the primary work force involved in the peanut value chain is women (farmers, traders and processors) and any economic development will enhance the livelihood of women-entrepreneurs and their families addressing the prevalent gender issues. The proposed project will also address the human capital improvement to offset the short supply of food processing professionals to improve the value chain including market information collection, processing and utilization in decision-making. Moreover, the team members at University of Georgia and Virginia Tech will employ a previously proven innovative approach used in South East Asia, Bulgaria, Ghana and Uganda referred to as PIIM (Peanut Industry incubator Model). The PIIM approach fast tracks the food process and product development cycle ensuring safe (aflatoxin free and microbiologically safe) and nutritious peanut based products. This model requires early engagement in partnerships between research institutions and private seed and food industry partners (IP), and agreement during early stage of development work of research project through intensive interactions. A key element involves front-end qualitative (interviews) and quantitative (house hold and market data research) for enhanced consumer insight leading to strategic product design, followed by incubation throughout the product development, transfer and commercialization. The peanut value chain in Mozambique has not yet been studied in any detail and understanding the links between players, the flows of information as well as the constraints and opportunities is essential for developing and implementing appropriate interventions. In Zambia, the project

will build on the existing work on value chains (under Feed the Future initiative) and use that information to guide the establishment and running of Innovation Platform, forums for research, development and private sector to diagnose and learn, jointly plan and coordinate activitess. Research centers will include North Carolina State University, the University of Georgia, Virginia Tech, Chitedze Agriculture Research Service, ICRISAT in Kenya, Malawi and Zimbabwe, Zambia Agricultural Research Institute, Bunda College of Agriculture in Malawi, and Lurio University and IIAM in Mozambique.

## Research Plan

### Objectives

There are ten key objectives with each playing a role in evaluating aflatoxin mitigation interventions implemented at various steps within the value chain:

1. Collaborate with the breeding project of Dr. Deom from the University of Georgia.
2. Evaluate the impact of reducing plant of pest stresses on *Aspergillus* infection and contamination. Evaluate cultural practices including rotation and harvest dates (maturity) with multiple cultivars on termite infestations, plant pathogens, and aflatoxin levels. Additionally, investigate drying techniques and storage insect pests and relationship to aflatoxin contamination.
3. Compare Level 1 (traditional village level) and Level 2 (latest technology-driven, comprehensive program) interventions on yield and aflatoxin contamination levels and utilize for farmer education with corporate farming enterprises and research stations (Chitedze, Exagris, Clinton Development Initiative).
4. Evaluate Malawi (ICRISAT) research base technology in Zambia and Mozambique
5. Develop risk indices based on soil characteristics, crop rotations, weather patterns, cultivars, and planting and harvest dates into a risk index to forecast aflatoxin incidence (based loosely on Australian models for maize and Auburn University model for peanuts).
6. Develop country specific appropriate and affordable storage conditions to reduce incidence of mold growth on raw peanuts
7. Develop and transfer appropriate good manufacturing practices (specifically HACCP) tailored to small and medium scale processors
8. Develop and transfer appropriate processing technologies to mitigate aflatoxin in the final peanut- based products.
9. Develop new and/or improve existing peanut-based products to address nutritional needs of the Population

10. Develop strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing peanut value chain information
11. Improve efficiency in the peanut sector through value chain analysis and household surveys
12. To identify options to improve the efficiency and profitability of the peanut value chain in Mozambique and Zambia.
13. Create multi-stakeholder forums (incl Learning Alliance and Innovation Platform) for cross-scale dialogue and learning (Mozambique and Zambia), prepare for up scaling the research outcomes and adjustments to future challenges

Role of each scientist/partner

Dr. Rick L. Brandenburg, Dr. Kai Mausch, Dr. David L. Jordan, Dr. Samuel Njoroge, Dr. Tito Fernandes, Dr. Manjeet Chinnan, Trust Donga, Dr. Agnes Mbachi Mwangwela, and Dr. Moses Siambi
will provide oversight and leadership. Key research team in Malawi (ICRISAT, Chitedze, and Bunda College of Agriculture) responsible for peanut agronomic studies, pest management research, and coordination with industry, processors, and industry groups with a focus on technology transfer.

Dr. Rick L. Brandenburg, Dr. David L. Jordan, and Brian Royals.
Key research personnel for research based in North Carolina to further address pest management complexities, cultural management strategies, and new cultivar integrations.

Dr, Kai Mausch
will provide leadership of value chain analysis

Dr. Rick L. Brandenburg, Dr. David L. Jordan, Dr. Samuel Njoroge, Prof. Tito Fernandes, Trust Donga.
Key research team for Malawi, Zambia and Mozambique for agronomic and pest management impact on aflatoxin research in southern Africa.

Dr. Manjeet S. Chinnan at the University of GA and P. Kumar Malliakrjunan at VA Tech.
Key research personnel for developing and transfer technologies related to post harvest operations and food processing.

Dr. Wojciech J. Florkowski at the University of Georgia.
Key research person to develop consumer data bases for marketing strategies of aflatoxin free peanut-based products.

Dr. Sabine Homann-Kee Tui
will lead/facilitate establishment of stakeholder forums in Mozambique and

Zambia, including a structured process to validate the research results with stakeholders, create awareness around aflatoxin mitigation options and introduce adaptation strategies.

## Collaborating and supporting partners

Dr. Tim Brenneman, Dr. J.W. Williams, Dr. Greg MacDonald, Dr. Mike Deom (no cost other than travel) to provide their expertise to the project on an as needed basis. Jim Goodman (Exagris), Austin Ngwira (CDI)
are willing to assist with seed multiplication, supporting research plots, and hosting farmer field schools and technology transfer. Paul Murphy, Tim De Borde, Andrew Emmott are key resources associated with marketing and processing and provide expertise, support, and insight into the research efforts to forecast aflatoxin contamination levels in the field and throughout the value chain.

## Annual work plan, milestones and timeline

### Year 1

*Southern Africa*
Meeting of all team members and refinement of objectives and work plans in Malawi (late 2013)

Evaluations of research technologies developed at ICRISAT in Malawi in field trials on station and in villages in Zambia and Mozambique in collaboration with Zambia Agricultural Research Institute and Lurio University with replicated research plots (limited in Mozambique in year 1).

Assessment of crop rotations and harvest date will be evaluated in replicated research plots on station in Zambia (led by Samuel Njoroge)

Comparative replicated research plots evaluating comprehensive peanut production management strategies (Level 2) at Chitedze, Exagris, and Clinton Development Initiative farms and compared to standard village production practices (Level 1). These studies will provide impact data for southern Africa peanut research, provide processors with insight into potential interventions to reduce aflatoxin contamination, provide baseline data for economic analysis, and be used by NASFAM, CDI, Exagris, Ministry of Agriculture and other groups for farmer field schools and education, awareness, and communication (led by DARS-Chitedze).

Assessment of termite abundance from ICRISAT-led research trials to evaluate impact of termites on yield and quality (led by Trust Donga).

Evaluations of drying techniques and impact on crop quality will be conducted in Malawi by ICRISAT (led by Samuel Njoroge )

Conduct surveys of farming households in Chinguluwe and Tembwe area to collect data on insect pest status and storage systems used by farmers, and other factors that affect groundnut utilization and aflatoxin contamination. (Led by Trust Donga at Bunda cooperating with Va Tech, ICRISAT).

Data will be collected on all research plots relative to all agronomic practices, harvest dates, soil, and weather information(rainfall and degree days) and used to create a risk indices for aflatoxin contamination. This will take advantage of knowledge gained from models on aflatoxin on maize in Australia and peanuts in Alabama, USA to develop a risk index. This will also incorporate previous ICRISAT studies and surveys to develop empirical models that give approximate risk ratings (led by NC State).

Assessment of existing storage conditions for raw peanuts along the value-chain and identification of areas for improvement (DARS-Chitedze, UGA, VT)

Assessment of prevalence of aflatoxin in peanut products from local markets and identification of target markets for further evaluation; and identification and examination of existing data bases in Malawi (Samuel Njoroge, DARS-Chitedze, UGA, VT)

Initiate identification of industrial partners (IPs) for improvement of existing processes and products or development of new processes and products in Malawi.

Implement protocols for engaging IPs in Malawi .

Identify processes and peanut based products and initiate development of new and/or improving existing processes and products in Malawi

Conduct workshops on improved processing techniques and HACCP to local traders and processors (UGA and Virginia Tech)

*In Mozambique (Led by K. Mausch):*

**Value chain survey** – Running at the same time as the baseline household survey, this activity will generate specific quantitative data along the peanut value chain. The survey will seek out information from the other actors along the chain (i.e., traders, private sector etc.) to understand the flow of the products from producers to consumers. The data will also generate information on the value addition along the chain. The value chain analysis will inform

identifying possible untapped opportunities and to determine the points of entry for specific interventions. By the end of the second year of the project there will be a full analysis of the data and a report produced.

**Baseline household survey as one crucial part of the value chain analysis** – 1200 households will be surveyed in two provinces in the first year. The survey will generate data on peanut production, management and marketing practices. This data will be used to establish the status quo at the time of the project inception and to provide a greater understanding of the current constraints facing farmers in Mozambique. In the second year of the project the data will be analyzed and a full report generated for project use and wider dissemination if need be.

**Nut health at household level** - In order to determine the presence and levels of aflatoxin in nuts at the farm level, the project will, in the first year, conduct surveys and collect samples of nuts from 200 households per province. This will be repeated at a later point in the season from the same households in order to determine the prevalence and levels of aflatoxin throughout the season. Eight hundred samples will be analyzed and the results reported by the end of the second year of the project.

**Nut health at market level** - In order to determine the safety of the nuts further along the value chain, the project will sample and test peanuts from various stages of the value chain. For example, nuts that have been held by traders before selling will be tested as will final products on supermarket shelves. Value addition practices can also be assessed for their likelihood in increasing aflatoxin contamination in this process. This activity will be conducted in year 1 and will use the value chain map developed in activity 2.

**Stakeholder workshops** – Stakeholder workshops will be held at local level to feed back the results of these surveys and obtain qualitative data that will verify the results with relevant actors. This process will also be useful in identifying possible solutions to improve the productivity and profitability of the peanut value chain and determining the feasibility of implementing these solutions. These workshops will also serve as a forum for discussing the problem of aflatoxin and the possible methods of mitigation. It can also be seen as platform for future upscaling of the research outcomes. These activities will take place in the first two years.

**Learning Alliance** – since the issue of aflatoxin will need policies and change at various levels and scales, the project will establish a Learning Alliance that will work at a national level. This platform will be used to encourage cross-scale dialogue and improve the likelihood of behavior change towards aflatoxin

mitigation. Results from the above activities will be used to provide evidence to policy makers of the prevalence of aflatoxin in Mozambique. The Learning Alliance will also be used to debate possible solutions and policies that could be implemented in the country.

In Zambia, we propose to use an Innovation Platform (IP) approach. The innovation platform will bring together various stakeholders along the peanut value chain to discuss the bottlenecks and solutions that could be implemented at the local level. The IPs will coordinate the necessary research that will need to be conducted or will source information from the research and development fraternity on possible solutions. These options will be collectively implemented and monitored. The process is iterative and flexible to accommodate for new emerging opportunities and challenges. The project will set up an IP in Zambia's Eastern Province where some value chain work is underway and there is a possibility to coordinate with the Feed the Future projects that are also operational there. (led by K. Mausch)

*U.S. (with future application in southern Africa)*

Multidisciplinary production and pest management research to investigate interactions amongst specific pest management strategies (North Carolina). Multiple locations of production and pest management strategies in replicated plots. Study interactions of various control methodologies on non- target components ie. impact of herbicides used at plant with in furrow insecticide rates on twin row production relative to stand counts, row cover, and yield. Study pesticide interactions for performance and phytotoxicity. Conduct trials on all primary cultivars in several locations throughout the production area. Additional trials will evaluate cost effective and reliable early season thrips management programs in replicated field trials. This will include three research farms: Peanut Belt Station at Lewiston, Rocky Mount Station and Whiteville Station as well as farmer fields.

Development of sustainable, non-traditional pest management approaches for insects, weeds, and diseases (North Carolina). Evaluations of non-chemical approaches will take place on three research stations in North Carolina. The primary treatment component will be cultivar with resistance used as the first line of control. Then cultural practices for the various pest challenges will be overlaid on the cultivars. Cultural practices will include planting dates, plant populations, twin vs single rows, harvest dates, etc. Each treatment and sub plot treatment will be evaluated for pest (weeds, diseases, insect) abundance and yield. Refinement of a decision support system for peanut production (North Carolina). The current decision support system for the virginia-carolina production area is maintained at North Carolina State University. Its relevancy

is dependent upon continual updates from research plots integrating changes in cultivars used in production systems and new plant protection and production products available. Research trials will be implemented at three university research locations (Lewiston, Rocky Mount, and Whiteville) and will utilize the newest cultivars into decision support trials. These will evaluate pest population responses based upon new cultivars and production management strategies and risk assignments modified based upon any variations observed. Development of HACCP plan for peanut processing (Virginia Tech) Design and development of alternative storage solutions (Virginia Tech)

Develop strategies to initiate development of new and/or improving existing processes and products in Malawi in light of availability of resources

Initiate development of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi

## Year 2

*Southern Africa*

Meeting of all team members to review Year 1 results and focus work plans based upon year 1 findings.

Evaluations of research technologies developed at ICRISAT in Malawi in field trials on station and in villages in Zambia and Mozambique in collaboration with Zambia Agricultural Research Institute and Lurio University with replicated research plots.

Assessment of crop rotations and harvest date will be evaluated in replicated research plots on station in Zambia (led by Samuel Njoroge).

Comparative replicated research plots evaluating comprehensive peanut production management strategies (Level 2) at Chitedze, Exagris, and Clinton Development Initiative farms and compared to standard village production practices (Level 1). These studies will provide impact data for southern Africa peanut research, provide processors with insight into potential interventions to reduce aflatoxin contamination, provide baseline data for economic analysis, and be used by NASFAM, CDI, Exagris, Ministry of Agriculture and other groups for farmer field schools and education, awareness, and communication (DARS-Chitedze).

Assessment of termite abundance from ICRISAT-led research trials to evaluate

impact of termites on yield and quality (led by Trust Donga).

Evaluations of drying techniques and impact on crop quality will be conducted in Malawi by ICRISAT (led by Samuel Njoroge).

Conduct surveys of farming households in Chinguluwe and Tembwe area to collect data on insect pest status and storage systems used by farmers, and other factors that affect groundnut utilization and aflatoxin contamination. (Led by Trust Donga at Bunda cooperating with Va Tech, ICRISAT).

Data will be collected on all research plots relative to all agronomic practices, harvest dates, soil, and weather information(rainfall and degree days) and used to create a risk indices for aflatoxin contamination. This will take advantage of knowledge gained from models on aflatoxin on maize in Australia and peanuts in Alabama, USA to develop a risk index. This will also incorporate previous ICRISAT studies and surveys to develop empirical models that give approximate risk ratings (led by NC State).

Implementation of alternative appropriate storage solutions.

Conduct workshop on GMP and HACCP with a follow-up to the previous participants.

Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products.

Continue to identify industrial partners (IPs) for improvement of existing processes and products or development of new processes and products in Malawi.

Continue to implement protocols for engaging IPs in Malawi.

Continue with the development of new and/or improving existing processes and products in Malawi.

Begin implementation of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi.

**Value chain survey** – finalization of full report.

**Baseline household survey as one crucial part of the value chain**

**analysis** – finalization of full report.

**Nut health at household level** - finalization of full report.

**Nut health at market level** - finalization of full report.

**Stakeholder workshops (2)** – Continue to facilitate the stakeholder workshops, using the research and secondary data to identify options for improving the peanut value chain, define capacity development needs and determine how selected technologies can be practically tested and promoted. This includes knowledge sharing on aflatoxin mitigation and possible methods of mitigation.

In Zambia, an Innovation Platform (IP) will be established in Zambia's Eastern Province. The innovation platform will bring together various stakeholders along the peanut value chain to discuss the bottlenecks and solutions that could be implemented at the local level. The IPs will coordinate the necessary research that will need to be conducted or will source information from the research and development fraternity on possible solutions. These options will be collectively implemented and monitored. The process is iterative and flexible to accommodate for new emerging opportunities and challenges. The IP will build on value chain work that is underway and will be coordinated with the Feed the Future projects that are also operational (led by K. Mausch).

*U.S. (with future application in southern Africa)*

Multidisciplinary production and pest management research to investigate interactions amongst specific pest management strategies and cultivars (North Carolina). Graduate student training.

Multiple locations of production and pest management strategies in replicated plots. Study interactions of various control methodologies on non-target components ie. impact of herbicides used at plant with in furrow insecticide rates on twin row production relative to stand counts, row cover, and yield. Study pesticide interactions for performance and phytotoxicity. Conduct trials on all primary cultivars in several locations throughout the production area. Additional trials will evaluate cost effective and reliable early season thrips management programs in replicated field trials. This will include three research farms: Peanut Belt Station at Lewiston, Rocky Mount Station and Whiteville Station as well as farmer fields.

Development of sustainable, non-traditional pest management approaches for insects, weeds, and diseases (North Carolina). Evaluations of non-chemical approaches will take place on three research stations in North Carolina. The

primary treatment component will be cultivar with resistance used as the first line of control. Then cultural practices for the various pest challenges will be overlaid on the cultivars. Cultural practices will include planting dates, plant populations, twin vs single rows, harvest dates, etc. Each treatment and sub plot treatment will be evaluated for pest (weeds, diseases, insect) abundance and yield.

Refinement of a decision support system for peanut production (North Carolina). The current decision support system for the virginia-carolina production area is maintained at North Carolina State University. Its relevancy is dependent upon continual updates from research plots integrating changes in cultivars used in production systems and new plant protection and production products available. Research trials will be implemented at three university research locations (Lewiston, Rocky Mount, and Whiteville) and will utilize the newest cultivars into decision support trials. These will evaluate pest population responses based upon new cultivars and production management strategies and risk assignments modified based upon any variations observed.

Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products.

Begin implementation of strategies for development of new and/or improving existing processes and products in Malawi in light of availability of resources.

Development of new and improved peanut based products.

Propose strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi.

## Year 3

*Southern Africa*

Meeting of all team members to review Year 2 results and focus work plans based upon year 2 findings.

Evaluations of research technologies developed at ICRISAT in Malawi in field trials on station and in villages in Zambia and Mozambique in collaboration with Zambia Agricultural Research Institute and Lurio University with replicated research plots.

Assessment of crop rotations and harvest date will be evaluated in replicated research plots on station in Zambia (led by Samuel Njoroge).

Comparative replicated research plots evaluating comprehensive peanut production management strategies (Level 2) at Chitedze, Exagris, and Clinton Development Initiative farms and compared to standard village production practices (Level 1). These studies will provide impact data for southern Africa peanut research, provide processors with insight into potential interventions to reduce aflatoxin contamination, provide baseline data for economic analysis, and be used by NASFAM, CDI, Exagris, Ministry of Agriculture and other groups for farmer field schools and education, awareness, and communication (led by DARS-Chitedze).

Assessment of termite abundance from ICRISAT-led research trials to evaluate impact of termites on yield and quality (led by Trust Donga).

Evaluations of drying techniques and impact on crop quality will be conducted in Malawi by ICRISAT (led by Samuel Njoroge).

Conduct surveys of farming households in Chinguluwe and Tembwe area to collect data on insect pest status and storage systems used by farmers, and other factors that affect groundnut utilization and aflatoxin contamination. (Led by Trust Donga at Bunda cooperating with Va Tech, ICRISAT).

Initiate development of risk index based on data collected. Collect more data where gaps exist and improve index.

Implementation and evaluation of alternative appropriate storage solutions.

Conduct workshop on GMP and HACCP with a follow-up to the previous participants.

Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products.

Continue with the development of new and/or improving existing processes and products in Malawi.

Initiate identification of industrial partners (IPs) for improvement of existing processes and products or development of new processes and products in Zambia.

Implement protocols for engaging IPs in Zambia.

Identify processes and peanut based products and initiate development of new and/or improving existing processes and products in Zambia.

Continue to implement and evaluate strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi.

Initiate assessment of prevalence of aflatoxin in peanut products from local markets and identification of target markets for further evaluation; and identification and examination of
existing data bases in Zambia.

**In Mozambique, a Learning Alliance will be established** – since the issue of aflatoxin will need policies and change at various levels and scales, the project will establish a Learning Alliance that will work at a national level. This platform will be used to encourage cross-scale dialogue and improve the likelihood of behavior change towards aflatoxin mitigation. Results from the above activities will be used to provide evidence to policy makers of the prevalence of aflatoxin in Mozambique. The Learning Alliance will also be used to debate possible solutions and policies that could be implemented in the country.

In Zambia, the Innovation Platform (IP) will continue in Zambia's Eastern Province. The focus will be on developing solutions for improving production to market processes, while including aflatoxin mitigation at all stages along the chain. Solutions must be tested and adapted to make sure they work. The innovation platform coordinates these experiments and monitors whether they are successful. Capacity development needs will be identified. The innovation platform identifies these needs and finds ways to develop the capacity required.

*U.S. (with future application in southern Africa)*

Multidisciplinary production and pest management research to investigate interactions amongst specific pest management strategies and cultivars (North Carolina). Graduate student training. Multiple locations of production and pest management strategies in replicated plots. Study interactions of various control methodologies on non-target components ie. impact of herbicides used at plant with in furrow insecticide rates on twin row production relative to stand counts, row cover, and yield. Study pesticide interactions for

performance and phytotoxicity. Conduct trials on all primary cultivars in several locations throughout the production area. Additional trials will evaluate cost effective and reliable early season thrips management programs in replicated field trials. This will include three research farms: Peanut Belt Station at Lewiston, Rocky Mount Station and Whiteville Station as well as farmer fields.

Development of sustainable, non-traditional pest management approaches for insects, weeds, and diseases (North Carolina). Evaluations of non-chemical approaches will take place on three research stations in North Carolina. The primary treatment component will be cultivar with resistance used as the first line of control. Then cultural practices for the various pest challenges will be overlaid on the cultivars. Cultural practices will include planting dates, plant populations, twin vs single rows, harvest dates, etc. Each treatment and sub plot treatment will be evaluated for pest (weeds, diseases, insect) abundance and yield.

Refinement of a decision support system for peanut production and regional expansion (North Carolina). The current decision support system for the virginia-carolina production area is maintained at North Carolina State University. Its relevancy is dependent upon continual updates from research plots integrating changes in cultivars used in production systems and new plant protection and production products available. Research trials will be implemented at three university research locations (Lewiston, Rocky Mount, and Whiteville) and will utilize the newest cultivars into decision support trials. These will evaluate pest population responses based upon new cultivars and production management strategies and risk assignments modified based upon any variations observed.

Develop strategies to initiate development of new and/or improving existing processes and products in Zambia in light of availability of resources.

Continue with the development of new and improved processes and peanut based products relevant to the US and Sothern Africa.

Initiate development of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Zambia.

Year 4

*Southern Africa*

Meeting of all team members to review Year 3 results and focus work plans based upon year 3 findings.

Evaluations of research technologies developed at ICRISAT in Malawi in field trials on station and in villages in Zambia and Mozambique in collaboration with Zambia Agricultural Research Institute and Lurio University with replicated research plots.

Assessment of crop rotations and harvest date will be evaluated in replicated research plots on station in Zambia (led by Samuel Njoroge).

Comparative replicated research plots evaluating comprehensive peanut production management strategies (Level 2) at Chitedze, Exagris, and Clinton Development Initiative farms and compared to standard village production practices (Level 1). These studies will provide impact data for southern Africa peanut research, provide processors with insight into potential interventions to reduce aflatoxin contamination, provide baseline data for economic analysis, and be used by NASFAM, CDI, Exagris, Ministry of Agriculture and other groups for farmer field schools and education, awareness, and communication (led by DARS-Chitedze).

Assessment of termite abundance from ICRISAT-led research trials to evaluate impact of termites on yield and quality (led by Trust Donga).

Evaluations of drying techniques and impact on crop quality will be conducted in Malawi by ICRISAT (led by Samuel Njoroge).

Conduct surveys of farming households in Chinguluwe and Tembwe area to collect data on insect pest status and storage systems used by farmers, and other factors that affect groundnut utilization and aflatoxin contamination. (Led by Trust Donga at Bunda cooperating with Va Tech, ICRISAT).

Validate risk index, provide to processors for feedback (NC State). Implementation and evaluation of alternative appropriate storage solutions.

Conduct workshop on GMP and HACCP with a follow-up to the previous participants.

Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products.

Continue with the development of new and/or improving existing processes

and products in Malawi and Zambia.

Begin implementation of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Zambia.

Initiate assessment of prevalence of aflatoxin in peanut products from local markets and identification of target markets for further evaluation; and identification and examination of existing data bases in Mozambique.

Focus on publication of research results.

Focus on impacts, accomplishments and additional research needs for Phase 2.

Increased linkages with processors and industry partners toward market development Economic analysis of impacts.

**The Learning Alliance will be continued in Mozambique**, with a focus on defining possible solutions and policies, based on an analysis of what has succeeded and what has not, and what has high chances of success in the country.

The Innovation Platform (IP) in Zambia's Eastern Province will emphasize evaluation of the solutions that have been put forward, especially in terms of productivity and profitability at farm level, improved value chain arrangements, suggested policy adjustments, lessons learned in the process and how these can be systematically linked and scaled out.

*U.S. (with future application in southern Africa)*

Publish research results Assemble all research findings into suitable manuscripts for refereed scientific publications and appropriate extension publications. Evaluate research findings for potential testing and evaluation in southern Africa.

Multidisciplinary production and pest management research to investigate interactions amongst specific pest management strategies and cultivars (North Carolina). Use research findings to update production manual. Multiple locations of production and pest management strategies in replicated plots. Study interactions of various control methodologies on non-target components ie. impact of herbicides used at plant with in furrow insecticide rates on twin row production relative to stand counts, row cover, and yield. Study pesticide

interactions for performance and phytotoxicity. Conduct trials on all primary cultivars in several locations throughout the production area. Additional trials will evaluate cost effective and reliable early season thrips management programs in replicated field trials. This will include three research farms: Peanut Belt Station at Lewiston, Rocky Mount Station and Whiteville Station as well as farmer fields.

Development of sustainable, non-traditional pest management approaches for insects, weeds, and diseases (North Carolina). Evaluations of non-chemical approaches will take place on three research stations in North Carolina. The primary treatment component will be cultivar with resistance used as the first line of control. Then cultural practices for the various pest challenges will be overlaid on the cultivars. Cultural practices will include planting dates, plant populations, twin vs single rows, harvest dates, etc. Each treatment and sub plot treatment will be evaluated for pest (weeds, diseases, insect) abundance and yield.

Refinement of a decision support system for peanut production and regional expansion (North Carolina). The current decision support system for the virginia-carolina production area is maintained at North Carolina State University. Its relevancy is dependent upon continual updates from research plots integrating changes in cultivars used in production systems and new plant protection and production products available. Research trials will be implemented at three university research locations (Lewiston, Rocky Mount, and Whiteville) and will utilize the newest cultivars into decision support trials. These will evaluate pest population responses based upon new cultivars and production management strategies and risk assignments modified based upon any variations observed.

Implement strategies to initiate development of new and/or improving existing processes and products in Zambia in light of availability of resources.

Continue with the development of new and improved processes and peanut based products relevant to the US and Sothern Africa.

Propose strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Zambia.

Initiate development of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Mozambique

## Outcomes and Impacts

- Refereed research publications
- Documentation of reductions in aflatoxin contamination at various steps of the value chain
- Economic analysis of research value and impact
- Risk index for aflatoxin
- Farmers trained
- Increased yields and quality in villages Number of farmers adopting specific practices Number of farmers adopting new cultivars
- Number of farmers adopting new drying techniques
- Seed distributed
- Gender issues

References cited

Letter of Support from the PI's Sponsored Programs Office or equivalent (see sample below)

## Gender Considerations

The examination and analysis of the existing data bases includes the roles and income effects at all stages of the peanut value chain; new data bases will account for gender role and income effects, including the ownership of peanut stocks, performance of pre-marketing functions, processing and trade in peanuts and peanut products. Cost effective peanut production improves market potential which can increase income. Improved quality through reduced aflatoxin contamination can potentially improve health of all consumers, but in particular to females who function as caregivers and provide significant labor. Higher yields and higher market value relate to increased income on few acres and reduced for the same income.

## Environmental Considerations

No research or evaluations of pesticides or genetically-modified organisms are planned in this proposal.

## Letter of Support from the PI's Sponsored Programs Office or Equivalent

Scope of Work

ICRISAT – Kenya

*K. Mausch*

**Overall Objective:** to identify options to improve the efficiency and profitability of the peanut value chain in Mozambique and Zambia

This objective will be carried out in only two out of the three focus countries in this project. Much research has already been conducted in Malawi on the peanut value chain and so this objective will focus on Mozambique and Zambia. The peanut value chain in Mozambique has not yet been studied in any detail and understanding the links between players, the flows of information as well as the constraints and opportunities is essential for developing and implementing appropriate interventions. In Zambia, the project will build on the existing work on value chains (under Feed the Future initiative) and use that information to guide the establishment and running of Innovation Platforms.

In Mozambique we plan to carry out the following activities:

1. **Value chain survey** – Running at the same time as the baseline household survey, this activity will generate specific quantitative data along the peanut value chain. The survey will seek out information from the other actors along the chain (i.e., traders, private sector etc.) to understand the flow of the products from producers to consumers. The data will also generate information on the value addition along the chain. The value chain analysis will serve as the basis of identifying possible untapped opportunities and to determine the points of entry for specific interventions. By the end of the second year of the project there will be a full analysis of the data and a report produced.
2. **Baseline household survey as one crucial part of the value chain analysis** – 1200 households will be surveyed in two provinces in the first year. The survey will generate data on peanut production and practices. This data will be used to establish the status quo at the time of the project inception and to provide a greater understanding of the current constraints facing farmers in Mozambique. In the second year of the project the data will be analyzed and a full report generated for project use and wider dissemination if need be.
3. **Nut health at household level** - In order to determine the presence and levels of aflatoxin in nuts at the farm level, the project will, in the first year, conduct surveys and collect samples of nuts from 200 households per province. This will be repeated at a later point in the season from the same households in order to determine the prevalence

and levels of aflatoxin throughout the season. Eight hundred samples will be analyzed and the results reported by the end of the second year of the project.

4. **Nut health at market level** - In order to determine the safety of the nuts further along the value chain, the project will sample and test peanuts from various stages of the value chain. For example, nuts that have been held by traders before selling will be tested as will final products on supermarket shelves. Value addition practices can also be assessed for their likelihood in increasing aflatoxin contamination in this process. This activity will be conducted in year 1 and will use the value chain map developed in activity 2.
5. **Stakeholder workshops** – Stakeholder workshops will be held at local level to feed back the results of these surveys and obtain qualitative data that will verify the results with relevant actors. This process will also be useful in identifying possible solutions to improve the productivity and profitability of the peanut value chain and determining the feasibility of implementing these solutions. These workshops will also serve as a forum for discussing the problem of aflatoxin and the possible methods of mitigation. These activities will take place in the first two years.
6. **Learning Alliance** – since the issue of aflatoxin will need policies and change at various levels and scales, the project will establish a Learning Alliance that will work at a national level. This platform will be used to encourage cross-scale dialogue and improve the likelihood of behavior change towards aflatoxin mitigation. Results from the above activities will be used to provide evidence to policy makers of the prevalence of aflatoxin in Mozambique. The Learning Alliance will also be used to debate possible solutions and policies that could be implemented in the country.

In Zambia, we propose to use an Innovation Platform (IP) approach. The innovation platform will bring together various stakeholders along the peanut value chain to discuss the bottlenecks and solutions that could be implemented at the local level. The IPs will coordinate the necessary research that will need to be conducted or will source information from the research and development fraternity on possible solutions. These options will be collectively implemented and monitored. The process is iterative and flexible to accommodate for new emerging opportunities and challenges. The project will set up an IP in Zambia's Eastern Province where some value chain work is underway and there is a possibility to coordinate with the Feed the Future projects that are also operational there.

Scope of Work

# N.C. State

*Rick Brandenburg and David Jordan*

Multidisciplinary production and pest management research to investigate interactions amongst specific pest management strategies (North Carolina). Multiple locations of production and pest management strategies in replicated plots. Study interactions of various control methodologies on non- target components ie. impact of herbicides used at plant with in furrow insecticide rates on twin row production relative to stand counts, row cover, and yield. Study pesticide interactions for performance and phytotoxicity. Conduct trials on all primary cultivars in several locations throughout the production area. Additional trials will evaluate cost effective and reliable early season thrips management programs in replicated field trials. This will include three research farms: Peanut Belt Station at Lewiston, Rocky Mount Station and Whiteville Station as well as farmer fields.

Development of sustainable, non-traditional pest management approaches for insects, weeds, and diseases (North Carolina). Evaluations of non-chemical approaches will take place on three research stations in North Carolina. The primary treatment component will be cultivar with resistance used as the first line of control. Then cultural practices for the various pest challenges will be overlaid on the cultivars. Cultural practices will include planting dates, plant populations, twin vs. single rows, harvest dates, etc. Each treatment and sub plot treatment will be evaluated for pest (weeds, diseases, insect) abundance and yield.

Refinement of a decision support system for peanut production (North Carolina). The current decision support system for the Virginia-Carolina production area is maintained at North Carolina State University. Its relevancy is dependent upon continual updates from research plots integrating changes in cultivars used in production systems and new plant protection and production products available. Research trials will be implemented at three university research locations (Lewiston, Rocky Mount, and Whiteville) and will utilize the newest cultivars into decision support trials. These will evaluate pest population responses based upon new cultivars and production management strategies and risk assignments modified based upon any variations observed.

Scope of Work

ICRISAT Malawi

*S. Njoroge*

Evaluations of research technologies developed at ICRISAT in Malawi in field trials on station and in villages in Zambia and Mozambique in collaboration with Zambia Agricultural Research Institute and Lurio University with replicated research plots. Assessment of crop rotations and harvest date will be evaluated in replicated research plots on station in Zambia.

Comparative replicated research plots evaluating comprehensive peanut production management strategies (Level 2) at Chitedze, Exagris, and Clinton Development Initiative farms and compared to standard village production practices (Level 1). These studies will provide impact data for southern Africa peanut research, provide processors with insight into potential interventions to reduce aflatoxin contamination, provide baseline data for economic analysis, and be used by NASFAM, CDI, Exagris, Ministry of Agriculture and other groups for farmer field schools and education, awareness, and communication.

Assessment of termite abundance from ICRISAT-led research trials to evaluate impact of termites on yield and quality and stored pest abundance and relationship to aflatoxin levels will be monitored in collaboration with Trust Donga, Bunda College of Agriculture. Evaluations of drying techniques and impact on crop quality will be conducted in Malawi by ICRISAT.

Conduct surveys of farming households in Chinguluwe and Tembwe area to collect data on insect pest status and storage systems used by farmers, and other factors that affect groundnut utilization and aflatoxin contamination.

Data will be collected on all research plots relative to all agronomic practices, harvest dates, soil, and weather information(rainfall and degree days) and used to create a risk indices for aflatoxin contamination. This will take advantage of knowledge gained from models on aflatoxin on maize in Australia and peanuts in Alabama, USA to develop a risk index. This will also incorporate previous ICRISAT studies and surveys to develop empirical models that give approximate risk ratings.

Scope of Work

# Focus Post Harvest Operations, Peanut Product and Process Development, and Marketing

*Project Title*

Aflatoxin Management Interventions at Various Steps within the Value Chain

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Overall this project will address a wide range of production, post-harvest handling, and processing issues relative to peanut in Malawi, Zambia, and Mozambique that can impact aflatoxin contamination levels, yield, and profitability. Our project with its multidisciplinary team will take a comprehensive approach to problem solving research and effective technology transfer through key partnerships with in country research counterparts and

NGOs. The higher level of peanut research in Malawi will be expanded and emphasis placed on implementation and additional research efforts will be rapidly phased in to Zambia and Mozambique creating a regional project providing research data with even wider scale application. The overall project will be led by Dr. Rick Brandenburg of NC State and detailed comprehensive proposal involving a score of collaborator and partners has been prepared.

A segment of the comprehensive project is led by Dr. Chinnan along with the US collaborators Dr. Florkowski of UGA and Dr. Mallikarjunan of VA Tech for the post production aspects of the project. The scope of that segment described below is for the funds available to Dr. Chinnan and Dr. Florkowski at UGA. Dr. Mallikarjunan at VA Tech will have his own budget at VA Tech.

Our project will use the unique and innovative approach known as PIIM (Peanut Industry incubator Model) to fast tracks the food process and product development cycle ensuring safe (aflatoxin free and microbiologically safe) and nutritious peanut based products. This model has been successfully implemented in other countries and requires early engagement in partnerships between research institutions and private food industry partners (IP), and agreement during early stage of development work of research project through intensive interactions. In addition, this approach will include development of good manufacturing practices such as HACCP and facilitate the development of value added peanut based products that will increase the livelihood. Moreover, the project will utilize the existing and new data bases from the surrounding market and nonmarket institutions to formulate and implement a strategy for the domestic peanut value chain capability for diversified and sustained supply of high quality and safe peanuts and peanut products.

Initial focus will be in Malawi and then the project will expand to Mozambique and Zambia and will utilize the knowledge gained in Malawi.

Following objectives will be addressed under the Scope of Work:

- Develop country specific appropriate and affordable storage conditions to reduce incidence of mold growth on raw peanuts
- Develop and transfer appropriate good manufacturing practices (specifically HACCP) tailored to small and medium scale processors
- Develop and transfer appropriate processing technologies to mitigate aflatoxin in the final peanut-based products.
- Develop new and/or improve existing peanut-based products to address nutritional needs of the population
- Develop strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing

peanut value chain information

*Role of each scientist/partner*

*Dr. Manjeet S. Chinnan at the University of GA and P. Kumar Mallikarjunan at VA Tech*

Key research personnel for developing and transfer technologies related to post harvest operations and food processing.

*Dr. Wojciech J. Florkowski at the University of Georgia*

Key research person to develop consumer data bases for marketing strategies of aflatoxin free peanut-based products.

*Annual work plan, milestones and timeline*

*Year 1*

*Southern Africa*

- Meeting of all team members and refinement of objectives and work plans in Malawi
- (late 2013)
- Assessment of existing storage conditions for raw peanuts along the value-chain and identification of areas for improvement (VA Tech and UGA)
- Assessment of prevalence of aflatoxin in peanut products from local markets and identification of target markets for further evaluation; and identification and examination of existing data bases in Malawi
- Initiate identification of industrial partners (IPs) for improvement of existing processes and products or development of new processes and products in Malawi.
- Implement protocols for engaging IPs in Malawi.
- Identify processes and peanut based products and initiate development of new and/or improving existing processes and products in Malawi
- Conduct workshops on improved processing techniques and HACCP to local traders and processors (UGA and Virginia Tech)

*U.S.*

- Development of HACCP plan for peanut processing (Virginia Tech)
- Design and development of alternative storage solutions (Virginia Tech)
- Develop strategies to initiate development of new and/or improving

existing processes and products in Malawi in light of availability of resources
- Initiate development of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi

## *Year 2*

*Southern Africa*

- Meeting of all team members to review Year 1 results and focus work plans based upon year 1finding.
- Implementation of alternative appropriate storage solutions
- Conduct workshop on GMP and HACCP with a follow-up to the previous participants
- (VA Tech and UGA)
- Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products
- Continue to identify industrial partners (IPs) for improvement of existing processes and products or development of new processes and products in Malawi.
- Continue to implement protocols for engaging IPs in Malawi
- Continue with the development of new and/or improving existing processes and products in Malawi
- Begin implementation of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi

*U.S.*

- Begin implementation of strategies for development of new and/or improving existing processes and products in Malawi in light of availability of resources
- Development of new and improved peanut based products
- Propose strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi

## *Year 3*

*Southern Africa*

- Meeting of all team members to review Year 2 results and focus work

plans based upon year 2 findings.
- Initiate development of risk index based on data collected. Collect more data where gaps exist and improve index.
- Implementation and evaluation of alternative appropriate storage solutions
- Conduct workshop on GMP and HACCP with a follow-up to the previous participants
- Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products
- Continue with the development of new and/or improving existing processes and products in Malawi
- Initiate identification of industrial partners (IPs) for improvement of existing processes and products or development of new processes and products in Zambia.
- Implement protocols for engaging IPs in Zambia
- Identify processes and peanut based products and initiate development of new and/or improving existing processes and products in Zambia
- Continue to implement and evaluate strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Malawi
- Initiate assessment of prevalence of aflatoxin in peanut products from local markets and identification of target markets for further evaluation; and identification and examination of existing data bases in Zambia

*U.S.*

- Develop strategies to initiate development of new and/or improving existing processes and products in Zambia in light of availability of resources
- Continue with the development of new and improved processes and peanut based products relevant to the US and Sothern Africa
- Initiate development of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Zambia

*Year 4*

*Southern Africa*

- Meeting of all team members to review Year 3 results and focus work plans based upon year 3 findings
- Conduct workshop on GMP and HACCP with a follow-up to the previous participants

- (VA Tech and UGA)
- Development and transfer of appropriate processing technologies to mitigate aflatoxin in the final peanut-based products
- Continue with the development of new and/or improving existing processes and products in Malawi and Zambia
- Begin implementation of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Zambia
- Initiate assessment of prevalence of aflatoxin in peanut products from local markets and identification of target markets for further evaluation; and identification and examination of existing data bases in Mozambique
- Focus on publication of research results
- Focus on impacts, accomplishments and additional research needs for Phase 2
- Increased linkages with processors and industry partners toward market development.

*U.S.*

- Publish research results Assemble all research findings into suitable manuscripts for refereed scientific publications and appropriate extension publications.
- Implement strategies to initiate development of new and/or improving existing processes and products in Zambia in light of availability of resources
- Continue with the development of new and improved processes and peanut based products relevant to the US and Sothern Africa.
- Propose strategies for addressing market challenges for diversified value added peanut
- products by developing data bases from new and existing consumer information in
- Zambia
- Initiate development of strategies for addressing market challenges for diversified value added peanut products by developing data bases from new and existing consumer information in Mozambique.

Virginia Tech

## Scope of Work

*Kumar Mallikarjunan*

The PI, Kumar Mallikarjunan from Virginia Tech will work with Dr. Manjeet Chinnan, University of Georgia on post-harvest handling, storage and value

added product/process development in Malawi, Mozambique and Zambia. Post-harvest storage solutions will be developed that are affordable and appropriate to the region. The design of handling and storage solutions and process development of value added products would be conducted as a part of undergraduate research and capstone design project at Virginia Tech. The students will work with local clients in the region in identifying design solutions and implementation of such solutions.

The project will use the unique and innovative approach known as PIIM (Peanut Industry incubator Model) to fast track the food process and product development cycle ensuring safe (aflatoxin free and microbiologically safe) and nutritious peanut based products. This model requires early engagement in partnerships between research institutions and private food industry partners (IP), and agreement during early stage of development work of research project through intensive interactions. In addition, this approach will include development of good manufacturing practices such as HACCP and facilitate the development of value added peanut based products that will increase the livelihood. Women owned and small-scale peanut processors will be identified and will be partnered to work in this PIIM. Training the processors on good manufacturing practices and Hazard Analysis Critical Control Points will address the reduction of aflatoxin in the finished product.