

# **Feed the Future Innovation Lab for Collaborative Research on Grain Legumes (Legume Innovation Lab)**

## **FY 2016 WORKPLAN**

**Project Code and Title:** Legumes and growth

**Lead U.S. Principal Investigator (PI) and affiliated Lead U.S. University:**

Mark Manary MD, Helene Roberson Professor of Pediatrics  
Washington University School of Medicine in St. Louis

**Host Country and U.S. Co-PIs and Institutions:**

- Ken Maleta MBBS PhD, Professor in Community Health, University of Malawi College of Medicine
- Chrissie Thakwalakwa PhD Lecturer in Community Health, University of Malawi College of Medicine
- Indi Trehan MD, Assistant Professor of Pediatrics, Washington University School of Medicine in St. Louis

### **I. Project Problem Statement and Justification:**

Each year millions of children in Africa die from malnutrition and even more are stunted due to nutritional and absorption deficiencies, interventions to help children affected and at risk are urgently needed to improve the lives of these children. Environmental enteropathy (EE), a pervasive chronic subclinical gut inflammatory condition is prevalent amongst these children and places them at high risk for stunting, malabsorption, and poor oral vaccine efficacy. EE is characterized by T-cell infiltration of the intestinal mucosa leading to a chronic inflammatory state with increased intestinal permeability, translocation of gut microbes, micro- and macronutrient malabsorption, poor weight gain, stunted physical and cognitive development, frequent enteric infections, and decreased response to enteric vaccines. EE often develops within the first three years of life, a high-risk period marked also by the transitions from exclusive breastfeeding to mixed feeding with complementary foods to the complete reliance on adult foods for sustenance. In traditional sub-Saharan African societies, complementary foods are dominated by protein-poor and micronutrient-poor starches such as maize, cassava, and sorghum. Alternative, yet culturally acceptable, complementary foods that could provide a better and more palatable balance of nutrients would potentially decrease in EE and improve growth amongst these at risk children. Legumes provide just such an opportunity, as their protein content is significantly higher than cereals, and they are rich in dietary fiber, starch, minerals, vitamins, and antioxidants.

### **II. Project Activities for the FY 2016 Workplan Period (October 1, 2015 – September 30, 2016)**

We will complete the clinical components of two randomized, controlled clinical trials investigating the effect of cowpea or common bean consumption on infant and young child growth and gut health.

#### **Objective 1:**

Enrollment, intervention delivery and specimen collection in infants with a dietary legume.

**Collaborators:**

University of Malawi, College of Medicine

**Approaches and Methods:**

Evaluate changes in childhood anthropometry (height-for-age and weight-for-height z scores), biomarkers of EE (lactulose:mannitol and a panel of human mRNA messages predictive of EE) and the characteristics of the microbiome (population taxonomy from phyla to genus, and the collective metabolic capacity expressed as Kyoto Encyclopedia of Genes and Genomes (KEGG) categories) after inclusion of either cowpeas or common beans as an integral component of complementary feeding for 6-11 month-old rural Malawian children.

*Study population.* Approximately 300 healthy children aged 6-11 months in villages surrounding Mitondo in the Chikwawa District of southern Malawi and Llmela in Machinga District will be randomized to receive a legume-based complementary food made from cowpeas, common beans or an isoenergetic amount of corn flour, a traditional Malawian complementary food. These villages are very similar in that the residents are subsistence farmers growing maize on small plots, live in mud huts with thatch roofs, and use boreholes or nearby streams as their water source.

These infants will be recruited between the ages of 5.5 and 6.5 months, and their participation will last for 6 months. Enrollment will be ongoing, and extend over a 9 month period and involve health surveillance assistants, midwives, and other local health staff and village leaders to maximize outreach into the community. Given our extensive prior experience working in this community and our excellent working relationship with the Ministry of Health and District Health Officers in this area, we are optimistic about community engagement and subject retention.

Eligible infants will be screened by the research supervisors and physicians from our team. Specific exclusion criteria will be severe or moderate acute malnutrition, severe developmental delay or congenital malformations (including congenital heart disease) or any other known chronic disorder. After a thorough, tiered informed consent process presented to the community and parents, written as well as oral consent will be sought from the primary caretaker, who is almost always the mother or another matriarchal figure. Attempts will be made to engage any paternal figures in the household in the consenting process as well in order to maximize compliance with the study interventions and decrease attrition. Any caretakers reluctant to participate will not be encouraged to do so, and any participant desiring to leave the study after enrollment will be allowed to do so without coercion. This method of informed consent has been used successfully by the research team in the past, and been endorsed by the University of Malawi College of Medicine Research and Ethics Committee and the Washington University Human Research Protection Office.

**Objective 2:**

Develop and test the acceptability of two sets of 3-4 recipes that include either cowpeas or common beans for use 12 – 35 month old rural Malawian children in the clinical trial.

**Collaborators:**

The Department of Food Science and Technology on the Bunda Campus of the Lilongwe University of Agriculture and Natural Resources (LUANAR): LUANAR, formerly known as the Bunda College of Agriculture.  
Malawi College of Medicine

**Approaches and Methods:**

Using food development techniques used by the Washington University team and the resources of LUANAR, the research team will develop food recipes using cowpeas and common beans. The recipes will be developed in accordance with the WHO specifications: The candidate recipes will then undergo acceptability testing in by children similar to the study population over a 2-week period to select those to be used in the study, the acceptability studies will receive the support of the Malawi College of Medicine. Prior to initiating the acceptability trial, we will submit ethical approvals for both the Malawian College of Medicine and the Washington University Human Research Protection Office for approval.

**Objective 3:**

Enrollment, intervention delivery and specimen collection in young children with a dietary legume.

**Collaborators:**

University of Malawi

**Approaches and Methods:**

Evaluate changes in childhood anthropometry (height-for-age and weight-for-height z scores), biomarkers of EE (lactulose:mannitol and a panel of human mRNA messages predictive of EE) and the characteristics of the microbiome (population taxonomy from phyla to genus, and the collective metabolic capacity expressed as Kyoto Encyclopedia of Genes and Genomes (KEGG) categories) after inclusion of either cowpeas or common beans as an integral component of complementary feeding for 12-24 month-old rural Malawian children.

*Study population.* Approximately 300 healthy children aged 12-24 months in villages surrounding Mitondo in the Chikwawa District of southern Malawi and Llmela in Machinga District will be randomized to receive a legume-based complementary food made from cowpeas, common beans or an isoenergetic amount of corn flour, a traditional Malawian complementary food. These villages are very similar in that the residents are subsistence farmers growing maize on small plots, live in mud huts with thatch roofs, and use boreholes or nearby streams as their water source.

These infants will be recruited between the ages of 12-24 months, and their participation will last for 12 months. Enrollment will occur in 3 month period and involve health surveillance assistants, midwives, and other local health staff and village leaders to

maximize outreach into the community. Given our extensive prior experience working in this community and our excellent working relationship with the Ministry of Health and District Health Officers in this area, we are optimistic about community engagement and subject retention.

Eligible children will be screened by the research supervisors and physicians from our team. Specific exclusion criteria will be severe or moderate acute malnutrition, severe developmental delay or congenital malformations (including congenital heart disease) or any other known chronic disorder. After a thorough, tiered informed consent process presented to the community and parents, written as well as oral consent will be sought from the primary caretaker, who is almost always the mother or another matriarchal figure. Attempts will be made to engage any paternal figures in the household in the consenting process as well in order to maximize compliance with the study interventions and decrease attrition. Any caretakers reluctant to participate will not be encouraged to do so, and any participant desiring to leave the study after enrollment will be allowed to do so without coercion. This method of informed consent has been used successfully by the research team in the past, and been endorsed by the University of Malawi College of Medicine Research and Ethics Committee and the Washington University Human Research Protection Office.

**Objective 4 :** Increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors in Malawi.

**Collaborators:**

University of Malawi  
LUANAR

While initiating Study Aims, the PI and his research team will promote sustainable research through relationships with the Malawi College of Medicine and with colleagues at LUANAR. The research team recognizes how integral it is that local Malawi institutions be equipped to initiate and conduct operational health, nutrition and agriculture studies to improve the health and wellness of its population, and extensive training and support will be offered. Chrissie Thakwalakwa of the College of Medicine, who received her PhD with support from the LIL, will be charged with developing the study procedures, guidelines and materials for the study, she will be under the guidance of the PI and his research team. The Agriculture Department at LUANAR, led by Vernon Kambambe, will be engaged developing formulations and recipes using cowpeas and common beans, the PI and his team will train two student LUANAR food scientists on the development processes used in the Washington University food science labs.

*Trainees*

Chrissie Thakwalakwa – PhD Candidate, Malawi College of  
Medicine 2 students from LUANAR to develop recipes  
2 COM PhD students to conduct the research project

**III. Contribution of Project to USAID Feed the Future Performance Indicators:**

This project supports the US Government's Feed the Future commitment to a multifaceted approach to nutrition and sustainably reducing global poverty and hunger. EE is estimated to cause about one third of the child stunting seen worldwide and the causes of EE are multifactorial. Our project aligns with these goals: developing a dietary intervention for children at risk for malnutrition and enteropathy using legumes, a local and common Malawian crop, is an opportunity to harness a local crop to resolve widespread condition afflicting children across the developing world. In the first year of the project we will set forth the methodology and training to develop a food that can treat this condition, and also train local universities and students on the methods to conduct this kind of research.

#### **IV. Outputs:**

- Recipe development report on lab development of cowpea and common bean interventions
- Enrollment and initial study results

#### **V. Engagement of USAID Field Mission(s)**

Continued communication, engagement and collaboration are planned with Cybill Sigler and John Edgar from the FTF team at the USAID mission in Lilongwe, Malawi. They will take on an associate role in this project. The PI and his team will remain in communication with their team and look for the potential of future engagements.

#### **VI. Partnering and Networking Activities:**

The PI and his team will work with the Program Manager for the Soil Health Consortium of Malawi about spreading the word about the projects development. The main role of the consortium is to encourage stakeholders to disseminate knowledge on Integrated Soil Fertility Management (ISFM), which includes legume rotation. The consortium holds ISFM symposia, travel workshops, and annual meetings, producing technical and policy briefs after these various consultations. Our research team will communicate with their group about relevant advances and technologies in the legume sector. All project outputs will be shared with these groups and the research team will seek out opportunities for synergy and collaboration.

#### **VII. Leveraged Resources:**

Ken Maleta is a lead member of the Investigation of Lipid Nutrient Supplements (iLiNS) project, a large Bill and Melinda Gates Foundation-supported effort in Malawi. He provides a direct link between this legumes project and any other international nutrition programs in Malawi.

Equipment will be shared with the iLiNS project, reducing the costs. All results will be presented at international nutrition and food research meetings focused on FTF themes, which will allow an opportunity to synergize with other projects.

#### **VIII. Timeline for Achievement of Milestones of Technical Progress:**

*See attached Milestones*

**Appendix 1: Workplan for Training and Capacity Strengthening (FY 2016)** (use format below).

**Degree Training:**

1. Nicole Benzoni, USA, Female  
Washington University in St. Louis, MPHS (Master of Population Health Sciences)  
Supervisor: Mark Manary  
Participant Trainee: Yes  
Host Country Institution to Benefit from Training: LUANAR  
Research Area: Development of common bean and cowpea flour recipes  
May 2015 – July 2015  
Training status: Completed  
Type of LIL Support: Indirect
2. Lucy Bollinger, USA, Female  
Washington University in St. Louis, MA in Biological Sciences  
Supervisors: Mark Manary and Indi Trehan  
Participant Trainee: Yes  
Host Country Institutions to Benefit from Training: LUANAR and University of Malawi College of Medicine  
Research Areas: Production and quality control of common bean and cowpea flour recipes; Clinical trial of flours to improve EED and stunting  
June 2015 – May 2016  
Training status: Active  
Type of LIL Support: Indirect
3. Kevin Stephenson, USA, Male  
Non-degree Training  
Supervisors: Mark Manary, Ken Maleta, Chrissie Thakwalakwa, Indi Trehan  
Participant Trainee: Yes  
Host Country Institutions to Benefit from Training: University of Malawi College of Medicine  
Research Area: Clinical trial of flours to improve EED and stunting  
July 2015 – May 2016  
Training Status: Active  
Type of LIL Support: Direct
4. Sophia Agapova, USA, Female  
Non-degree Training  
Supervisors: Mark Manary, Ken Maleta, Chrissie Thakwalakwa, Indi Trehan  
Participant Trainee: Yes  
Host Country Institutions to Benefit from Training: University of Malawi College of Medicine  
Research Area: Clinical trial of flours to improve EED and stunting  
July 2015 – May 2016  
Training Status: Active  
Type of LIL Support: Indirect
5. Theresa Ngoma, Malawi, Female

- LUANAR, MSc in Food Science and Technology  
 Supervisors: Mark Manary, Ken Maleta, Indi Trehan  
 Participant Trainee: Yes  
 Host Country Institutions to Benefit from Training: LUANAR  
 Research Areas: Development of common bean and cowpea flour recipes ;  
 Production and quality control of common bean and cowpea flour recipes  
 January 2015 – December 2015  
 Training status: Active  
 Type of LIL Support: Direct
6. Ulemu Chimimba, Malawi, Female  
 LUANAR, MSc in Food Science and Technology  
 Supervisors: Mark Manary, Ken Maleta, Indi Trehan  
 Participant Trainee: Yes  
 Host Country Institutions to Benefit from Training: LUANAR  
 Research Areas: Development of common bean and cowpea flour recipes ;  
 Production and quality control of common bean and cowpea flour recipes  
 January 2015 – December 2015  
 Training status: Active  
 Type of LIL Support: Direct
7. Yankho Kaimila, Malawi, Female  
 University of Malawi College of Medicine, PhD in Epidemiology  
 Supervisors: Mark Manary, Ken Maleta, Indi Trehan  
 Participant Trainee: Yes  
 Host Country Institutions to Benefit from Training: LUANAR  
 Research Areas: Clinical trial of flours to improve EED and stunting; Laboratory  
 techniques to measure biomarkers of EED  
 August 2015 – July 2017 (estimated)  
 Training status: Active  
 Type of LIL Support: Direct
8. Oscar Divala, Malawi, Male  
 University of Malawi College of Medicine, PhD in Epidemiology  
 Supervisors: Mark Manary, Ken Maleta, Indi Trehan  
 Participant Trainee: Yes  
 Host Country Institutions to Benefit from Training: LUANAR  
 Research Areas: Clinical trial of flours to improve EED and stunting; Laboratory  
 techniques to measure biomarkers of EED  
 August 2015 – July 2017 (estimated)  
 Training status: Active  
 Type of LIL Support: Direct

Short-term Training: Recipe Development

Type of training: Recipe development for dietary interventions

Description of training activity: Develop recipes based on WHO recommendations for dietary interventions using cowpeas and common beans

Location: LUANAR Duration: 2 months

When will it occur? October 2015

Participants/Beneficiaries of Training Activity: Graduate students and researchers at LUANAR

anticipated numbers of Beneficiaries (male and female): 2

PI/Collaborator responsible for this training activity: Mark Manary List other funding sources that will be sought (if any): None

Training justification: By engaging students and faculty at LUANAR, the development of appropriate recipes for our chosen legume varieties will also be culturally sensitive and feasible in the village setting, and the interventions that are successful are more likely to be implemented for the long term. Students will also be trained by the Washington University research team, a group that has successfully developed over 50 recipes in prior studies that have been accepted by the Malawian general population.

Short-term Training: Staff Field Training

Type of training: Field training for research activities

Description of training activity: Training study research nurses, drivers, research assistants and staff on the field study guidelines. Trainees will receive training in "Good Clinical Practice" guidelines, anthropometric data collection skills, biological sample collection methods and community engagement.

Location: Malawi College of Medicine Duration: 1 week

When will it occur? November 2015/ongoing

Participants/Beneficiaries of Training Activity: Research team Anticipated numbers of Beneficiaries (male and female): 10

PI/Collaborator responsible for this training activity: Indi Trehan and Ken Maleta List other funding sources that will be sought (if any): None

Training justification: this training is necessary to conduct the research projects, having a knowledgeable and capable staff is imperative to conducting this research.

Equipment (costing >\$5,000):