Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
LEGUME INNOVATION LAB

2015 ANNUAL TECHNICAL PROGRESS REPORT
(October 1, 2014 – September 30, 2015)

Project Code and Title: Legumes and growth

Lead U.S. Principal Investigator and University:
Mark Manary MD, Helene Roberson Professor of Pediatrics
Washington University School of Medicine in St. Louis

Collaborating Host Country and U.S. 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. Abstract of research achievements and impacts

In FY 14-15, this project initiated several activities to meet the objectives of evaluating changes in childhood anthropometry, biomarkers of environmental enteropathic dysfunction (EED), and the characteristics of the intestinal microbiome after inclusion of either cowpeas or common beans as an integral component of complementary feeding in two large cohorts of rural Malawian children. In FY13-14, the project obtained IRB approval, conducted acceptability trials to determine the food formulas, and create the operational manual that contains operating procedures that are being utilized for the duration of trail was developed. The operational manual was developed by Chrissie Thakwalakwa, who completed her PhD in Public Health Nutrition utilizing this study to complete her thesis. The local team implementing the clinical trial continues ongoing training in the principles of "Good Clinical Practice." Two Malawian Master level students enrolled at LUANAR and 2 Malawian PhD students enrolled at the University of Malawi-College of Medicine were identified and began work on the project. More than 50% enrollment in Study 1 and full enrollment in Study 2 have been completed.

II. Project Problem Statement and Justification

Successful interventions to help prevent children from becoming malnourished and achieve their full growth potential remain lacking. EED, a pervasive chronic subclinical gut inflammatory condition, places rural children at high risk for malabsorption, stunting, and acute malnutrition. Minimizing EED is an essential step in improving the survival and growth of at-risk children. EED is characterized by T-cell infiltration of the

intestinal mucosa leading to a chronic inflammatory state with increased intestinal permeability, translocation of microbes, nutrient malabsorption, poor weight gain, stunted physical and cognitive development, frequent enteric infections, and decreased response to enteric vaccines. EED often begins to develop shortly after the transition away from exclusive breastfeeding and increases progressively during the first several years of life, a high-risk period marked by 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 EED and improve growth amongst these at risk children. In this study, we are testing two different legume foods as complementary food products, given that their protein content is significantly higher than cereals, and they are rich in dietary fiber, starch, minerals, vitamins, and antioxidants. The active engagement of several Malawian graduate students as part of the capacity-building activities is essential to this work, as their local insights and knowledge of food systems and cultural feeding practices will help guide the optimal development and implementation of these bean flours at scale if they prove to be successful in reducing EED and stunting.

III. Technical Research Progress

Objective 1:

Develop a working Manual of Operations to conduct the research projects in the field.

The Manual of Operation to conduct the research projects in the field was developed by Chrissie Thakwalakwa with input from the rest of the research team. The study procedure guide describes the mode of operations for all study related participants and community interactions, including clinic operations, patient and participant screening, participant consent, enrollment, and food distribution. The manual also provides guidelines for data collection, giving instructions on surveys, home visits, anthropometric techniques, the collection of biological samples, and event reporting procedures for any unexpected and adverse events. The manual provides the field work directives for the field team.

Objective 2:

Develop and test the acceptability of two sets of 3-4 recipes that include either cow peas or common beans for use infants in the clinical trial.

The LUANAR graduate students developed food recipes using cowpeas and common beans. The recipes were developed in accordance with WHO specifications and the candidate recipes underwent acceptability testing in Malawian infants with the support of the Malawi College of Medicine. The acceptability data from these studies has been submitted for publication. The preferred flour recipes have been selected and are currently being used in the clinical trials.

Objective 3:

Complete preparations to initiate study aim 1, including staff recruitment, training and community engagement and organization.

All ethical approvals were obtained from the institutional review boards at the University of Malawi College of Medicine and Washington University in St. Louis. Two Food Science and Technology master level students were recruited and enrolled at LUANAR. Also, two PhD students were recruited at the Malawi College of Medicine. All local staff were recruited and underwent extensive training in Clinical Good Practice techniques and data collection methods to properly conduct all enrollment and data collection. The field teams visited the areas near Masenjere in Nsanje District and Limela in Machinga District to mobilize and engage the district in the research project and started the study in these areas. More than 50% enrollment in Study 1 and full enrollment in Study 2 have been completed. Meetings with local community leaders and health centers continue to take place.

Objective 4:

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

The PI and the research team continue to promote sustainable research through relationships with the University of Malawi College of Medicine and with colleagues at LUANAR. In addition to the training of four graduate students, a junior faculty member, Chrissie Thakwalakwa at the College of Medicine, continues to be supported by this project and provide overall supervision of the field studies. The Agriculture Department at LUANAR was engaged in developing the formulations and recipes using cowpeas and common beans, and the Washington University team trained two student LUANAR food scientists on the development processes used in the Washington University food science lab. The LUANAR masters students continue to be engaged in the clinical trial even after having developed the food recipes, supervising bean sourcing, flour production, preparation, and safety monitoring of the intervention foodss.

IV. Major Achievements

1. Development of the Operational Manual to delineate procedures and guidelines for the conduct of the clinical trials.
2. Chrissie Thakwalakwa received her PhD, supporting the Aim of capacity building.
3. Development and testing of multiple legume recipes and completion of an acceptability study involving more than 100 children to help determine the optimal recipes for usage in the clinical trial.
4. Identification and preparation of the two large clinical trial sites, including education of local village health workers and engagement of community leadership.
5. Submission of the first manuscript from the study to a peer-reviewed journal, describing the study motivation, methods, and progress to date.

6. More than 50% enrollment in Study 1 and 100% enrollment in Study 2, requiring a large amount of effort and resources, including collaboration in the districts where the studies are being conducted. It also required ethics approval to be obtained, all staff to be hired and trained and food formulas to be developed and selected.

V. Research Capacity Strengthening

The PI and the research team continue to promote sustainable research through relationships with the Malawi College of Medicine and with colleagues at LUANAR. The training provided to the four Malawian graduate students continues and will help to develop them into investigators able to continue research on childhood malnutrition, especially in the use of grain legumes. Chrissie Thakwalakwa of the College of Medicine, with support from Drs. Manary, Trehan and Maleta, developed the study procedures, guidelines and material for the study, and continues to supervise the field team, honing and improving her skills in conducting large collaborative clinical trials aimed at improving the nutritional status of impoverished rural children. The Agriculture Department at LUANAR was engaged in developing the formulations and recipes using cowpeas and common beans, and the Washington University team trained two student LUANAR food scientists on the development processes used in the Washington University food science lab. A freezer was purchased that will be maintained at Washington University and utilized to store samples.

VI. Human Resource and Institution Capacity Development

1. Short-Term Training: Recipe Development

(Provide the following information for each short-term training activity completed.)

- *i.* *Purpose of Training:* Equip local Malawian institution with the tools needed to initiate and conduct operational health, nutrition, and agriculture studies to improve the health and wellness of its population
- *ii.* *Type of Training:* Recipe development for dietary interventions
- *iii.* *Country Benefiting:* Malawi
- *iv.* *Location and dates of training:* Malawi, 2014-2015
- *v.* *Number receiving training (by gender):* 2 female
- *vi.* *Home institution(s) (if applicable):* LUANAR
- *vii.* *Institution providing training or mechanism:* Washington University in St. Louis

2. Short-Term Training: Staff Field Training

- *i.* *Purpose of Training:* Study research nurses, drivers, research assistants and staff received training in study guidelines, anthropometric data collection skills, biological sample collection methods and community engagement. Having a knowledgeable and capable staff is vital to conducting research.
- *ii.* *Type of Training*: Field training for research activities
- *iii.* *Country Benefiting:* Malawi
- *iv.* *Location and dates of training:* Malawi, 2015
- *v.* *Number receiving training (by gender):* 6 female nurses, 4 male drivers, 15

village health workers (11 male, 4 female)

vi. *Home institution(s) (if applicable):* Nurses and drivers are from the University of Malawi College of Medicine; village health workers are employed by the Ministry of Health

vii. *Institution providing training or mechanism:* University of Malawi College of Medicine

3. Degree Training

i. *Name of trainee:* Lucy Bollinger
ii. *Country of Citizenship:* United States
iii. *Gender:* Female
iv. *Host Country Institution Benefitting from Training:* United States
v. *Institution providing training: Washington University in St. Louis*
vi. *Supervising CRSP PI:* Mark Manary
vii. *Degree Program:* Masters
viii. *Field or Discipline:* Biological Sciences
ix. *Research Project Title (if applicable)*
x. *Start Date:* May 2015
xi. *Projected Completion Date:* May 2016
xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?: No*
xiii. *Training status (Active, completed, pending, discontinued or delayed):* Active

i. *Name of trainee:* Nicole Benzoni
ii. *Country of Citizenship:* United States
iii. *Gender:* Female
iv. *Host Country Institution Benefitting from Training:* United States
v. *Institution providing training: Washington University in St. Louis*
vi. *Supervising CRSP PI:* Mark Manary
vii. *Degree Program:* Masters in Population Health Sciences
viii. *Field or Discipline:* Medicine
ix. *Research Project Title (if applicable)*
x. *Start Date:* March 2015
xi. *Projected Completion Date:* May 2015
xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?: No*
xiii. *Training status (Active, completed, pending, discontinued or delayed):* completed

i. *Name of trainee :* Theresa Ngoma
ii. *Country of Citizenship:* Malawi
iii. *Gender:* Female

iv. *Host Country Institution Benefitting from Training:* The Lilongwe University of Agriculture and Natural Resources (LUNAR)
v. *Institution providing training:* LUNAR
vi. *Supervising CRSP PI:* Mark Manary, Indi Trehan, Ken Maleta
vii. *Degree Program:* Masters
viii. *Field or Discipline:* Food Science and Technology
ix. *Research Project Title:* N/A
x. *Start Date:* January 2015
xi. *Projected Completion Date:* December 2015
xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?* No
xiii. *Training status (Active, completed, pending, discontinued or delayed):* Active

i. *Name of trainee:* Ulemu Chimimba
ii. *Country of Citizenship:* Malawi
iii. *Gender:* Female
iv. *Host Country Institution Benefitting from Training:* LUNAR
v. *Institution providing training:* LUNAR
vi. *Supervising CRSP PI:* Mark Manary, Indi Trehan, Ken Maleta
vii. *Degree Program:* Masters
viii. *Field or Discipline:* Food Science and Technology
ix. *Research Project Title:* N/A
x. *Start Date:* January 2015
xi. *Projected Completion Date:* December 2015
xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?:* No
xiii. *Training status (Active, completed, pending, discontinued or delayed) Active*

i. *Name of trainee:* Oscar Divala
ii. *Country of Citizenship:* Malawi
iii. *Gender:* Male
iv. *Host Country Institution Benefitting from Training:* University of Malawi College of Medicine
v. *Institution providing training:* University of Malawi College of Medicine
vi. *Supervising CRSP PI:* Mark Manary, Ken Maleta, Indi Trehan
vii. *Degree Program:* PhD
viii. *Field or Discipline:* Epidemiology
ix. *Research Project Title:* N/A
x. *Start Date*: August 2015
xi. *Projected Completion Date:* July 2017

xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?:* No
xiii. *Training status (Active, completed, pending, discontinued or delayed):* Active

i. *Name of trainee:* Yankho Kaimila
ii. *Country of Citizenship:* Malawi
iii. *Gender:* Female
iv. *Host Country Institution Benefitting from Training:* University of Malawi College of Medicine
v. *Institution providing training:* University of Malawi College of Medicine
vi. *Supervising CRSP PI:* Ken Maleta
vii. *Degree Program:* PhD
viii. *Field or Discipline:* Epidemiology
ix. *Research Project Title:* N/A
x. *Start Date*: August 2015
xi. *Projected Completion Date:* July 2017
xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?:* No
xiii. *Training status (Active, completed, pending, discontinued or delayed):* Active

i. *Name of trainee:* Chrissie Thakwalakwa
ii. *Country of Citizenship:* Malawi
iii. *Gender:* Female
iv. *Host Country Institution Benefitting from Training:* University of Malawi College of Medicine
v. *Institution providing training:* Tampere University in Finland
vi. *Supervising CRSP PI:* Ken Maleta
vii. *Degree Program:* PhD
viii. *Field or Discipline:* Community Health
ix. *Research Project Title:* N/A
x. *Start Date*: August 2015
xi. *Projected Completion Date:* July 2017
xii. *Is trainee a USAID Participant Trainee and registered on TraiNet?:* No
xiii. *Training status (Active, completed, pending, discontinued or delayed):* Active

VII. Achievement of Gender Equity Goals

Beneficial findings and knowledge gained from these studies will benefit both women and men in these societies, including parents and children. Farming work is generally carried out by both men and women in this agrarian culture, so this will benefit both genders. Improvements in child health are most likely to benefit women in Malawi, as

they have the primary role in childrearing. Health improvements that lead to improved survival and intellectual development of girls will also likely translate into improved school performance and capacity for careers. Demonstrating achievement of such goals is beyond the scope of the current project.

In terms of training future scientists, all but one of our Malawian graduate students is female. Both American graduate students are female. One of our non-degree American students is female.

VIII. Achievement and Progress Along the Impact Pathway

We remain on track with the Impact Pathway developed during the project planning and workplan stage. Both Goal 1 (capacity building) and Goal 2 (clinical trial decreasing stunting and EED) are being carried out as planned. The measurements of success (Steps 3 and 4) are still several years away from completion, as originally planned.

IX. Explanation for Changes

We have no significant changes or delays to report.

X. Self-Evaluation and Lessons-Learned

This project has proceeded quite well, beginning with the identification and training of Malawian graduate students. We are optimistic that this will improve host country capacity by improving the talent pool of young scientists who will continue to study innovative agricultural approaches to reducing childhood malnutrition. The development of legume recipes for the clinical trials also proceeded well, led by the LUANAR students. The LUANAR students, in collaboration with Washington University graduate students, conducted an acceptability study for these foods, learning and refining clinical trial methods including consenting, blinding, and data management. The two actual large randomized clinical trials have also begun without much difficulty at both clinical sites, with more than half of the children already enrolled in Study 1 and all of the children already enrolled in Study 2. These children are actively being followed for the duration of the study. The conduct of these trials has been without any unexpected challenges, given our prior clinical trial experience with these types of field studies and the methods involved in studying EED in rural children. The collaboration with LUANAR and the University of Malawi scientists and graduate students has been fruitful, with many shared ideas and insights between all parties as we have all been working side-by-side together in the field.

Our only major challenge has been a logistical one as the government of Malawi has instituted new rules and taxes on imported items for the study, including significant new import duties on vehicles which have made it difficult to complete our work as older and less reliable vehicles have had to be used for the field work. A lesson to be learned here is to have “wiggle room” in the budget for the costs and timeline related to obtaining these large purchases in host countries, as they may change quite rapidly depending on shifting political whims. Proactively obtaining signed agreements with host government

ministries may be a wise strategy to take as well, as even prior agreements with USAID may be invalidated by the host government.

XI. Scholarly Accomplishments

Chrissie Thakwalakwa from the Malawi College of Medicine completed her thesis and received her PhD.

The first manuscript from this project, entitled “Legumes as Complementary Foods to Reduce Environmental Enteric Dysfunction and Stunting in Malawian Children: Study Protocol for Two Randomized Controlled Trials” has been submitted for publication and is currently undergoing peer review.

XII. Data Management

Please see attached data management plan.

ANNEXES:

Annex 1. Tables, Figures and Photos Cited in the Report

Annex 2. Literature Cited