



**FEED THE FUTURE**

The U.S. Government's Global Hunger & Food Security Initiative



**Innovation Lab for Nutrition- Africa  
Annual Report  
October 1<sup>st</sup>, 2014- September 30<sup>th</sup>, 2015**

**Lessons learned from programs  
in Uganda that integrate  
agriculture and nutrition actions**

**Award  
#AID-OAA-L-10-00006**

**Feed the Future Innovation Lab  
for Nutrition-Africa**

## U.S. Government Partners



## Partners in Uganda



Friedman School  
of Nutrition Science  
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UNIVERSITY



**Feed the Future Innovation Lab  
for Nutrition-Africa  
Annual Report  
Fiscal Year 2014-2015 (Year 5)**

**Management Entity Information**

Tufts University's Friedman School of Nutrition Science and Policy is the Management Entity (ME) for the Feed the Future Innovation Lab for Nutrition-Africa (hereafter called the Nutrition Innovation Lab-Africa). Its activities are funded under cooperative agreement AID-OAA-L-10-00006 from the United States Agency for International Development (USAID).

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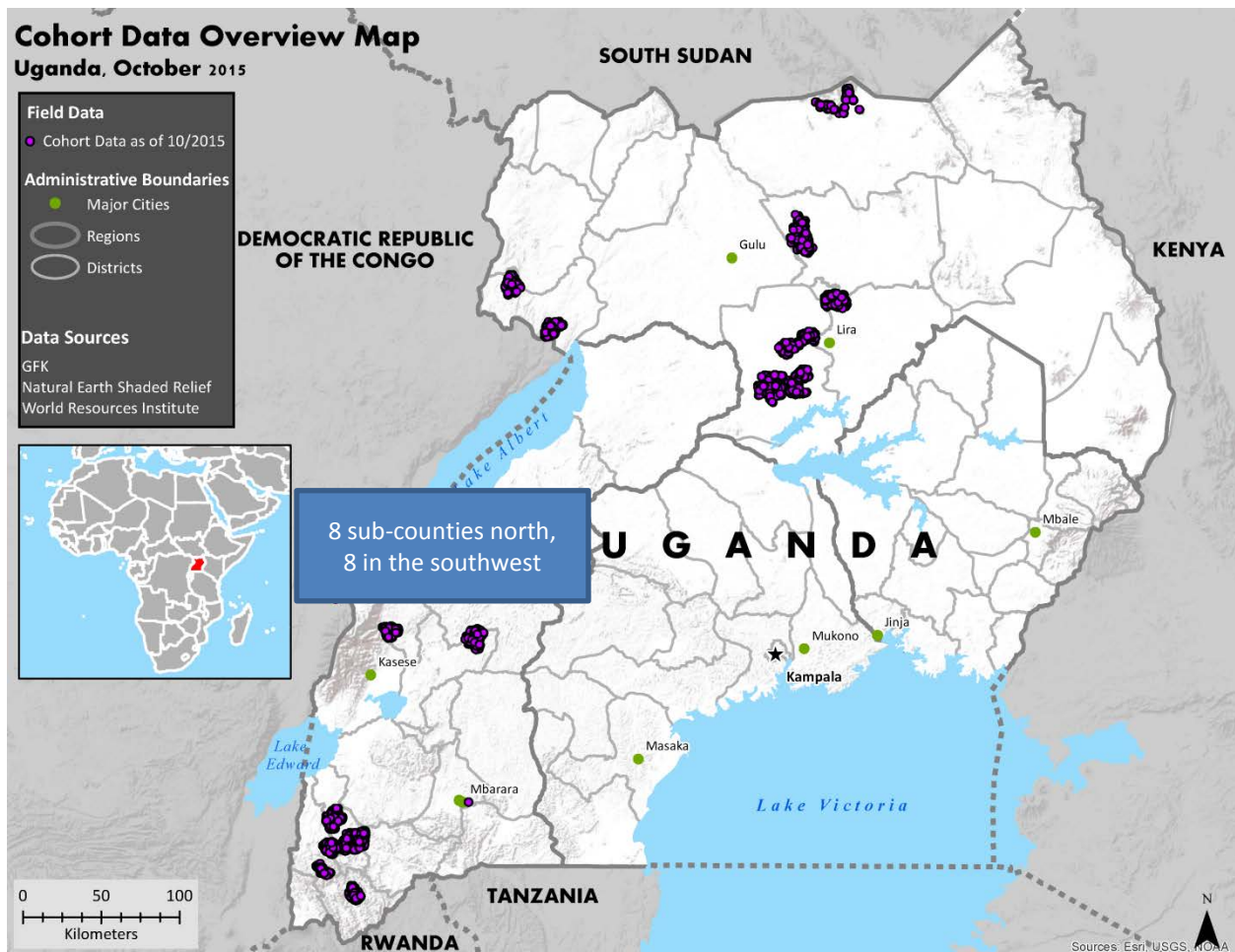
## Uganda Study Sites

In Fiscal Year 2015, three primary data studies were operational in Uganda. Studies A and B involve ~ 8,680 separate households and persons, and these maps detail their locations.

- A. A birth cohort study that enrolled 5,044 women in 12 districts (16 sub-counties) in Feed the Future zones of influence in Uganda. (Map 1)
- B. A repeated panel survey of 3,630 households in four northern and two southwestern districts (Map 2)
- C. A birth cohort study that enrolled 403 women in Gulu

(These maps were constructed using GPS data collected from individual study households by Carolyn Talmadge, courtesy of the Tufts GIS Center.)

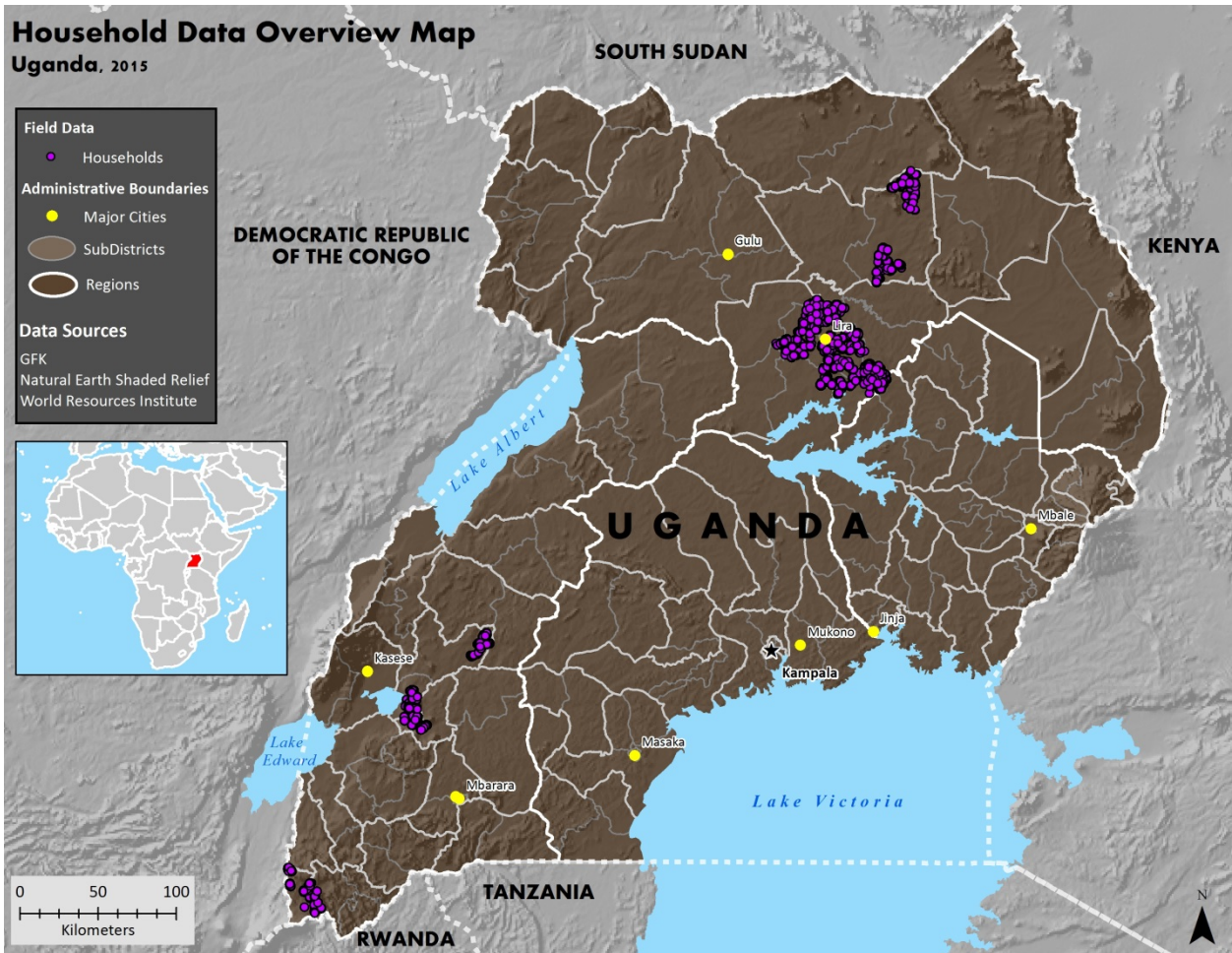
### Map 1 – Birth Cohort Study



### Map 2 – Repeated Panel Survey Households

# Household Data Overview Map Uganda, 2015

- Field Data**
  - Households
- Administrative Boundaries**
  - Major Cities
  - SubDistricts
  - Regions
- Data Sources**
  - GFK
  - Natural Earth Shaded Relief
  - World Resources Institute



## **List of Program Partners**

### US Partners

- Harvard TH Chan School of Public Health
- Purdue University
- Tuskegee University
- Johns Hopkins University
- Boston University (informal partner)
- University of Georgia (aflatoxin assays; contractual partner)
- Development Alternatives Inc. (DAI)
- International Food Policy Research Institute (IFPRI)
- National Aeronautics and Space Administration (NASA)
- SPRING (USA and Kampala, Uganda)
- Texas A&M University: Feed the Future Innovation Laboratory for Small Scale Irrigation

### Uganda-Based Partners

- Makerere University: School of Agriculture Sciences
- Makerere University: School of Public Health
- Gulu University
- FHI 360 (Uganda Community Connector Project)
- Government of Uganda districts and line ministries
- National Agriculture Research Council

### Malawi-Based Partners

- Bunda College, Lilongwe University of Agriculture and Natural Resources (LUANAR)
- University of Malawi, College of Medicine
- Department of Nutrition, Ministry of Health (formerly Department of Nutrition and HIV and AIDS, Office of the President, Malawi)

### Egypt-Based Partners

- General Organization for Teaching Hospitals & Institutes (GOTHI), Ministry of Health
- Department of Human Nutrition National Research Center, Cairo, Egypt

### Other International Partners

- LCIRAH (Leverhulme Centre for Integrated Research on Agriculture and Health-University of London)
- UNICEF – sharing of resources and knowledge in Uganda and Malawi
- Food and Agriculture Organization of the United Nations (FAO) – technical support in Malawi
- Heifer International
- Department of Foreign Affairs and Trade (Australia)
- University of Jakarta (for Timor Leste study of aflatoxins)
- St Johns Medical College, Bangalore, India (BBNC)

## **Acronyms**

DFAT: Department of Foreign Affairs and Trade (Australian Government)

BBNC: Bangalore-Boston Nutrition Collaborative  
BIFAD: Board for International Food and Agricultural Development  
CDC: Centers for Disease Control and Prevention  
DAI: Development Alternatives Inc.  
FAO: Food and Agriculture Organization of the United Nations  
FTF: Feed the Future  
GOTHI: General Organization for Teaching Hospitals & Institutes, Ministry of Health, Egypt  
IFPRI: International Food Policy Research Institute  
LCIRAH: Leverhulme Centre for Integrated Research on Agriculture and Health  
(University College London)  
MOOC: Massive Online Open Course  
NGO: Non-governmental organization (or private voluntary organization)  
NASA: National Aeronautics and Space Administration  
UNICEF: United Nations International Children's Emergency Fund  
UNSCN: United Nations Standing Committee on Nutrition  
USAID: United States Agency for International Development  
UCCP: Uganda Community Connector Project



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## **I) Executive Summary**

In Fiscal Year 2015, the Nutrition Innovation Lab-Africa continued large-scale, comprehensive, prospective studies which address globally-relevant agriculture to nutrition issues. These include: how and why agriculture can be most effectively utilized to improve nutrition; how integrated policy and program activities, using the example of the Uganda Community Connector Project (UCCP) succeed or fail to yield benefits to target populations; and the delineation of neglected biological pathways which affect maternal and child nutrition and health. In particular, the Nutrition Innovation Lab-Africa has focused on aflatoxins, and water, sanitation and hygiene. In response to an external review, the Nutrition Innovation Lab-Africa improved its coordination with US and African partners, enhanced its external communications, and reviewed its own structures. In Fiscal Year 2016, the Nutrition Innovation Labs for Africa and Asia will join as a single project directed by Dr. Patrick Webb.

During Fiscal Year 2015, 5,044 pregnant women and their households enrolled in a birth cohort spread across 16 sub-districts of 12 Ugandan districts, evaluating agriculture, socioeconomic, and health factors tied to nutrition and health. Women in UCCP targeted communities, and in “counterfactual,” closely matched agro-ecologically similar settings without UCCP interventions, were surveyed. Over 4,000 infants have already been born to these women. The Nutrition Innovation Lab-Africa also returned to 3,630 households (first assessed in Fiscal Year 2013) who had received staged UCCP interventions. These studies will, in combination, allow the Nutrition Innovation Lab-Africa to provide USAID/Uganda and the Government of Uganda valuable information on the >\$30 million (US dollar) project, the UCCP. Above and beyond this, the study has been framed to answer larger questions of global relevance, relating locally implemented policy, agricultural activities, health, and nutrition outcomes with comprehensive analyses of agriculture, nutrition and health data. More than 12,000 serum samples have been obtained for nutritional assessments. Concurrent prevalence surveys for malaria have been conducted, and water supplies for contamination have been tested—rather than using inaccurate proxy measures.

The benefits of this rigorous approach can already be seen in the following two examples. Stunting is causally related to poor protein intake globally, and dairy intake can prevent this serious condition in children. Thus, cattle ownership to enhance household dairy intake and income is widely promoted in Africa. In the repeated panel household study, significant and robust adverse linkages between cattle ownership, malaria and nutrition were discovered. This may call into question how current policies to enhance cattle ownership are implemented, and what is needed to prevent unexpected adverse consequences.

In a small, separate birth cohort in Gulu, extremely high (>99%) aflatoxin exposure was discovered in pregnant women, as well as shockingly elevated exposure levels in women with HIV and their infants. This was indeed over an order of magnitude higher than in their HIV negative peers—with additional poor gestational weight gain and lower infant birth weights. This research is likely to be of global importance to understanding health and nutrition issues relating to cattle ownership and aflatoxin exposure. These highly novel findings will help guide analysis of the larger birth cohort and panel study data. In Fiscal Year 2016, the Nutrition Innovation Lab will pivot its efforts to the analysis of the remaining rigorously-collected data.

The major challenges faced by the Nutrition Innovation Lab-Africa in its work in Uganda have been the difficulty in supporting field staff in many locations, the maintenance of a distributed national cold chain for blood samples, and the financial costs thereof. In Fiscal Year 2015, the Nutrition Innovation Lab-Africa focused on research conduct and data collection, rather than outputs. Nonetheless, the publications target was exceeded, with 11 published outputs in Fiscal Year 2015. The goals set for students trained in degree programs were also met with 12 students currently being supported. The Nutrition Innovation Lab-Africa met or exceeded all of our other goals for students trained in degree programs and in more informal settings, and substantive relationships were strengthened in the districts in Uganda where the Nutrition Innovation Lab-Africa works. Through the medium of online mechanisms, the Nutrition Innovation Lab-Africa has reached hundreds of degree students in Uganda and more than 10,000 persons in 150 countries via a massive open online course (MOOC). In Fiscal Year 2015, the Nutrition Innovation Lab-Africa has continued its capacity-building efforts in Malawi, both with significant challenges and successes. The Nutrition Innovation Lab-Africa also received an Associate Award in Egypt to examine the conundrum of simultaneous under and over-nutrition, and joined successfully with the Small-Scale Irrigation Innovation Lab in a new venture to study sustainable irrigation and nutrition in Ethiopia. The Nutrition Innovation Lab-Africa is deeply thankful to USAID/East Africa for its ongoing support of aflatoxin work in Gulu as well.

## II) Program Activities and Highlights

The Nutrition Innovation Lab-Africa in Uganda is now producing research outputs of importance, including capacity building in Uganda, progress in Malawi, and framing activities in Egypt.

### Research

- A large birth cohort study, begun in late Fiscal Year 2014, enrolled 5,044 women in 16 sub-counties of 12 districts. (Enrollment ended April 2015; see Map 1). Participating women belong either to communities in districts targeted by the UCCP, or to communities in districts not targeted by UCCP, matched by agro-ecologies. Comprehensive data on demographics, agricultural practices, dietary diversity and nutrition, water and sanitation, and related factors were collected, as were serum samples for the assessment of biochemical nutritional markers, aflatoxin exposure (in a subsample), malaria prevalence, and hemoglobin levels. Water samples were collected to assess household water contamination. More than 4,000 births have now occurred and factors relating to maternal status, birth weights and initial infant growth, including the UCCP, will be assessed in Fiscal Year 2016.
- A panel study of 3,630 households was repeated in six districts (four north and two south; Map 2), which were sequentially enrolled in the UCCP, collecting information similar to that in the birth cohort. In Fiscal Year 2014, an analysis was published demonstrating that fruit and vegetable consumption reduced maternal anemia and household food insecurity. Fiscal Year 2013 and Fiscal Year 2015 data indicate cattle ownership as a risk factor for child malaria and, thus, anemia. These data were presented to USAID in Uganda and in Washington, DC, and a manuscript has been drafted. (A third round of data collection is planned for Fiscal Year 2017).
- A second (smaller) birth cohort study in Gulu in the north was completed in Fiscal Year 2015. Several papers were published on the validation of a new, individually-focused food insecurity index and a screening tool for depression, both of which affect maternal nutrition, weight gain, and infant/child care. Maternal serum samples obtained during pregnancy, one month after delivery, and (from the infants) at nine months of age were analyzed by our partners at the Peanut & Mycotoxin Innovation Lab at the University of Georgia, using funding from a USAID East Africa Mission buy-in. Ubiquitous exposure to aflatoxin existed and levels in HIV (+) women and HIV-exposed infants were an order of magnitude higher than in their HIV (-) colleagues. Novel findings include interacting HIV and aflatoxin exposure affecting gestational weight gain, birth weights, and subsequent infant growth. Presentations for meetings and publications are being prepared by Dr. Barnabas Natamba who is the study principal investigator (PI) and a former PhD student supported by this Innovation Lab.
- Qualitative studies were conducted in several districts demonstrating that while several central government ministries had goals for improved nutrition, no actual targets were identified for local governments. No funds were allocated to assessing district-level basic nutrition indicators. These results were presented in London at the LCIRAH meeting in June 2015 and a manuscript has been drafted. District-level seminars and feedback were provided, reporting data on maternal and child nutrition, income, agricultural practices, malaria, and water quality.

- An in-depth literature review assessing the determinants of stunting and obesity in Egypt was completed.
- A pilot study to develop an inexpensive assay for aflatoxins in blood was initiated.
- Eleven peer-reviewed publications, nine authored or co-authored with African colleagues, were published.

In Fiscal Year 2016, the Nutrition Innovation Lab will continue to collect data from the large birth cohort and turn to the analysis of the very rich datasets from its various studies for publication. In Egypt, a protocol for studying stunting and obesity, as well as exposure to aflatoxins and sanitary risks, was developed.

### Capacity Building

- Eleven Master of Science (MSc), Master of Public Health (MPH), Doctor of Philosophy (PhD), and postdoctoral students from Uganda (two female and nine male) were actively supported in Fiscal Year 2015, contributing to the total of 21 students supported in the five years of funding. Fifty-one additional students at Makerere University used nutrition curricula developed by the Lab (11 on campus and 40 long-distance). Two hundred seventeen persons received short-term training as enumerators, survey supervisors, phlebotomists, water testers, or attendees at the Bangalore-Boston Nutrition Collaborative course.
- Offered a massive open online course (MOOC), “The Biology of Water and Health,” highlighting the issues of nutrition and Water and Sanitation for Health (WASH) and reached > 10,000 persons in > 150 countries in Fiscal Year 2015.
- Facilitated a laboratory assessment (for possible aflatoxin testing) by Professor JS Wang of the Peanut and Mycotoxin Innovation Lab of the Ministry of Health’s Core Lab in Egypt.
- Hired an in-country dietitian (Molly Uebele) in Malawi for the LUANAR dietetics program, and continued work on nutrition curricula and food composition tables.

## III) Key Accomplishments in Fiscal Year 2015

The Nutrition Innovation Lab is tasked with conducting policy-relevant research, and building personal and institutional capacity.

### Policy-Relevant Research Outputs

- **Second round of panel survey data from UCCP districts–Presentations to USAID/Uganda & UCCP.** In Uganda, after conducting the second round of the Panel Survey in six UCCP districts in the first quarter of Fiscal Year 2015, we then analyzed survey data within three months. This data was presented to a wide audience in the UCCP and USAID/Uganda in the second quarter of Fiscal Year 2015 both electronically and discussed in person in Kampala. Key variables were also compared to the Fiscal Year 2013 baseline. No evidence was found that the key variables (child stunting, child anemia or maternal anemia, and women’s anthropometric status) had changed significantly between the two survey rounds.



- **Presentations to Ugandan District Administrations on District Agriculture and Nutrition status.** Uganda has a decentralized administrative system. In the qualitative work conducted in Fiscal Year 2015, it was found that districts do not have the resources, expertise, or experience to gather basic nutrition data (Agaba, et al). Thus, before and after Fiscal Year 2015 data collection, all districts in which we work had sensitization and district-specific meetings with the Chief Administrative Officer (CAO), Deputy CAO, and district Health Officers as well as their staff on the nutritional status of districts. Often this is the only district-specific data that has ever been made available to the district administrations.
- **Identification of an adverse relationship between cattle ownership and malaria in the panel survey population.** Cattle ownership, which can enhance household incomes and household consumption of dairy products and reduce undernutrition, is being promoted by a wide variety of organizations in Uganda and East Africa. An adverse effect of cattle ownership, which increased malaria in children under five years of age (12-14%), was found. Malaria increases a child's risk of anemia by ~ 75%. This data was presented to USAID in Uganda, and in Washington, DC, as well as to Centers for Diseases Control (CDC) malaria experts.
- **Dramatically high aflatoxin blood levels were found in Gulu pregnant women and infants, which interacted with HIV (despite HIV treatment) to reduce birth weights and gestational weight gain.** This study is the first to *prospectively* study pregnant HIV (+) and HIV (-) women. High and near universal aflatoxin exposure in all women and their infants was found, with levels were greater than 10-fold higher in women with HIV than in their HIV (-) peers. Aflatoxin levels were also higher in HIV-exposed infants than in the infants of HIV (-) women. This data was presented in Washington, DC in September 2015, has been submitted to meetings in abstract form, and will be discussed widely as the manuscripts are written by Dr. Barnabas Natamba and his colleagues.
- **Eleven manuscripts, chapters, or meeting presentations (all peer reviewed) were published in Fiscal Year 2015.**

#### Human and Institutional Capacity Building

- One doctoral student, one postdoctoral student, and nine Master's degree students were supported.
- Fifty-nine students (23 female and 36 male) used curricula designed by us in Makerere University MPH courses.
- Four individuals from Uganda attended the nutrition research course at St. John's Research Institute in Bangalore (BBNC).
- Another 201 persons (96 female and 105 male) received training in survey methods as part of our birth cohort and repeated panel survey studies.
- Water testing has been conducted in 16 sub-counties of 12 districts, with training of district persons.
- *In Malawi:* Continued program building at LUANAR's Bunda campus.
- *In Egypt:* Assisted with Peanut and Mycotoxin Innovation Lab evaluation of Ministry of Health Lab.
- *Globally:* Findings outlined above were presented at meetings and video-conferenced globally. Dr. Griffiths taught a massive open online course (MOOC), which focused on

nutrition, water and sanitation, which reached > 10,000 persons in 150 countries, using explicit examples from Nutrition Innovation Lab-Africa.

## IV) Research Program Overview and Structure

The Nutrition Innovation Lab-Africa represents a research platform that provides numerous opportunities for cutting-edge research on agriculture, diet and nutrition in developing countries. In line with findings of the 2012 report from the Board for International Food and Agriculture Development (BIFAD)<sup>1</sup>, the Nutrition Innovation Lab leverages the exceptional capacity of the US research community by conducting research on priority questions in a “collaborative, interdisciplinary and development-focused” manner. Such research has an applied focus (operations or “delivery science” research rather than bench science), it is country-owned (supporting research that includes national stakeholders and informs locally-defined priorities in food and nutrition), and it allocates resources to few grants at larger scale, rather than many small grants supporting studies of experimental or pilot activities. The research is pursued in ways that seek to enhance policymaker understanding of how to overcome constraints in policy and program design and implementation, while also producing global public goods in the form of new scientific knowledge of relevant and diverse settings.

Following these principles, the Nutrition Innovation Lab is framed by three over-arching research questions, namely: 1) How can investments in agriculture achieve measurable impacts in nutrition (can pathways to impact be empirically demonstrated)?; 2) How can large-scale programs and policies be enhanced to support nutrition-specific and nutrition-sensitive actions?; and 3) What role is played in nutrition by biological mechanisms that have been relatively overlooked or ignored in past research (including aflatoxins, water quality, chemical contamination, etc.)?

Tufts University’s Friedman School of Nutrition Science and Policy serves as the Management Entity (ME) for the Nutrition Innovation Lab for Africa (as well as for Asia, which allows for intellectual synergies and cost-savings to both programs). The Friedman School implements the program of work in partnership with several US university partners—Tuskegee, Purdue, Johns Hopkins, and Harvard.

Additional US universities and research entities (University of Georgia, Texas A&M University, Cornell University, as well as the International Food Policy Research Institute), European universities (the London School of Hygiene & Tropical Medicine), and developing-country universities (Makerere University and Gulu University in Uganda; Lilongwe University of Agriculture & Natural Resources (LUANAR) and the College of Medicine in Malawi; the General Organization of Teaching Hospitals & Institutes (GOTHI) in Egypt; St John’s Research Institute in Bangalore, and the University of Jakarta) are current partners.

Close collaboration is also pursued with numerous in-country partners, including Heifer International in Uganda, SPRING in Uganda, and the United Nations’ Food and Agriculture Organization (FAO) in Malawi.

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<sup>1</sup> BIFAD (2012). *BIFAD Review of the Collaborative Research Support Program (CRSP) Model*. A Report Commissioned By BIFAD at the Request of USAID. August 2012. Washington, DC, Mimeo.

## **V) Research Project Reports**

### **Research on Policy-Relevant Agriculture-to-Nutrition Relationships**

#### **Uganda: Gulu Birth Cohort Study**

Description: This project was the doctoral thesis project of Dr. Barnabas Natamba of Gulu University, who received support from Nutrition Innovation Lab-Africa for his doctoral work. Four hundred and three pregnant women were enrolled into a birth cohort (2/3 HIV negative, 1/3 HIV positive) at ~ 20 weeks of gestation. In addition to anthropometrics and diets, Dr. Natamba validated instruments for individual food insecurity and for depression to assess impacts on gestational weight gain, birth weights, and infant growth. With Nutrition Innovation Lab-Africa support, 250 women and their infants were enrolled in a postnatal cohort that followed infants to 12 months of age. Additional funding was received from USAID East Africa to conduct serum aflatoxin studies on samples from mid-gestation, one month after delivery of the baby, and from the infants at nine months of age.

Collaborators: Gulu University, Cornell University, Tufts University, Peanut and Mycotoxin Innovation Lab, and University of Georgia

Achievements: Cohort study was completed. Dr. Natamba has published multiple manuscripts on food insecurity, depression, the role of HIV, and infant feeding practices (see list of publications). Aflatoxin analyses show near universal exposure to high levels of aflatoxin in the mothers, and in HIV-infected women, exposure is an order of magnitude higher than in the HIV-negative women. Infant birth weight is significantly adversely affected by HIV and aflatoxin exposure, as is gestational weight gain and infant weight gain and growth.

Capacity Building: Dr. Natamba received his PhD from Cornell University, and while remaining a faculty member at Gulu University. He is currently a postdoctoral student at the Harvard School of Public Health. (His return to Uganda is anticipated in 2017 or earlier). Colleagues at Gulu University were sponsored both for the BBNC course and for MPH degree studies at Makerere University.

Lessons Learned: Challenges included technical issues relating to sample storage, transportation and testing. This study provides a reminder that potentially important results can be derived from relatively small but well conducted studies. Aflatoxin results from this cohort of ~ 400 women will guide our analysis of aflatoxin samples from our larger (5,044 women) Uganda Birth Cohort (see below).

Presentations and Publications: Dr. Natamba has now authored or coauthored, and published five peer-reviewed papers (two in Fiscal Year 2014 and three in Fiscal Year 2015), and gave six presentations in Fiscal Year 2015 which were subsequently published (all peer reviewed).

#### **Uganda: Repeated Panel Surveys in Six UCCP Districts**

Description: The UCCP project is a > \$30 million USAID project which incorporates integrated agriculture and nutrition programming. Our repeated panel survey is designed as a baseline, two-year, and end-line assessment of many factors that could have an impact on maternal and child nutrition and health. An assessment of program exposure is part of the study. Four districts in the north, and two in the southwest, are included. Panel surveys were conducted in the first quarter of Fiscal Year 2013 and Fiscal Year 2015, and should be conducted in Fiscal Year 2017.

Collaborators: Makerere University, Harvard TH Chan School of Public Health, and IFPRI Uganda

Achievements: The 3,630 households surveyed in late 2012 were again visited with only a seven percent attrition rate. Data were collected electronically, then collated, and analyzed for outcome measures relevant to the UCCP within 90 days, and reported to USAID Uganda and to the UCCP. In addition, a relationship between cattle ownership and significantly-increased malaria in household children was detected.

Capacity Building: Ninety persons were trained in survey techniques and methods through this research activity.

Lessons Learned: Demand for findings from this research activity has grown and we will shift additional resources to the analysis of this study in Fiscal Year 2016 and thereafter. The dataset is very rich, as evidenced by the detection of the connection between cattle and malaria.

Presentations and Publications: In Fiscal Year 2014, one study was published demonstrating that fruit and vegetable consumption in this group reduces maternal anemia and household food insecurity. Another publication on cattle and malaria has been drafted for publication in Fiscal Year 2016. Multiple presentations have been given to stakeholders in Kampala, Uganda and Washington, DC regarding these findings.

## **Uganda Birth Cohort Study in UCCP and Non-UCCP Districts**

Description: The UCCP project is a > \$30 million USAID project which incorporates integrated agriculture and nutrition programming. Complementary to the repeated panel survey is this study conducted in 16 sub-counties of 12 districts where the UCCP is active, nearby (e.g. in the same district but not in the sub-county), or not active. Five thousand forty-four pregnant women were enrolled by the end of May 2015 and enrollment has ceased. The project is now following women through birth and the children through 24 months of age. The data being collected is similar to the panel study but is enhanced by water quality data, and selected aflatoxin blood testing will be done. This study will allow us to assess factors which affect birth weight and infant growth.

Collaborators: Makerere University, Harvard TH Chan School of Public Health, University of Georgia, and IFPRI



*Achievements:* The 5,044 women have now delivered more than 4,000 infants. Data are being collected electronically, and initial results will be analyzed in Fiscal Year 2016. More than 12,000 serum samples have been collected for biochemical testing.

*Capacity Building:* Sixty persons were trained in survey techniques and methods through this research activity and are living in the study communities to collect data and samples.

*Lessons Learned:* The infrastructure for this study has been more expensive than anticipated. The individual districts have little or no capacity for assessing nutrition and so our results are of intense interest and policy importance to them.

*Presentations and Publications:* In Fiscal Year 2015, the Uganda-based team interacted with all districts where the study operates and has provided updates to USAID in Kampala approximately every four months. Initial analyses anticipated for Fiscal Year 2016 will relate to factors affecting birth outcomes. Blood samples will be selected for aflatoxin assessments from the cohort, and preliminary data may be available in Fiscal Year 2016.

## **Qualitative Study on District Capacity to Implement the Uganda Nutrition Action Plan**

*Description:* Uganda has rapidly devolved governance to its districts. Little is known of district capacity to integrate nutrition metrics or objectives into their policies and plans. A qualitative assessment of their capacities was conducted in Fiscal Year 2015 as an exploratory collaboration between the Nutrition Innovation Lab-Africa and SPRING.

*Collaborators:* Tufts University and SPRING, Ugandan Districts

*Achievements:* Several districts were assessed using qualitative methods and interviews. It demonstrated that little capacity exists at the district level to assess nutrition in their populations, and that district metrics and goals for reporting to the central government lacked any nutrition.

*Capacity Building:* Not applicable

*Lessons Learned:* The potential for integrating nutrition into district policy planning was demonstrable and large.

*Presentations and Publications:* In Fiscal Year 2015, Mr. Edgar Agaba presented these findings at the LCIRAH meeting in London (June 2015) and they are being prepared for publication.

## **VI) Associate Award Research Project Reports**

## **Aflatoxins Project: Associate Award (USAID, Washington, DC) and buy-in from USAID East Africa**

Description: This project aims to assess the relationships between dietary aflatoxin exposure and adverse gestational and early childhood outcomes. Aflatoxins are believed to inhibit fetal and child growth, and cause stunting, as well as cause liver cancer.

Collaborators: Makerere University, Gulu University, and the University of Georgia

Achievements: Proof of concept studies were conducted via the Gulu cohort study prospectively demonstrating that aflatoxins and HIV interact to cause reduced gestational weight gain, reduce birth weight, and reduce infant growth. Dr. Wang of the University of Georgia conducted the analyses.

Capacity Building: Not applicable

Lessons Learned: Efforts to collect accurate birth weights on infants, including those born at home, are important to this study and efforts were redoubled to ensure this was done.

Presentations and Publications These findings were presented in Washington, DC on September 30, 2015 (in Fiscal Year 2015). Publication of the Gulu results is expected in Fiscal Year 2016.

## **Associate Award: Malawi Project**

No research activities are included in this award. This Associate Award focused on capacity building.

## **Associate Award: Egypt**

Description: The project focuses on potential causes for the dual burden of stunting and obesity in Egypt, including aflatoxin exposure, and insufficient water and sanitation quality.

Collaborators: General Organization of Teaching Hospitals & Institutes (GOTHI), Ministry of Health, and National Research Institute of Nutrition

Achievements: A literature review to understand the determinants of stunting and obesity was conducted. A secondary analysis using Demographic Health Surveys and Household Income, Expenditure and Consumption Surveys was started. A protocol for studying the interaction of stunting and overweight/obesity was developed. A policy-oriented study was developed but cancelled at the request of the Mission. The Nutrition Innovation Lab-Africa assisted in an evaluation of the Ministry of Health's Core Laboratory for aflatoxin analysis.

Capacity Building: Not applicable

Lessons Learned: National capacity is critical to the successful conduct of complex projects such as this one.

Presentations and Publications: These findings were presented in Cairo to USAID Egypt.

## **VII) Human and Institutional Capacity Building**

### Short-Term Training-Uganda

Number: 264 (121 female and 143 male)

Purpose 1: Short-term, degree granting training: 59 (23 female and 36 male)

Home Institution: Makerere University

Institution: In Fiscal Year 2015, 59 students enrolled at Makerere University received short-term (individual course) training while enrolled in an MPH program at Makerere University School of Public Health.

Purpose 2: Short-term, non-degree granting training: 205 (98 female and 107 male). In Fiscal Year 2015, 205 individuals received training in how to conduct nutrition surveys or assessments. Four of these individuals attended the Bangalore-Boston Nutrition Collaborative nutrition research course at St John's Medical College in Bangalore, India.

Home Institution: Not applicable

Mechanism: Employment via subcontracts with IFPRI or Makerere University, or support via BBNC.

Long-term degree training: (12 total in Fiscal Year 2015)

Name	Sex	University	Degree	Major	Graduation Date (mo/yr)	Home Country
Barnabas Natamba	M	Gulu University faculty member- supported PhD (Cornell) field studies in Uganda	PhD from Cornell	Nutrition	May 2015	Uganda
Nassul Kabunga	M	Tufts University/ IFPRI	Post- Doctorate	Post- Doctorate	N/A	Uganda
Elizabeth Asiimwe	F	Makerere University	Master's	Agriculture Education & Extension	Dec. 2015	Uganda
Elizabeth Atim	F	Makerere University	Master's	Applied Human Nutrition	Dec. 2015	Uganda
Joakin Opelel Mori	M	Tuskegee University	Master's	Food & Nutrition	August 2016	Uganda
Onyekachi Aghasili	M	Purdue University	Master's	Agricultural Economics	August 2016	Uganda
George Omiat	M	Purdue University	PhD	Agricultural Economics	Sept. 2015	Uganda
Ben Okia	M	Makerere University	Master's	Nutrition	August 2015	Uganda
Edgar Agaba	M	Tufts University	Master's	Public Health	June 2015	Uganda
Henry Galiwango	M	Makerere University	Master's	Agriculture Education & Extension	Dec. 2015	Uganda
Edward Kansiime	M	Makerere University	Master's	Applied Human Nutrition	Dec. 2015	Uganda
Joshua Ssemakula	M	Makerere University	Master's	Applied Human Nutrition	Dec. 2015	Uganda

**Institutional Development-Uganda**

- Description: Supported PhD field work of Gulu University faculty member and his associated team via the Gulu cohort study.  
Partner: Gulu University

- Description: Developed curriculum in partnership with the Makerere School of Public Health faculty is now used by MPH-Nutrition students and MPH–Distance Education students.  
Partner: Makerere University
- Description: Attempted to hold a Scientific Symposium with the other Innovation Labs operating in Uganda in collaboration with Makerere University, but the other Innovation Labs were unable to financially support this effort.  
Partners: Other Feed the Future Innovation Laboratories.

### **Institutional Development-Malawi Associate Award**

Description: The project in Malawi has three aims: 1) The launch of a dietetics program at LUANAR, Bunda campus. The Nutrition Innovation Lab-Africa has employed a registered dietitian, Molly Uebele, to facilitate this and to provide instruction to the first group of students. The Award is supporting curriculum development, the accreditation of the program, and funding a portion of the teaching. The launch is anticipated for Fiscal Year 2016. A relationship with the College of Medicine to provide clinical supervision of the students is being developed. Dr. Lynne Ausman has played a major role in curriculum assessment and in the design of the program. 2) A curriculum review by the College of Medicine for its nutrition instruction is also being supported. Dr. Edward Saltzman of Tufts University met with the College of Medicine staff in Fiscal Year 2015. 3) The third activity in Malawi is the development of food tables. Food table data was compiled in Fiscal Year 2015 and the Award will be supporting the salary of an individual to assist with this process based at Bunda campus of LUANAR.

Partners: Bunda College of LUANAR, College of Medicine of Malawi.

### **Institutional Development-Egypt Associate Award**

Description: Egypt has no capacity in the Ministry of Health to test blood for aflatoxins. The Nutrition Innovation Lab-Africa supported an evaluation by Dr. JS Wang of the University of Georgia, Peanut and Mycotoxin Innovation Lab, of the Core Laboratory of the Ministry of Health as a basis for capacity building.

Partners: Ministry of Health-Egypt, University of Georgia, and Peanut & Mycotoxin Innovation Lab

## **VIII) Technology Transfer and Scaling Partnerships**

Unlike other Feed the Future Innovations Labs which focus on generating new varieties of seeds, techniques for pest control or tools for market analyses, the Nutrition Innovation Labs' (Asia and Africa) main intellectual property relates to dissemination of research findings that directly impact policy and program design, and the methods of implementing both. The Nutrition Innovation Lab-Africa has always used electronic tablets to implement field surveys in its panel and cohort studies. This has informed the process of using tablets in Nepal by the Nutrition Innovation Lab-Asia.

## **IX) Governance and Management Entity Activities**



The ME tasks for Fiscal Year 2015 of the program were implemented smoothly by Tufts University. Research and training funds were almost exclusively disbursed among partners. Elizabeth Marino-Costello, assisted by Ranjita Shrestha, worked with Nutrition Innovation Lab-Africa partners in the US as well as in Africa, both online and via site-visits to Uganda and Malawi.

As planned and budgeted for in the Fiscal Year 2015 work plan, the ME was able to restructure the Nutrition Innovation Labs' website, leading to a re-launch in mid-2015. This has been widely viewed and continues to garner praise from other Innovation Labs, users among the professional community, and across Tufts University.

### **X) Other Topics**

In Fiscal Year 2015, Dr. Griffiths of the ME helped teach a MOOC entitled "the Biology of Water and Health" on EdX, which reached more than 10,000 students in 150 countries. The content heavily utilized the intellectual space occupied by the Nutrition Innovation Lab-Africa in terms of nutritional outcomes relating to water and sanitation. Currently, it is not possible for this global reach to be captured using USAID metrics for training.

In April 2015, the Nutrition Innovation Lab-Africa committed to working with other Innovation Labs in the arena of sustainable intensification. In August and September 2015, Dr. Griffiths worked with Dr. Neville Clarke of Texas A&M University and the Irrigation Lab, and Dr. Claudia Ringler of IFPRI, among others, on a proposal to collaborate in Ethiopia.

### **XI) Issues (financial, management, regulatory)**

In Fiscal Year 2015, the Nutrition Innovation Lab-Africa continued its work in Uganda despite the decreased funding in Year 5 as compared to previous years. Activities were executed as outlined in the Work Plan along with the additional recommendation of activities presented in the External Review Report. Specifically, the Nutrition Innovation Lab website was refurbished under the direction of a new communications staff person. Also, a data analyst joined the Nutrition Innovation Labs' ME team. There were a number of unbudgeted activities that the ME managed to support this past year, such as the research dissemination event in Washington, DC. The ME supported our US and international collaborators to participate in this event and held it at the Willard Hotel. In addition, the ME funded activities to promote the event through social media and created materials that will allow viewing post-event. At the end of 2015, the ME exhausted the remaining funds in the core award.

### **XII) Future Directions**

A five-year renewal of Nutrition Innovation Lab work was communicated to the Nutrition Innovation Labs' ME on September 29, 2015. The separate Asia and Africa Labs were consolidated into a single Nutrition Innovation Lab with Professor Patrick Webb as the overall Program Director and Dr. Shibani Ghosh continuing as Associate Director. Dr. Jeffrey Griffiths

has assumed the title of Navigator and will work on specific projects and data analyses including those in Africa.

## **Appendix I: List of Awards to US universities**

1. *Harvard TH Chan School of Public Health*: Year 5 Total: \$80,948; Years 2010-2015 Total: \$643,451.
2. *Purdue University*: Year 5 Total: \$119,438; Years 2010-2015 Total: \$434,471.
3. *Tuskegee University*: Year 5 Total: \$60,500; Years 2010-2015 Total: \$279,330.
4. *Johns Hopkins University*: Year 5 Total; \$2,500; Years 2010-2015 Total; \$131,000.

## Appendix 2: List of Presentations Made on Nutrition Innovation Lab-Africa Research Activities

Presenter	Event	Place	Title	Date	Size of Audience
Jeffrey K. Griffiths	USAID Presentation	Washington, DC	New Domains for Nutrition Research	Sept. 30, 2015	120 in person, 150 online
Jeffrey K. Griffiths	Course: Biology of Water and Health	Tufts School of Medicine, Boston, MA	Nutrition and Infection in Children	Sept. 9, 2015	14
Jeffrey K. Griffiths	Boston University	Boston, MA	Why Food is Not Enough	Feb. 27, 2015	60
Jeffrey K. Griffiths	BBNC	Bangalore, India	Why Food is Not Enough	Jan. 2015	70
Jeffrey K. Griffiths	USAID Presentation	Washington, DC	Connecting the Dots between Human Malaria, Livestock, and Under-Nutrition: An Unexpected Pathway	March 9, 2015	>50
Jeffrey K. Griffiths	Malawi Director's Meeting	Malawi	Update on the Nutrition Innovation Lab Approach	April 21, 2015	80
Jeffrey K. Griffiths	USAID Presentation	Kampala, Uganda	Malaria Predicts Maternal and Child Anemia in Uganda and is Modulated by Altitude and Prior IRS	Feb. 10, 2015	15
Jeffrey K. Griffiths	USAID Presentation	Cairo, Egypt	Obesity and Stunting in Egypt, and The Roles of Water, Sanitation, and Mycotoxins	Aug. 4, 2015	7
Jeffrey K. Griffiths	Center for Global Public Health	Tufts University, Boston, MA	Eat your Fruits and Vegetables and Don't Get Malaria": Linkages between Agriculture, Nutrition, and Health in Uganda	Nov. 20, 2014	50
Nassul Kabunga/ Jeffrey K. Griffiths	USAID Presentation	Washington, DC	Household Malaria and Livestock: Linking Health, Nutrition and Agriculture	March 9, 2015	>50
Nassul Kabunga	USAID Presentation	Washington, DC	Livestock Production, Anemia, and Malaria Linkages: Findings from the Uganda Panel Studies	Sept. 30, 2015	120 in person, 150 online
Bernard Bashaasha	USAID Presentation	Washington, DC	Aspects of Nutrition Programming and Policy in Uganda	Sept. 30, 2015	120 in person, 150 online
Barnabas Natamba	Environmental Biology Conference	Boston, MA	Social Support Modifies the Bidirectional Linkages between Food Insecurity and Prenatal Depressive Symptoms while Domestic Violence Alters the Unidirectional Impact of Food Insecurity on Prenatal Depressive Symptoms	March 28- April 1, 2015	>50
Barnabas Natamba	Environmental Biology Conference		Maternal HIV Infection, but Not Food Insecurity Access Score, Predicts the Rate of Weight Change in Pregnant Women Attending Antenatal Services in N. Uganda	March 2015	>10
Edgar Agaba	ALE Presentations	Boston, MA	Understanding Pathways of Better Nutrition	April 29, 2015	30
Edgar Agaba	LCIRAH	London, UK	Understanding Pathways of Better Nutrition	June 3-4, 2015	> 250
Florence Kinyata	District Officials	Kole, Uganda	District Update presentation	Sept. 28, 2015	44
Florence Kinyata	District Officials	Rukugiri Uganda	District Update presentation	Sept. 30, 2015	30

Florence Kinyata	District Officials	Buyanja, Uganda	District Update presentation	Sept. 30, 2015	
Florence Kinyata	District Officials	Bugangari, Uganda	District Update presentation	Sept. 30, 2015	



### Appendix 3: Peer-Reviewed Papers (bold name indicates Nutrition Innovation Lab-Africa member)

1. Young SL, **Natamba B**, Luwedde F, Nyafwono D, Okia B, Osterbauer B, Natureeba P, Johnson L, Michel C, Zheng A, Robine M, Achan J, Charlebois E, Cohan D, Havlir D. 2015. "I Have Remained Strong Because of That Food: Acceptability and Use of Lipid-Based Nutrient Supplements Among Pregnant HIV-Infected Ugandan Women Receiving Combination Antiretroviral Therapy." *AIDS Behavior* 2015;19(8):1535-1547. doi: 10.1007/s10461-014-0947-0.
2. Young SL, Plenty AH, Luwedde FA, **Natamba B**, Natureeba P, Achan J, Mwesigwa J, Ruel TD, Ades V, Osterbauer B, Clark TD, Dorsey G, Charlebois ED, Kanya M, Havlir DV, Cohan DL. 2014. "Household food insecurity, maternal nutritional status, and infant feeding practices among HIV-infected Ugandan women receiving combination antiretroviral therapy." *Maternal and Child Health Journal* 2014; 18(9):2044-2053. doi: 10.1007/s10995-014-1450-y.
3. Shahi N, Min B, **Bonsi E**. 2015. "Microbial Decontamination of Fresh Produce (Strawberry) Using Washing Solutions." *Canadian Center of Science and Education, Journal of Food Research*, Vol. 4 (3). DOI:10.5539/jfr.v4n3p128
4. **Masters W**, Colaiezzi B, Dennison K, Hill J, Jordan-Bell E, Kablan A, Thurber M, et al. 2015. "Agricultural policy for improved nutrition in Africa and Asia: evidence to guide the US Government's investments in food security." *Food Security*. 7:747-750 DOI: 10.1007/s12571-015-0444-y

#### Book Chapters (Peer Reviewed)

5. **Griffiths J, Kikafunda J**. 2015. Chapter 7: Childhood Threats to Adult Cognition in Sub-Saharan Africa: Malaria, Anemia, Stunting, Enteric Enteropathy, and the Microbiome of Malnutrition. *Brain Degeneration and Dementia in Sub-Saharan Africa*. ISBN: 978-1-4939-2455-4

#### Published, Peer-Reviewed Abstracts/Proceedings

6. Pelletier D, Gervais S, Rafeez-Ur-Rehman H, **Natamba B**, Sanour D, Tuwmine J. 2015. "Building Strategic Capacities to Strengthen the Enabling Environment for Nutrition Policies and Programs in Four African Countries." *European Journal of Nutrition & Food Safety* 2015; 5(5):727-728 EJNFS.2015.255
7. Collins S, **Natamba B**, Arbach A, Widen E, Desai P, Khan H, **Griffiths J**, Young S. 2015. "Alcohol Use Among Pregnant Ugandan Women of Mixed HIV Status is Associated with Social Environment and Food Insecurity." *The FASEB Journal*, Vol. 29 (1 Supplement) 585.6

8. **Natamba B**, Young S, Widen E, **Ghosh S**, Brannon P, **Griffiths J**, Mehta S. 2015. "Maternal HIV Infection, but Not Food Insecurity, Predicts the Pattern of Weight Gain in Pregnant Women Attending Antenatal Services in Northern Uganda." *The FASEB Journal*, Vol. 29 (1Supplement) 579.19
9. **Natamba B**, Mehta S, Mou S, **Ghosh S**, Stoltzfus R, **Griffiths J**, Young S. 2015. "Social Support Modifies Bidirectional Linkages Between Food Insecurity and Prenatal Depressive Symptoms while Domestic Violence Alters the Unidirectional Impact of Food Insecurity on Prenatal Depressive Symptoms." *The FASEB Journal*, Vol. 29 (1 Supplement) 261.8
10. Widen, E, **Natamba, B**, Collins, S, Kahn, H, Biribawa, C, Sirotin, N, **Ghosh, S**, **Griffiths, J**, Young, S. 2015. "Maternal Food insecurity is Associated with Loss of Fat but not Lean Mass during Lactation among Uganda women of Mixed-HIV status." *The FASEB Journal*, Vol. 29 (1 Supplement) 898.14
11. **Natamba, B**, Bangirana, P, Achan, J, Birabwa, A, Achola, H, Onen, D, Collins, S, Widen, E, Mehta, S, **Griffiths, J**, Young, S. (2015, May) "Perinatal HIV Exposure Affects Infant Cognition at 6 Months but not Changes in Cognitive Scores between 6 and 12 Months." *European Society for Pediatric Infectious Diseases (ESPID)*; Leipzig, Germany. May 12-16, 2015.