Africa RISING Early Wins Project Proposal

IITA, 16 April 2012

Mycotoxin contamination in Tanzania: quantifying the problem in maize and cassava in households and markets

1. Objectives, outputs and activities

Mycotoxins are highly toxic substances produced by fungi, and their presence in food and feed is linked to cancer, immune system suppression, growth retardation, liver disease and death. Adverse effects of mycotoxin poisoning have been well documented over the years. Mycotoxin contamination also limits income of smallholder farmers, because food quality and safety concerns resulting from contamination present trade restrictions. For example, nearly 2.3 million bags of maize from a food deficit area of Kenya in 2010 were found unfit for human consumption due to high levels of aflatoxin. To make matters worse, products are screened for mycotoxins prior to export, without destruction of contaminated material, thus concentrating contaminated crops in the local food chain. Mycotoxin-contaminated feed also reduces non-ruminant productivity thereby reducing profitability of animal industries. Tackling mycotoxin contamination is now seen as a priority in sub-Saharan Africa. In 2011, the 7th Comprehensive Africa Agriculture Development Program's Partnership Platform underscored the urgent need to mitigate mycotoxin contamination by recommending the establishment of a Partnership for Aflatoxin Control in Africa (PACA), which is endorsed by USAID and other donors.

Mycotoxin contamination starts in fields, and ultimately cuts across the value chain, affecting farm families, traders, markets and finally, consumers. Several mycotoxins exist, produced by a plethora of fungi, and toxin profiles differ across crops, countries and regions within countries. Maize, for example, among the most important staples across Tanzania, is one of the crops most prone to aflatoxins. Mycotoxin contamination of cassava, the most important smallholder crop in Tanzania, is ill-quantified although visual observations of processed cassava in households and markets show severe contamination by several fungi[1]. LC-MS/MS, a new detection method using liquid chromatography, is now capable of quantifying more than 50 toxic metabolites in a single analysis[2]. Recently, several studies aimed at establishing prevalence of key mycotoxins in the region have been initiated[3456], although only a few have been carried out in Tanzania, and all have focused on aflatoxin and fumonisins. In Tanzania, high aflatoxin prevalence was observed in groundnut during efforts to promote aflatoxin-mitigating practices among groundnut farmers.

In Tanzania, several indicators allude to high exposure levels among maize and cassava-growing rural households, such as (1) erratic rainfall, and high temperature and humidity levels in crop production areas; (2) presence of predominantly small farm holdings (85% of maize in Tanzania is grown on less than 1 ha) that produce for informal, local markets and that escape regulation mechanisms; and (3) a general lack of awareness about mycotoxins and their effects.

Quantification of mycotoxin contamination is a first and essential step in addressing the problem. Management options to mitigate mycotoxin contamination during growth and storage of maize and cassava are available. However, in order to optimally target and implement these options, it is imperative that mycotoxin contamination is quantified and mapped. Proper quantification of mycotoxin contamination will provide the basis for (1) risk assessment of key mycotoxins, which in turn will help in

[1] Wareing et al. 2001. *International Journal of Food Science and Technology* 36:1-10.
[2] Sulyok et al. 2007. *Analytical and Bioanalytical Chemistry* 389:1505-1523.
[3] Kimanya et al. 2008. *Food Additives and Contaminants, Part A* 25:1353-1364.
[4] Manjula et al. 2009. *Toxin Reviews* 28:63-69.
[5] Mutegi et al. 2009. *International Journal of Food Microbiology* 130:27-34.
[6] IFPRI, 2011. http://programs.ifpri.org/afla/

identifying target areas for intervention; (2) harmonization of mycotoxin standards for enhancing trade in the region, and (3) stimulating local monitoring/surveillance and enforcement mechanisms, thereby ensuring that the staples consumed locally are safe.

The ***objective*** of the project is to quantify mycotoxin contamination levels on maize and cassava in Tanzania, and provide an objective basis for commissioning interventions to dramatically improve the health and livelihoods, and increase income of rural households.

The ***specific objectives*** are:

1. to quantify key mycotoxins among toxic microbial metabolites in maize and cassava in rural households and markets;
2. to sensitize stakeholders in Tanzania about occurrence of key mycotoxins, allowing targeted mycotoxin mitigation strategies;
3. to establish a prevalence database that can guide mycotoxin risk assessment and risk mapping activities in the country and hence strengthen standards and regulation mechanisms.

The project will deliver the following ***outputs***:

1. contamination from at least five types of mycotoxins (aflatoxin, fumonisin, ochratoxin, zearalenone, deoxynivalenol) in maize and 50 mycotoxins in cassava quantified in 1,000 geo-referenced samples collected from *African RISING* intervention areas in Tanzania;
2. key mycotoxins affecting maize and cassava in Tanzania communicated to stakeholders;
3. risk-prone areas (hotspots) requiring immediate intervention identified.

Activities will be carried out as follows.

April 2012

- Planning meeting to identify key stakeholders and their contacts; and to discuss, with key stakeholders, detailed sampling plan, identify of actual sampling sites, and delineate responsibilities and timelines. A survey instrument used in Aflasafe bio-control projects will be modified and administered to document pre- and post-harvest crop handling practices that influence mycotoxin contamination in maize and cassava. To capture all types of marketing systems, market outlets will be categorized into formal and informal outlets and subdivided further to accommodate the various categories within.

May to June 2012

- Collection of samples from maize and cassava products in formal and informal markets prior to harvest of crops (500 samples). These samples will provide information on contamination in stored products in the households and markets.
- Collection of samples from maize and cassava in farmers' fields (500 samples). These samples will provide information on contamination at harvest for maize and early processing stages for cassava.
- A 1-kg sample will be acquired from each sampling event and sample providers will be compensated.

June 2012

- Processing of all maize and cassava samples (grinding, subsampling) in Tanzania.
- Shipping all processed cassava samples to Austria for multi-mycotoxin analysis using LC/MS-MS.
- Pre-screening of all maize samples for aflatoxins and fumonisins using rapid screening assay (ELISA) in Tanzania.

July 2012

- Shipping of maize samples with >4 ppb aflatoxin or 1 ppm fumonisins to Austria for accurate quantification of multiple mycotoxins using LC/MS-MS.

August 2012

- Completion of multi-mycotoxin analysis of maize and cassava samples and results available.

September 2012

- Preparation of final report.
- Organization of stakeholder meeting in Dar-es-Salam to report results and plan follow-up action.

2. Fulfilling USAID/FtF's criteria

- The project will elucidate the impact of mycotoxin contamination on food and feed safety and trade of maize and cassava in maize-legume-livestock and cassava-based farming systems. The project is also linked to PACA since the prevalence data will be used in models to determine the economic impact of mycotoxins in Tanzania by Abt Associates, a subgrantee of Meridian Institute (facilitator of PACA). Presently, the subgrant lacks funds for generating prevalence data. In addition, the maize samples can act as a source of atoxigenic strains for the development of regional products for biological control of aflatoxins, which is the objective of another subgrant of PACA led by IITA and USDA-ARS.
- Africa RISING's concept note, as well as USAID's mission in Tanzania, have identified mycotoxin mitigation as a priority area. Specifically, the draft report 'Aflatoxin Abatement Activities of FtF Programs, USAID Tanzania' (dated February 24, 2012) has recommended support for operational research efforts to better define the larger mycotoxin problem in Tanzania and interactions of aflatoxin and fumonisins in food and feeds.
- The project will develop new partnerships between a CGIAR center (IITA), three national research institutions (Sokoine University of Agriculture [SUA], Morogoro; Tanzania Food and Drugs Authority [TFDA], Dar-es-Salam; and Ministry of Agriculture [MinA], Dar-es-Salam) and an advanced research institute (Center for Analytical Chemistry [IFA-Tulln], Austria). Since the two national institutions will carry out the field work, a strong focus will beon their capacity building.
- As evidenced in the timeline, a clear set of activities will be completed and reportable results will be available by September 30, 2012.

3. Specific locations, intermediate and ultimate beneficiaries

The project aims to establish prevalence data on key mycotoxin contaminants in the FtF target areas: Dodoma and Manyara regions located in the Southern Agriculture Growth Corridor of Tanzania. The two regions will be stratified further based on administrative boundaries to ensure representative sampling. For maize, 500 samples will be collected from Zones II and III, covering the central and southern part of Kondoa District, the northern part of Dodoma District, the whole of Kongwa District, parts of Mpwapwa District, and the Bereko Highlands in Kondoa District. For cassava, 500 samples will be collected from Zone I, including most of the Manyara region and the Masai steppe in the northeastern part of Kondoa, the southern part of Dodoma Rural and the southwest part of Mpwapwa District.

The intermediate beneficiaries of the project are at least three policy-making agencies and one regulatory agency that will have information on the scale and hotspots of the mycotoxin problem. This information will allow them to make informed decisions for proposing workable solutions to mitigate against mycotoxin, thereby ensuring safe food and enhancing regional trade. The final beneficiaries will be the more than 10,000 smallholder farmers, traders, food and feed processors, and consumers who will have access to mycotoxin-safe food and feed once information generated in the project is translated into suitable interventions to mitigate against mycotoxins.

4. Timeline

A timeline is included in the description of activities in '1. Objectives, outputs and activities'.

5. Partners and roles

IITA (lead partner)	Responsible for deliverables, reporting and financial management Sample collection, processing, pre-screening for aflatoxins and fumonisins
SUA, TFDA and MinA	Sample collection, pre-screening of maize samples and stakeholder sensitization
IFA-Tulln, Austria	LC-MS/MS multi-mycotoxin analysis of samples

6. Illustrative list of personnel

SUA: Delphina Mamiro; TFDA: Martin Kimanya; MinA: to be identified; IITA: Charity Mutegi, Fen Beed, Ranajit Bandyopadhyay and Thomas Dubois; IFA-Tulln: Rudi Krska and Michael Sulyok