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

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The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

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Purpose

In Tanzania, several indicators allude to high mycotoxin exposure levels among maize and cassava-growing rural households, such as (1) erratic rainfall, 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 critical first step to address the problem. Management options to mitigate mycotoxins during growth and storage of maize and cassava can be publicised in those regions identified as being the worst affected, thereby ensuring that the staples consumed locally become safer for consumption and also eligible for regulated trade opportunities.

Objective

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. In detail to;

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

Outputs

1. contamination from over 200 mycotoxins (including aflatoxin, fumonisin, ochratoxin, zearalenone, deoxynivalenol) in maize and cassava quantified in 1,000 geo-referenced samples collected from *African RISING* intervention areas
2. effect of mycotoxins affecting maize and cassava in Tanzania communicated to stakeholders
3. key mycotoxins, agricultural practices and risk-prone areas (hotspots) requiring immediate intervention identified.

Partners

At project inception partners were selected based on their strategic role in Tanzania to influence research, raise awareness and to develop and regulate policies to determine prevalence of mycotoxins and to use this information to mitigate their impact. Particular attention was made to link both the research and crop development sections of the Ministry of Agriculture, Food Security and Cooperatives (MAFSC) with the Tanzanian Food and Drug Agency, Tropical Pesticide Registration Institute with research and development partners. A workshop was held for 2 days to refine activities and to reach consensus on which areas should be targeted for surveys. The surveys were a massive undertaking and aimed to collect samples for mycotoxin analyses and also knowledge on farmer / market vendor practices and their perceptions of mycotoxins. Key responsibilities for the surveys and other project tasks were also assigned and shown in Table 1, below.

Table 1.Details of partners and their contribution to the Mycotoxin jumpstart project

Individuals	*Position*	*Institute and contact details*	*Responsibility*
Bakari Kaoneka Emmanuel Mausa	Registrar of Pesticides, Research Associate	Tropical Pesticides Research Institute (TPRI) Ministry of Agriculture Food Security and Cooperatives, P.O. Box 3024, ARUSHA, Tanzania bkaoneka2012@gmail.com mausaemmanuel@yahoo.com +255 754476346; +255 754637868	Plan activities and target survey regions and districts. Increase awareness of mycotoxins. Survey regions of Dodoma, Manyara and Tanga in collaboration with IITA. Facilitate registration of biological control agent derived from PACA study.
Martin Kimanya Moses Mbambe Immaculate Justin Mohamed Iwodyah	Manager, Food Evaluation and Registration and Food risk Analysts	Tanzania Food and Drugs Authority (TFDA) P. O Box 77150, Dar es Salaam, Tanzania mekimanya@yahoo.co.uk, mbambem@yahoo.com justinimmaculate@yahoo.com, modiwodyah@yahoo.com +255 754 317 687	Plan activities and target survey regions and districts. Increase awareness of mycotoxins. Survey district; Mwanza. Analyse PACA samples for aflatoxin in collaboration with IITA and Abt Associates.
Delphina Mamiro Jackson Nashon Juma Chacha Hosea Mtui	Mycologist, Research scientists	Sokoine University of Agriculture (SUA) Morogoro, Dar es Salaam, Tanzania E-mail: delphimamiro@yahoo.com +255 757724446; +255 757724447	Plan activities and target survey regions and districts. Increase awareness of mycotoxins. Survey districts; Morogoro, Iringa, Ruvuma. Provide linkages to MSc students and teaching curricula
Omari Mponda Happy Daudi	Legume breeder, research scientist	Department of Research Ministry of Agriculture, Food Security and Cooperatives (MAFSC), Naliendele Agricultural Research Institute, P.O. Box 509, Mtwara, Tanzania mpondaomari@hotmail.com kalanjekanduru@gmail.com daudihappy@yahoo.com +255 784 471 813; +255787026265	Plan activities and target survey regions and districts. Increase awareness of mycotoxins. Survey district of Mtwara. Provide linkages to ICRISAT and McKnight Foundation. Nominated scientist to characterise PACA isolates for potential as biocontrol agent.
Kido Mtunda	Breeder (maize, cassava) and Station Head	Department of Research, Ministry of Agriculture, Food Security and Cooperatives (MAFSC), Sugarcane Research Institute Kibaha, Tanzania kidomtunda@yahoo.com +255 754 466 201	Plan activities and target survey regions and districts. Increase awareness of mycotoxins
Fabian Mkondo	Assistant Director - Plant Health Services, MAFSC	Crop Development, Ministry of Agriculture, Food Security and Cooperatives, PO Box 9192, Dar es Salaam, Tanzania pps@kilimo.go.tz corneliusmkondo@yahoo.com +255 22 286 5642	Plan activities and target survey regions and districts. Increase awareness of mycotoxins. Facilitate transfer of maize and groundnut for testing of potential biocontrol agents of aflatoxin under PACA.
Dave Kraybill	Capacity building specialist, Ohio State University	FtF Training, Sokoine University of Agriculture, Morogoro, Dar es Salaam, Tanzania kraybill.1@gmail.com+255757420308	Increase awareness of mycotoxins and link to capacity building through MSc and PhD students in subsequent, longer term activities.
Simon Boniface	Consultant;	IITA Regional Hub for East Africa,	Survey districts; Dodoma, Manyara and

Emmanuel Chriss Roland Djekno	research scientist, technicians	Plot 25, Mikocheni Industrial Estate PO BOX 34441, Dar es Salaam, Tanzania b.simon@cgiar.org emmochriss@gmail.com +255 776 000 655 or +255 767 644 895	Tanga in collaboration with TPRI. Sample processing, sub-sampling and pre-testing using serological tests. Despatch of samples to IFA-Tulln. Data entry from questionnaires and chemical analyses.
Nicholas Mlingi Edward Kanju Abass Adebayo Catherine Njuguna	Cassava specialist Cassava breeder Post harvest specialist Regional media specialist	IITA Regional Hub for East Africa, Plot 25, Mikocheni Industrial Estate PO BOX 34441, Dar es Salaam, Tanzania nmlingi@yahoo.co.uk e.kanju@cgiar.org a.abass@cgiar.org +255 754 563 353; +255 754 897 182; +255 754 206 853	Plan activities and target survey regions and districts. Increase awareness of mycotoxins
Anthony Lyamunda	Director	Cesope, Dodoma, Tanzania cesopetz@gmail.com + 255 754 340 690	Assist with surveys in Dodoma.
Regional Government	Official	Representing Manyara, Dodoma, Tanga, Mwanza, Morogoro, Iringa, Ruvuma & Mtwara	Plan regional surveys based on maize and cassava cultivation. Increase awareness of mycotoxins
District Government	Official	District Agricultural Livestock Development Officers representing Babati, Kiteto, Hanang, Bahi, Dodoma, Kondoa, Kongwa, Pangani, Handeni, Ukerewe, Misungwi, Kilosa, Ifakara, Iringa Rural, Makambako, Songea, Mbinga, Masasi and Tandahimba.	Plan district surveys based on maize and cassava cultivation and provide contact details for local extension officers. Increase awareness of mycotoxins
Local extension officers	Official	Local extension officers from villages across districts detailed above.	Execute surveys at village and market level in collaboration with lead institute.
Michael Sulyok Rudolf Krska	Chief analyst, Head of Department	Center for Analytical Chemistry, Department of Agrobiotechnology (IFA-Tulln), University of Natural Resources and Applied Life Sciences, Vienna Konrad Lorenzstr. 20, A-3430 Tulln michael.sulyok@boku.ac.at rudolf.krska@boku.ac.at Tel: +43-2272-66280-409 or 457	LC-MS/MS based multi-mycotoxin method for detection and quantification of 200 targeted metabolites in cassava and maize samples.

Achievements against plan

Planning and execution of surveys was successfully achieved. A protocol and standard questionnaire were used to ensure commonality of approaches between survey teams led by different institutions. The questionnaire was designed to harness information from household and markets on details of samples provided i.e. cultivar, pre and post harvest agricultural practices, and processing and storage techniques plus awareness of mycotoxins. The protocol and questionnaire are shown in Appendix 1. The intended number of samples (1000) were collected and processed and forwarded to IFA-Tulln for thorough analyses of mycotoxin levels. An important output was to increase awareness (but not alarm) and this was achieved through handing out a factsheet in Swahili to everyone that provided a sample and to anyone who expressed an interest i.e. local extension officers and village elders. 3000 of these factsheets were distributed (Appendix 2). Further, to provide a little more detail a double sided factsheet in English was provided to DALDOS, collaborating scientists and partners. 1000 of these were distributed (Appendix 3).

A total of 525 samples of maize (234 from the field and 291 from stores and markets) and 404 samples of cassava (113 of fresh/dried and 291 processed) were collected against the plan of

540 for maize (250 from the field and 290 from stores and markets) and 480 for cassava (180 of fresh/dried and 300 processed). The total samples collected for the two crops from all 19 districts, therefore, were 929 against 1020 planned as shown in Table 2.

Table 2. Number of maize and cassava samples planned and collected from 19 districts of Tanzania for mycotoxins analyses

Region	District	Samples planned				Samples collected			
		maize	maize	cassava		maize	maize	cassava	
		field	stored	fresh/dried	processed	field	stored	fresh/dried	processed
Survey Group 1 - IITA and TPRI									
Manyara	Babati	50	50			50	50		
	Kiteto	50	50			50	50		
	Hanang	50	35			50	35		
Dodoma	Bahi			30				22	
	Dodoma		30				30		
	Kondoa	50	35	30		35	35	20	
	Kongwa	50	50			49	50		
Tanga	Pangani				30			11	19
	Handeni				30			1	29
Total		250	250	60	60	234	250	54	48
Survey Group 2 - TFDA									
Region	District	Planned				Already collected			
		maize field	maize stored	cassava fresh/dried	cassava processed	maize field	maize stored	cassava fresh/dried	cassava processed
Mwanza	Ukerewe			30	30			0	60
	Misungwi			30	30			39	21
Total				60	60			39	81
Survey Group 3 - SUA									
Region	District	Planned				Already collected			
		maize field	maize stored	cassava fresh/dried	cassava processed	maize field	maize stored	cassava fresh/dried	cassava processed
Morogoro	Kilosa		10		20		11	19	1
	Ifakara				20				4
Iringa	Iringa Rural		10		20		10		0
	Makambako				20				1
Ruvuma	Songea		10		20		10		17
	Mbinga		10		20		10		20
Total			40		120		41	19	43
Survey Group 4 - MAFSC									
Region	District	Planned				Already collected			
		maize field	maize stored	cassava fresh/dried	cassava processed	maize field	maize stored	cassava fresh/dried	cassava processed
Mtwara	Masasi			30	30			1	59
	Tandahimba			30	30			0	60
Total				60	60			1	119

Summary of the number of samples planned		Summary of the number of samples collected	
Maize from the field	250	Maize from the field	234
Maize from stores and markets	290	Maize from stores and markets	291
Total maize samples	***540***	***Total maize samples***	***525***
Cassava fresh/dried	180	Cassava fresh/dried	113
Cassava processed	300	Cassava processed	291
Total cassava samples	***480***	***Total cassava samples***	***404***
Grand total	**1020**	**Grand total**	**929**

IITA has ensured all samples are dry, milled and sub-sampled and cross referenced with codes linking them to accompanying questionnaires.

All of the cassava samples were sent directly to IFA-Tulln for analyses of mycotoxin profiles. The LC-MS analytical equipment was successfully calibrated for mycotoxin evaluation in cassava substrates. The analysis of each sample requires up to a few hours and hence months are required to complete the full analyses but Appendix 4 describes available results from preliminary cassava samples. For maize samples it was agreed that positive pre-testing of aflatoxins through serological kits at a threshold of 4 ppb was necessary before samples were sent to IFA-Tulln in order to avoid time being wasted testing samples that were unlikely to be contaminated with mycotoxins. For the 315 samples that have been pre-tested for 4 ppb aflatoxin; (from Kiteto (100), Babati (100), Hanang (85) and Dodoma (30) districts) - 11% from Kiteto, 34% from Babati, 16% from Hanang and 40% from Dodoma tested positive for aflatoxin. All of these aflatoxin positive samples have been dispatched to Department IFA-Tulln, BOKU Vienna, Austria for detailed analyses of mycotoxins. The remaining maize samples are in the process of being tested for aflatoxin and those tested positive will be forwarded to IFA-Tulln.

IITA is finalising all data entry from the questionnaires (929) into an electronic databases (using completed copies of the questionnaire shown in Appendix 1).

Once results of mycotoxin profiles are known based on results from IFA-Tulln, IITA will interrogate the database to identify the key geographical areas, agricultural practices, storage and processing methods that increase mycotoxin contamination.

A wrap up workshop will be held to share results and to reach consensus from partners as to how and who to disseminate information to in order to take appropriate action. The goal will be to provide an objective basis for commissioning interventions to dramatically improve the health and livelihoods, and increase income of rural households for the areas already targeted. Links between detected mycotoxin levels and consumption patterns for humans and livestock will be correlated in order to determine absolute risk of poisoning through mycotoxin exposure. For regions and districts with high mycotoxin contamination levels; more thorough follow up surveys with more detailed sampling per unit area, will be undertaken to better understand factors responsible and to mitigate these in an appropriate manner.

The partnerships and methods developed during the jumpstart project will be out-scaled to Africa RISING FtF targeted action sites to quantify mycotoxin prevalence with a focus on vulnerable crops such as maize and grain legumes to then justify management interventions. for maize based systems.

Key Deliverable Deviation

Bureaucracy by the administrative authorities of partner institutions significantly slowed down the signing of agreements and distribution of funds to enable agreed activities to be undertaken.

Delayed surveys meant delayed processing of samples and pre-testing of maize samples for aflatoxin by IITA and full mycotoxin profile analyses by IFA-Tulln.

Stored cassava samples were infested with post harvest insects. This was to be expected for maize but was a surprise for cassava. Each sample required to be cleaned to be free of insect pests prior to milling and sub-sampling which was an additional time burden and delayed despatch to IFA-Tulln.

Staff hired as consultants to process samples for this jumpstart project were lured away to other positions as they favoured the more long term job security offered elsewhere.

The intention was to also test maize samples using serological methods for fumonisin but the required reagents could not be procured within the time frame of the jumpstart project (we are still awaiting delivery).

Delayed analyses of results and as a consequence, the wrap up workshop to plan how to use this information to improve the livelihoods and income generation potential of farmers.

The total number of samples, of each desired type, collected was less than intended;

Cassava: while a target was to collect processed cassava as it is more likely that this would be more contaminated by mycotoxins (due to fermentation process) it was observed that some farmers prefer fresh cassava (boiled or fried) and these were the only samples available or dried samples that were of inferior quality to that eaten fresh. In some districts, cassava was too young to have been harvested at the time of surveys. In some areas targeted for sample collection due to high cassava production the cultivation of this crop was reduced because of the invasion of diseases such as brown streak disease – CBSD and mosaic disease – CMD).

Maize: during the time when surveys were undertaken it was difficult to collect maize samples from the field as the growing season had ended. Conversely, stored maize was scarce as it had been consumed prior to recent harvest of current maize crops.

List of geo-tagged locations/sites were activities took place

Every sample collected was GPS linked and this data was recorded onto questionnaires and entered into an electronic database and is available to all FtF partners. The dates when surveys were completed is also shown in Table 3 below.

Table 3: Dates and locations for GPS tagged maize and cassava samples for mycotoxin analyses

Region	District	Crop	Date	Responsible institution
Manyara	Babati	Maize	09 – 18/06/2012	IITA
	Kiteto	Maize	20/06 – 13/07/2012	IITA and TPRI
	Hanang	Maize	09 – 13/06/2012	TPRI
Dodoma	Bahi	Cassava	17 – 20/09/2012	TPRI
	Dodoma	Maize	24 – 26/08/2012	IITA
	Kondoa	Maize	12 – 16/09/2012	TPRI
		Cassava	12 – 15/09/2012	
	Kongwa	Maize	13 – 18/09/2012	TPRI
Tanga	Pangani	Cassava	18 – 21/05/2012	TPRI
	Handeni	Cassava	18 – 22/05/2012	IITA
Mwanza	Ukerewe	Cassava	25 – 26/06/2012	TFDA
	Misungwi	Cassava	27 – 28/06/2012	TFDA
Morogoro	Kilosa	Cassava	12 – 15/06/2012	SUA
		Maize	12 – 16/06/2012	
	Ifakara	Cassava	18/07/2012	SUA
Iringa	Iringa Rural	Maize	14 – 17/07/2012	SUA
	Makambako	Cassava	05/07/2012	SUA
Ruvuma	Songea	Cassava	08 – 10/07/2012	SUA
		Maize	08 – 10/07/2012	
	Mbinga	Cassava	11 – 13/07/2012	SUA
		Maize	11 – 13/07/2012	
Mtwara	Masasi	Cassava	11/06/2012	MAFSC
	Tandahimba	Cassava	09 – 10/06/2012	MAFSC

Support of AFRICA RISING

The outputs from this jumpstart project will directly support the longer term objectives of Africa RISING. The partnerships and methods developed can be targeted to the identified action sites in order to quantify mycotoxin prevalence with a focus on vulnerable crops such as maize and grain legumes to then justify tailored management interventions. Risk-prone sub-sites (hotspots), agricultural practices, cultivars, processing techniques and storage conditions that contribute towards mycotoxin contamination can be identified. Furthermore, other initiatives such as the development of a Tanzanian specific biocontrol technology for the control of aflatoxins (Aflasafe – www.aflasafe.com/) has recognised partnership opportunities with Africa RISING FtF i.e. if the action sites quantify the prevalence of aflatoxin and identify the most vulnerable sites, crops and practices then this would justify interventions later to apply Tanzanian specific Aflasafe). Similarly Abt Associates have praised the work led by IITA and the profile of partners included and as a consequence has provided TFDA with funds to further analyse samples using their HPLC detection system for comparison of results with the more technologically advanced LC-MS system used at IFA-Tulln in order to calibrate protocols and support precise quantification, in country, for aflatoxin testing in the future.

Scalability

Continue present partnerships, increase awareness and demonstrate results generated to policy makers to ensure livelihoods and incomes are increased through the mitigation of health destroying mycotoxins.

To extend partnerships and methods to targeted action sites and to include prominent crops and livestock in maize based cropping systems, to justify and prioritise control interventions, to ensure food is not poisonous to animals or humans and is therefore also safe to trade.

Conduct studies to show impact of mycotoxin poisoning (blood and milk samples) on health of humans and animals and to quantify negative impacts on health for specific and targeted areas. This information then can be scaled out to represent similar cropping systems / trading patterns to justify interventions elsewhere.

Increase awareness of the problems caused by mycotoxin contamination and the on farm methods to manage these.

Regulate markets through the development of policies to test for mycotoxin contamination.

Implement certification system to recognise high quality food products without mycotoxins.

Extend and link to neighbouring regions and countries in order to safeguard trade and food safety (and prevent dumping of mycotoxin contaminated products into local and non regulated markets, where those with the least money become the mot poisoned).

Deploy nationwide and regional solutions such as biological control through Aflasafe at action sites and to those crops and situations most vulnerable to mycotoxin contamination.

Lessons learned

- Planning for surveys needs to be done with consideration of the seasons and harvesting time of the crops in question to allow availability of the type (field vs. stored) of sample intended.
- Most of the members of the households/markets who delivered maize and or cassava samples have not heard about mycotoxins nor do they know that they cause health problems but when shown photographs with crops infected with toxigenic fungi, most of them recognize to have seen such problem in their crops. There is therefore a need to raise awareness of mycotoxins among these communities followed by knowledge of the control strategies.
- In many places where samples were collected, it was learnt that bad maize (possibly including those infected with toxigenic fungi) are used to make local brews or animal feeds. This is concentrating mycotoxins and causing severe health risks to consumers.
- The native terms used for processed cassava in Tanzania vary greatly among the communities visited and a similar term may have different meaning (i.e. makopa) across two or more communities so definitions need to be clarified and used routinely. In this study any dried cassava which was not subjected to any process other than pealing and directly sundried was considered as freshly prepared and those subjected to other processes like dry or wet fermentation and smoking over the fire place were considered as processed.
- Despite the discrepancies observed of bureaucracy in some of the partner institutions towards signing agreements and implementing activities the trust now created can be capitalised upon in the future. Should there be no further continuation of partnerships through subsequent activities then the trust created will be lost.

Publicity

This jumpstart project has attracted significant publicity starting from the inception workshop; where a suite of journalists were invited to attend and there was even a designated Q and Q session with the media and lead scientists from each of the collaborating institutes and continuing through to now. This interest from the media I partly as a consequence of the importance of mycotoxins on human health and trade and will be capitalised upon when the full set of mycotoxin results are processed and correlated with farmer practices and other factors that cause high contamination. Examples of press articles;

- Daily news, Research to control food contamination launched
  http://dailynews.co.tz/index.php/local-news/4461-research-to-control-food-contamination-launched 24/04/12
- Feed the Future, Research to control food contamination launched
  http://feedthefuture.gov/country-tagged-content/tanzania?page=1

- IITA News Blog, Making food safe: Two projects to combat mycotoxin contamination in Tanzania launched http://iitanews.blogspot.com/2012/04/making-food-safe-two-projects-to-combat.html
- Africa news science, http://www.africasciencenews.org/en/index.php/life-and-style/49-food/410-projects-to-combat-mycotoxin-contamination-in-tanzania-launched
- CGIAR roots and tubers, Making food safe: Two projects to combat mycotoxin contamination in Tanzania http://www.rtb.cgiar.org/news-blog/feeds/b3e7b943cb36a95fd9aa96ddf5ddec94
- Non-Profits blog, Making food safe: Two projects to combat mycotoxin contamination in Tanzania http://nonprofitblogs.info/making-food-safe-two-projects-to-combat-mycotoxin-contamination-in-tanzania-launched/
- The Guardian (an editorial), We can rescue our agriculture, http://www.ippmedia.com/frontend/index.php?l=40864
- Newstime Africa, Making food safe: Two projects to combat deadly mycotoxin contamination in Tanzania launched http://www.newstimeafrica.com/archives/
- Netherlands Aid, Food Dangers, Poison, http://www.nl-aid.org/continent/sub-saharan-africa/food-dangers-poison/
- The Citizen, Killing ourselves and our cows softly, http://thecitizen.co.tz/sunday-citizen/-/22677-killing-ourselves-and-our-cows-softly
- Pulver Media, http://www.pulvermedia.com/8d7adeceh608e66532912/killing-ourselves-and-our-cows-softly.html

Scientific Publications

- Beed F, Boniface S, Bandyopadhyay R, Sulyok M, Krska R (2012). Mycotoxin contamination in Tanzania: quantifying the problem in maize and cassava in households and markets. 7th Conference of The World Mycotoxin Forum® and the XIIIth IUPAC International Symposium on Mycotoxins and Phycotoxins. Rotterdam, the Netherlands, on 5-9 November 2012.
- Bandyopadhyay R, Atehnkeng J, Augusto J, Beed F, Cassidy D, Cotty P, Dubois T, Hasson O, Masha K, McDaniel M, Mignouna J, Mutegi C and Warrior P. 2012. Aflasafe in Africa: progress and prospects for biocontrol in aflatoxin mitigation. WMF meets IUPAC Meeting Rotterdam, the Netherlands, 5-9 November, 2012.
- It is expected that 2 further peer reviewed scientific publications will be produced once the data has been fully analysed and that these will be published in high impact journals.

USAID indicators

Output 1.1 Integrated crop and livestock production systems developed, evaluated, and effectively delivered to end users

Activity 1.1.1 Safety to both humans and livestock of maize based cropping system products quantified. Mitigation strategies identified. Opportunities through linkages to trade routes where mycotoxin levels are regulated created. Over 1000 samples collected, characterised (farming practices, processing and storage techniques and GPS tagged) and analysed.

Output 2.1 Improved nutrient cycling and use efficiency

Activity 2.1 Nutrients wasted when used to produce maize based cropping system products that are contaminated with mycotoxins as they are unfit for consumption by humans, animals or for trade.

Output 4.1 Desk study of key nutritional and food safety issues of the target population

Activity 4.1.1 Prevalence of key mycotoxins determined for the first time in Tanzania for maize based cropping systems. Partnerships and methods developed to out-scale this approach and to increase awareness of the problems caused and how to mitigate them. 3000 farmers and local extension officers briefed and received factsheet in Swahili and 1000 DALDOS and partners received more comprehensive factsheet in English.

Output 4.3 Increased availability, utilization and consumption of high nutritious foods (fruits, vegetables, legumes, meat, and milk)

Activity 4.3.1 Mycotoxin contamination prevents uptake of other nutrients in food and suppresses the immune system of both humans and livestock. Therefore the impact of the availability of highly nutritious foods will not occur if mycotoxin contaminated products are also included in diets.

Output 4.4 Evidence based dietary strategies for target population developed, tested, and communicated

Activity 4.4.1 To be developed through reaching consensus with strategic partners at wrap up workshop once all mycotoxin prevalence data has been produced and analysed.

Output 5.1 Research framework developed

Activity 5.1.1 Partnerships and methods to determine prevalence of mycotoxins, to increase awareness of how to mitigate their production achieved.

Output 5.2 Functional partnerships, effective project management

Activity 5.2.1 Trust created between IITA as lead institute and collaborating organisations to determine prevalence of mycotoxins and how to increase awareness of mitigation strategies.

Output 5.3 Strengthened capacity of partners

Activity 5.3.1 Increased knowledge of risks posed by mycotoxin contamination and methods to detect them i.e. for TFDA using HPLC and methods to mitigate their development in the field and through improved storage and processing

Links with other research and development projects

PACA – see above and in particular note opportunity for PACA to apply Aflasafe at target sites for maize based cropping systems within Babati, Kiteto and Kongwa districts if shown to be the most vulnerable to mycotoxin contamination by prevalence data collected during next phase of Africa RISING?

Concluding remarks

Excellent foundation developed for further targeted studies at action sites.