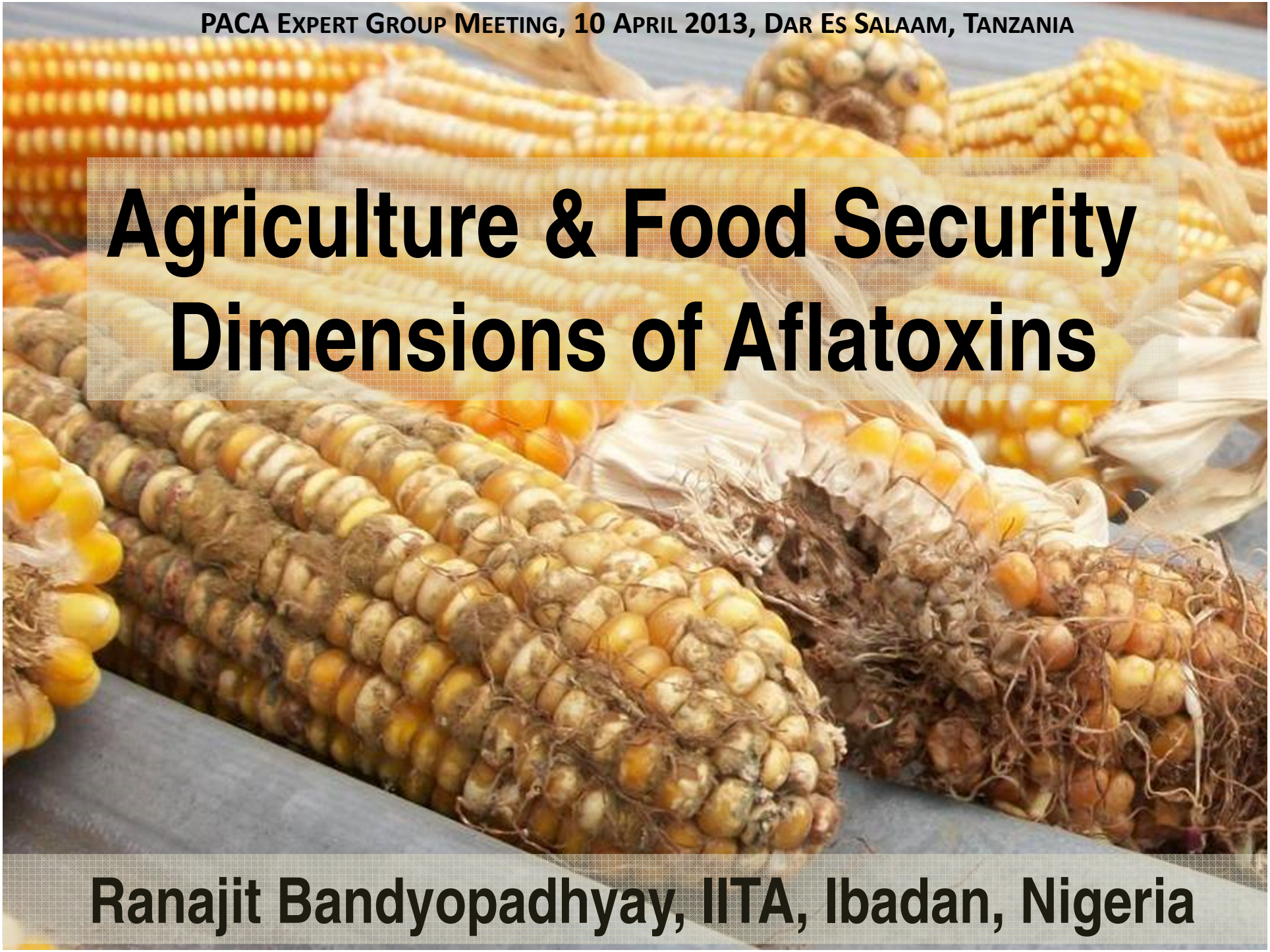
PACA EXPERT GROUP MEETING, 10 APRIL 2013, DAR ES SALAAM, TANZANIA



Agriculture & Food Security Dimensions of Aflatoxins

Ranajit Bandyopadhyay, IITA, Ibadan, Nigeria

Aflatoxin Facts

- Highly toxic metabolite produced by the ubiquitous *Aspergillus flavus* fungus
- The fungus resides in soil and crop debris, infects crops and produces the toxin in the field and in stores
- Fungus carried from field to store

- Contamination possible without visible signs of the fungus

Aflatoxin Contamination Occurs in Two Phases

Phase I: Before Crop Maturity

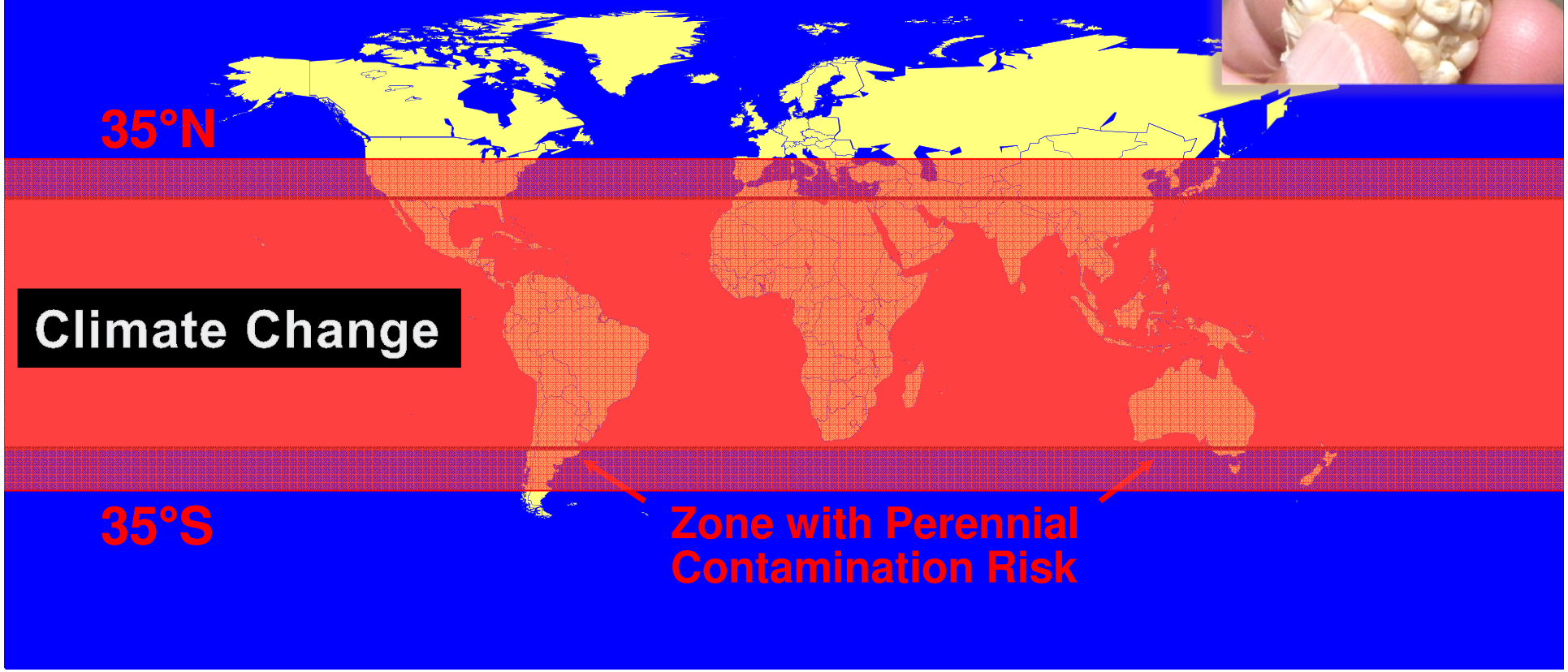
- Developing crops become infected.
- Associated with crop damage (insect, bird, stress).
- Favored by high temperature (night) and dry conditions.

Phase II: After Crop Maturity

- Aflatoxin increases in mature crop.
- Seed is vulnerable until consumed.
- Rain on the mature crop increases contamination.
- Associated with high humidity in the field & store, insect damage, and improper crop storage or transportation.

Aflatoxin Contamination: A Perennial Concern in Warm Climates

Contamination is most severe at low elevations and during dry periods. During drought the zone with contamination expands.



Aflatoxin Impacts People's Lives

Prevalence of Aflatoxins in Food & Feed

- Several African staple commodities affected
- High human exposure in Africa – mother to baby
- Levels and frequency of occurrence high
- Concern for food and feed processors, government

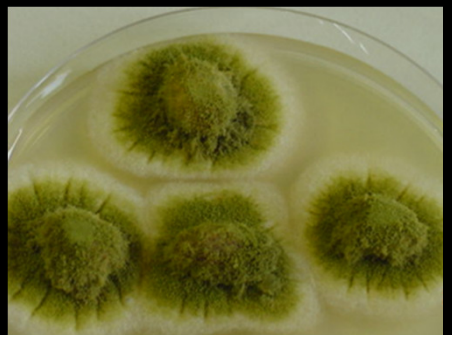
0802
0802
Say what
you want
to say

Aflatoxin Contamination in West Africa

Primary products

MTL = 10 - 20 ng/g

- Maize: 4,000 – Benin
- Peanut: 925 – Burkina
- Sorghum: 80 – Ghana
- Rice: 372 – Nigeria
- Millet: 200 – Nigeria
- Tiger nuts: 120 – Nigeria



Food products

- Peanut paste: 3,278 – Ghana
- Peanut sauce: 943 – Ghana
- Leaf sauce: 775 – Gambia
- Maize dough: 313 – Ghana
- Kenkey: 524 – Ghana
- Cashew paste: 366 – Ghana
- Peanut oil: 500 – Nigeria
- Yam flour: 7,600 – Nigeria
- Local beer: 135 – Nigeria
- Infant food: 19* – Burkina

Aflatoxin Concentration in Groundnut and Maize Samples at Harvest, 2012, Nigeria

Aflatoxin (ppb)	Peanut (n = 188)	Maize (n = 241)
Distribution (% samples)		
> 4	54	70
> 10	41	52
> 20	29	24
Descriptive statistics (ppb)		
Minimum	< LOQ	< LOQ
Maximum	3487	838
Mean	111	33

LOQ = Limit of Quantification; States sampled: Nassarawa, Katsina, Kaduna, Kano, Bauchi, Jigawa & Niger

Risk of Aflatoxin Exposure from Cereals Vary

Crop	*Aflatoxin (ng/g)*			*Samples > 20 ppb aflatoxin (%)*	*Exposure (ng/kg bw/day)*
	Mean ± SD	Median	Range		
Maize	36 ± 100	4.2	1.1 – 480	17	226.8
Sorghum	8.8 ± 14	5.0	1.6 – 90	5	55.5
Pearl millet	4.6 ± 1.8	4.4	2.6 – 8.1	0	29.0
CODEX	20	-	-	-	126.0

- Maize could have up to 24-fold MTL, sorghum 4.5-fold
- Risk from sorghum is 4-fold less, and pearl millet 8-fold less than maize (consumption: 378 g/day; BW: 60 Kg)
- Diets have impact on aflatoxin risk and exposure

Aflatoxin and Poultry (Broilers)

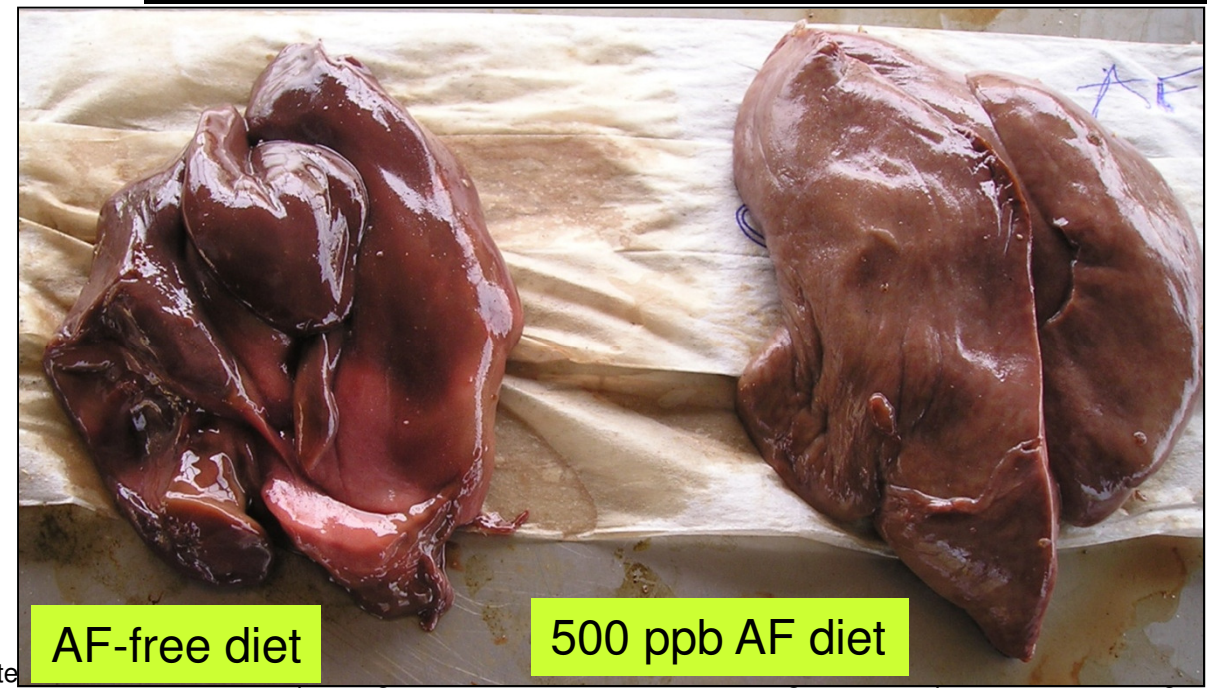
500 ppb AF diet

~40% reduction in live weight (8 weeks)

AF-free diet

Aflatoxin levels in feeds in Nigeria

Aflatoxin level (ppb)	Samples (%)
<20 (safe)	38
>20 to 100 (up to 5x)	14
>100 to 500 (up to 25x)	41
>500 to 1,000 (up to 100x)	7

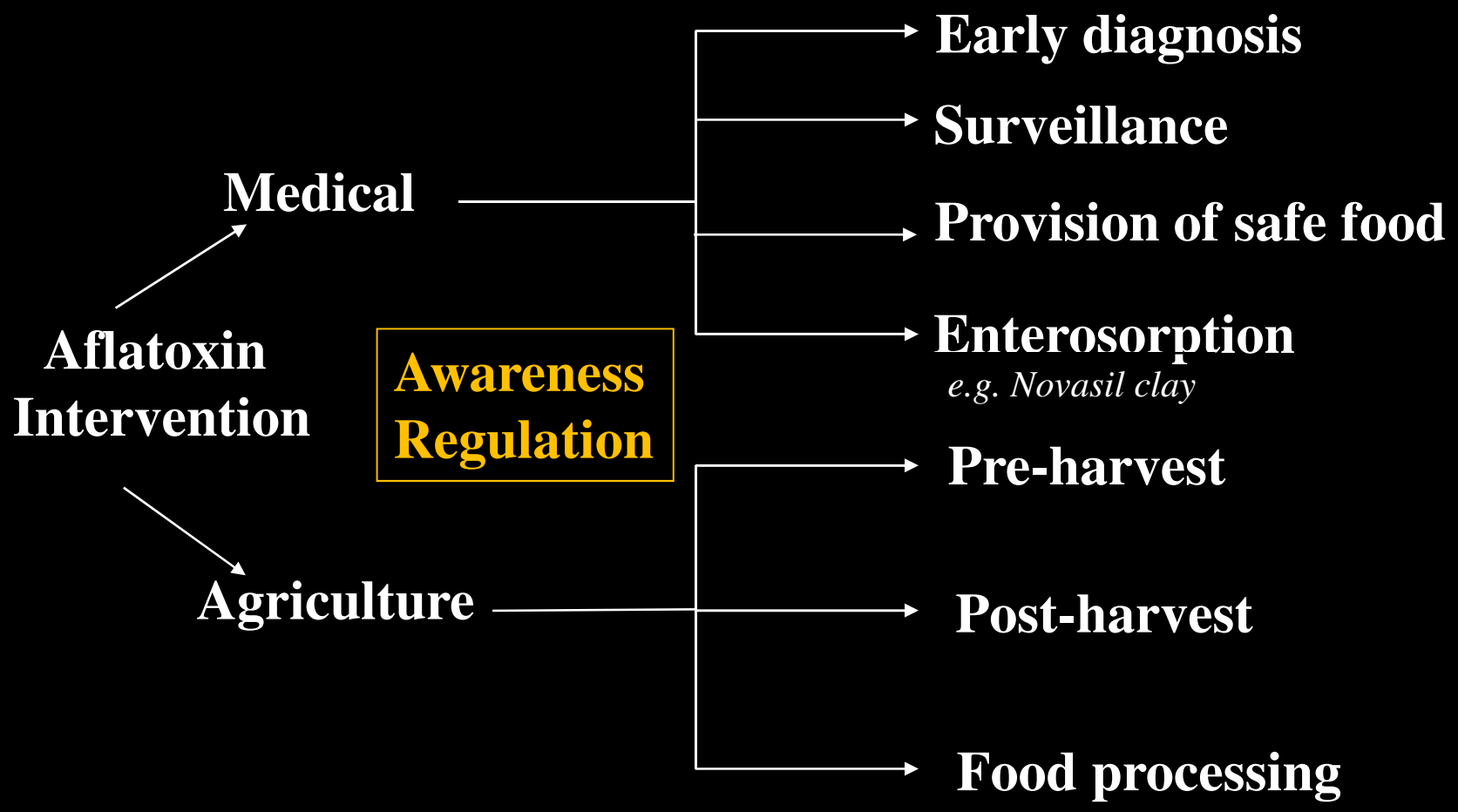


AF-free diet

500 ppb AF diet

Inte

Agriculture & Medical Prevention of Aflatoxin-related Food Security and Health Effects



(Adapted from Wild and Hall, Mutation Res., 2000)

Awareness and Training

Advocacy and Policies

- National and regionally harmonized standards in foods and feeds
- Intra-regional trade of safe food
- Enhanced capacity of regulators
- Alternative uses
- Disposal of contaminated material
- Regionally harmonized protocols for biopesticides registration
- Inclusion of aflatoxin in nutrition and health policies
- Aflatoxin alert system in Africa
- Critical role of PACA and RECs

Agriculture Based Prevention of Aflatoxin-related Food Security and Health Effects

- Pre-harvest
  - Resistant cultivars, if available
  - Biological control, e.g., aflasafe
  - Irrigation and water conservation practices
  - Lime and FYM application
- Post-harvest
  - Sorting
  - Insect control
  - Improved drying and storage
  - Food/feed processing methods
  - Alternative uses including blending

Product: Aflasafe

Biocontrol

Mixture of 4 native atoxigenic strains

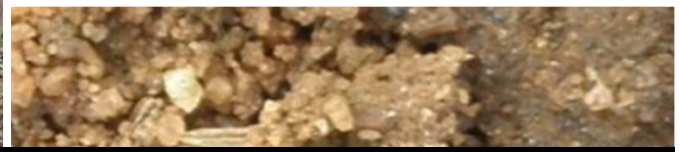
IITA

Farmers treating maize and groundnut fields with AflaSafe

MAIZE: Aflatoxin reduction (%)

Stage	2009	2010	2011
Harvest	82	94	83
Storage	92	93	x

71% and 52% carry-over of inoculum 1 & 2 years after application

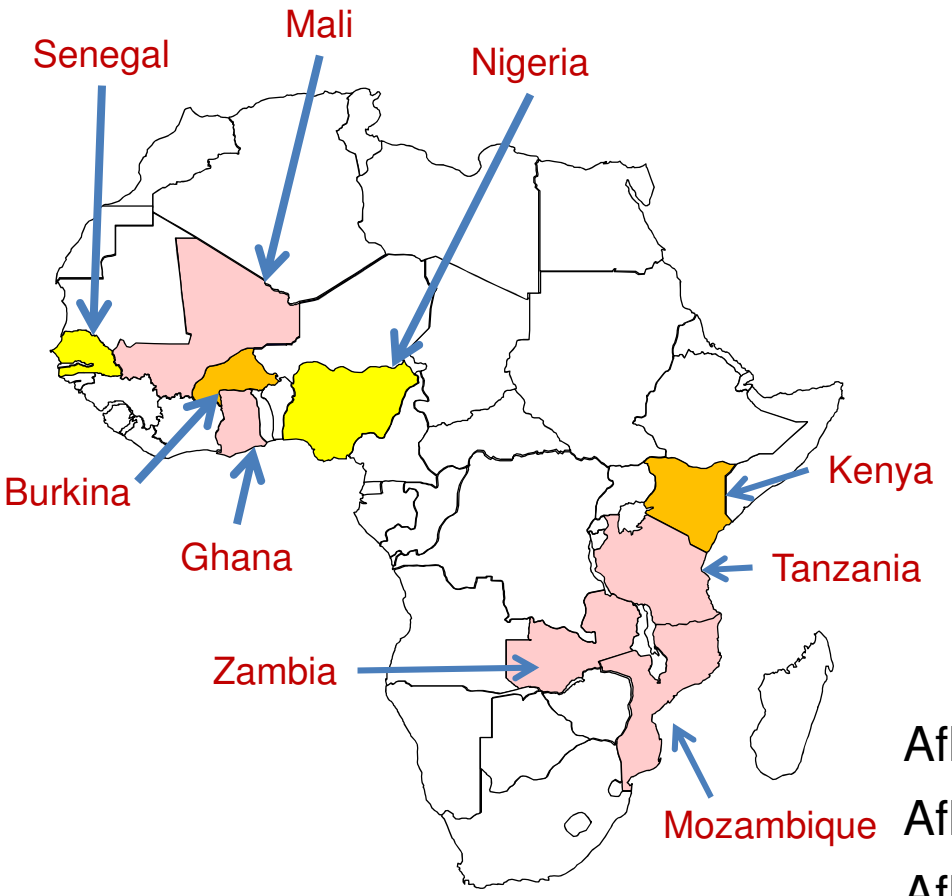


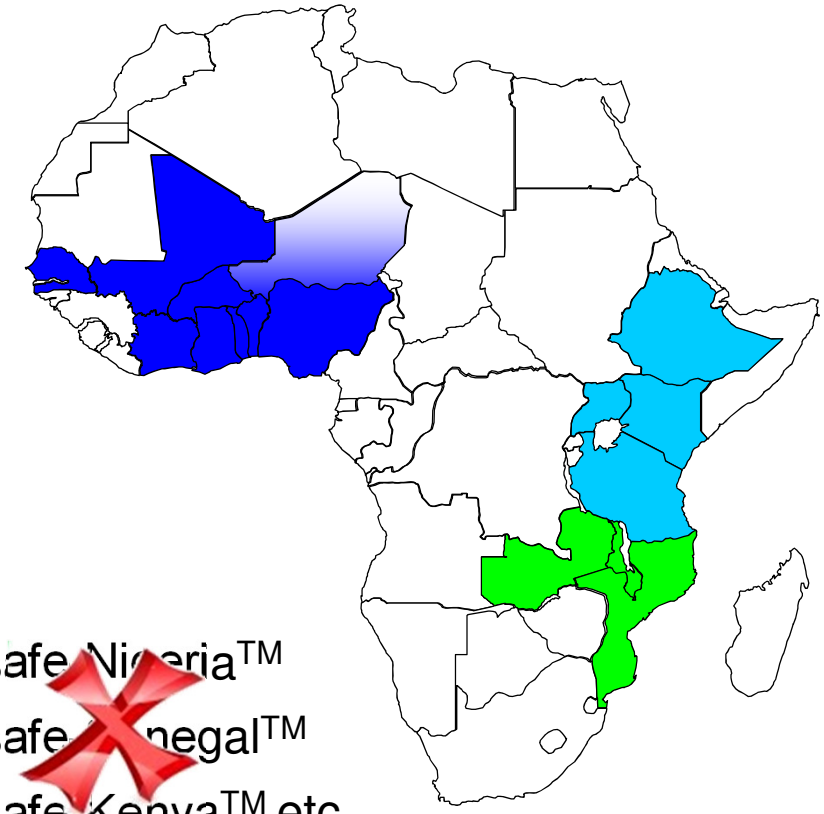
PEANUT: Aflatoxin reduction (%)

Stage	2009	2010	2011
Harvest	-	95	82
Storage	100	80	x

Results from 382 on-farm trials

National Products → Regional Products





Aflasafe Nigeria™
Aflasafe Senegal™
Aflasafe Kenya™ etc…

Aflasafe-West™
Aflasafe-East™
Aflasafe-South™

Products ready for registration

Products under testing in farmers' fields

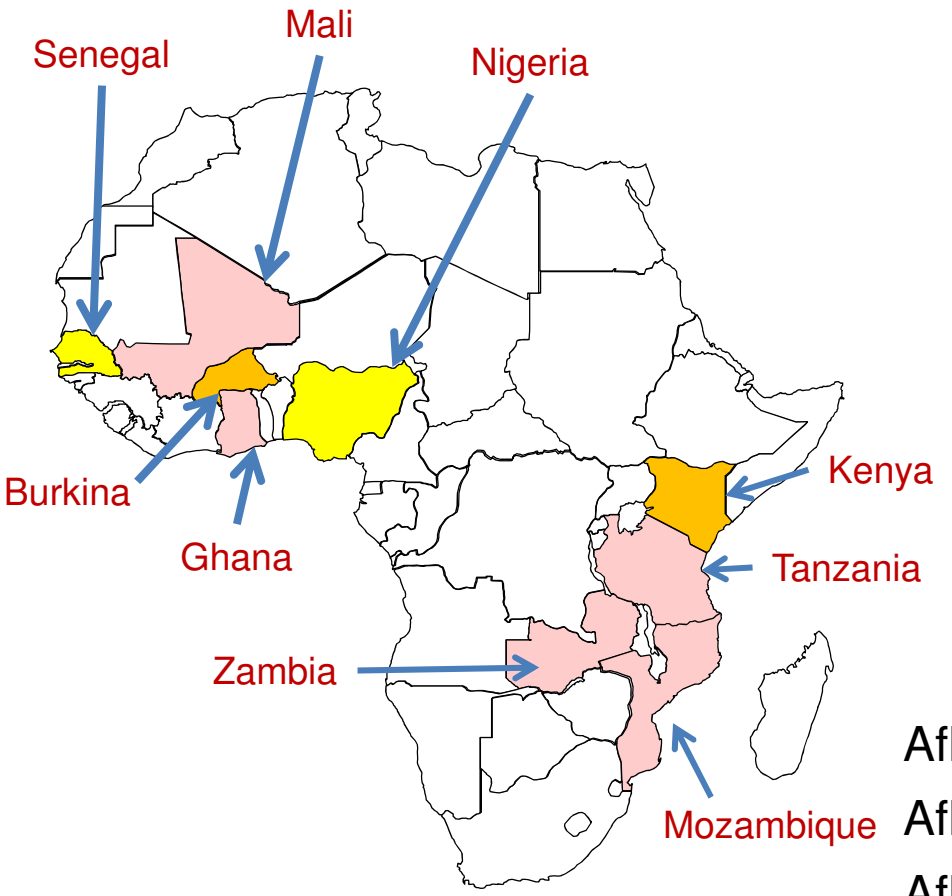
Strain development in progress

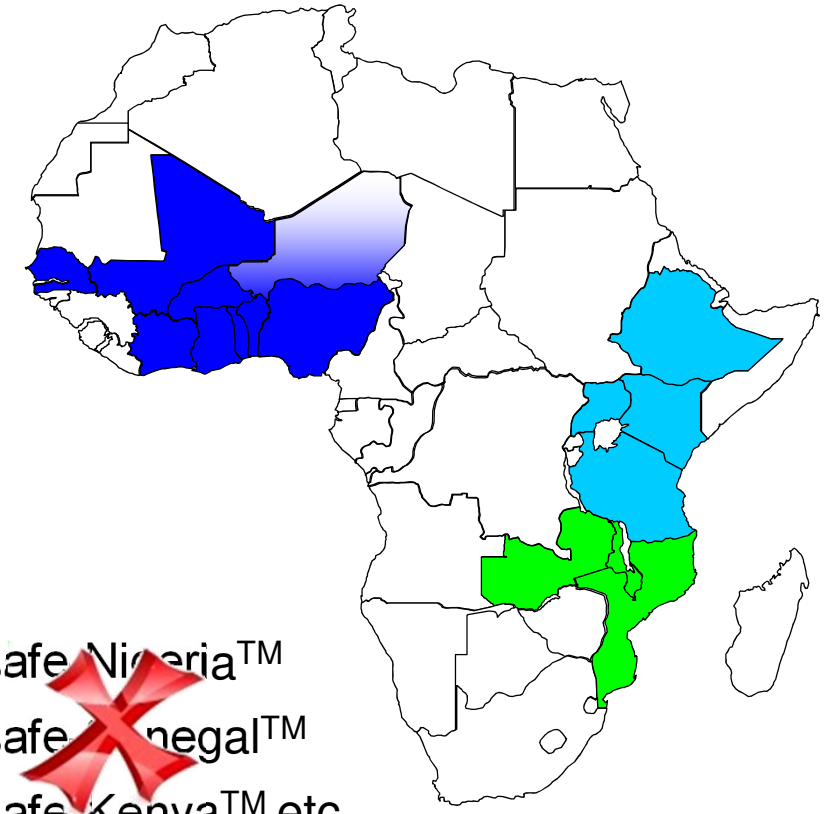
Aflatoxin (ppb) in Low-Aflatoxin Maize Lines With and Without Aflasafe Treatment

Experimental variety	At harvest		After poor storage	
	Control	Aflasafe	Control	Aflasafe
RSYN2-Y	19.6	1.7	462	44
RSYN3-W	6.9	1.8	627	38
SYN3-Y	18.4	1.7	387	19
TZB-SR (susc.)	57.5	4.7	1152	163

Combining management tactics increases extent of aflatoxin reduction

National Products → Regional Products





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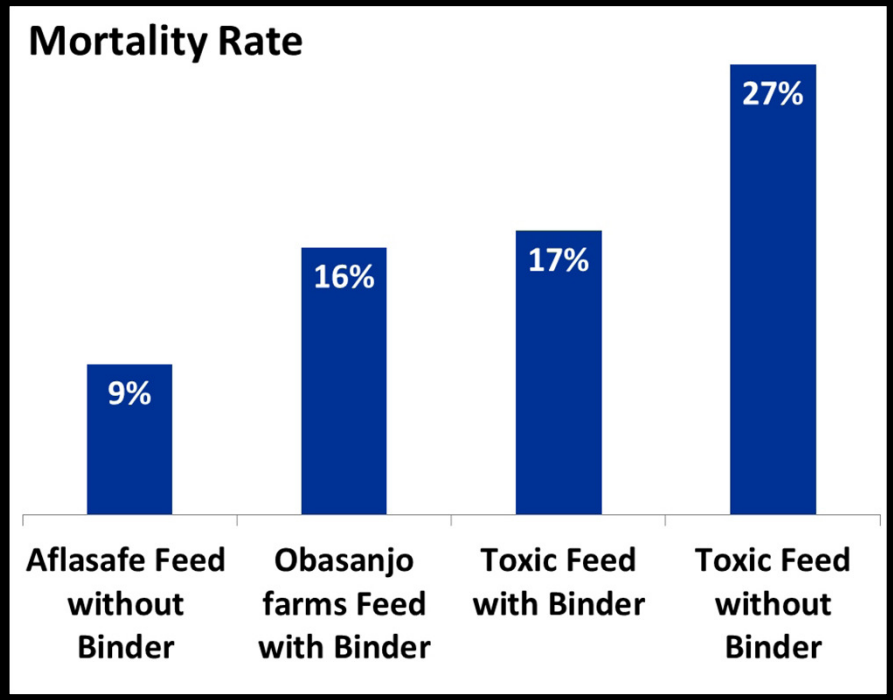
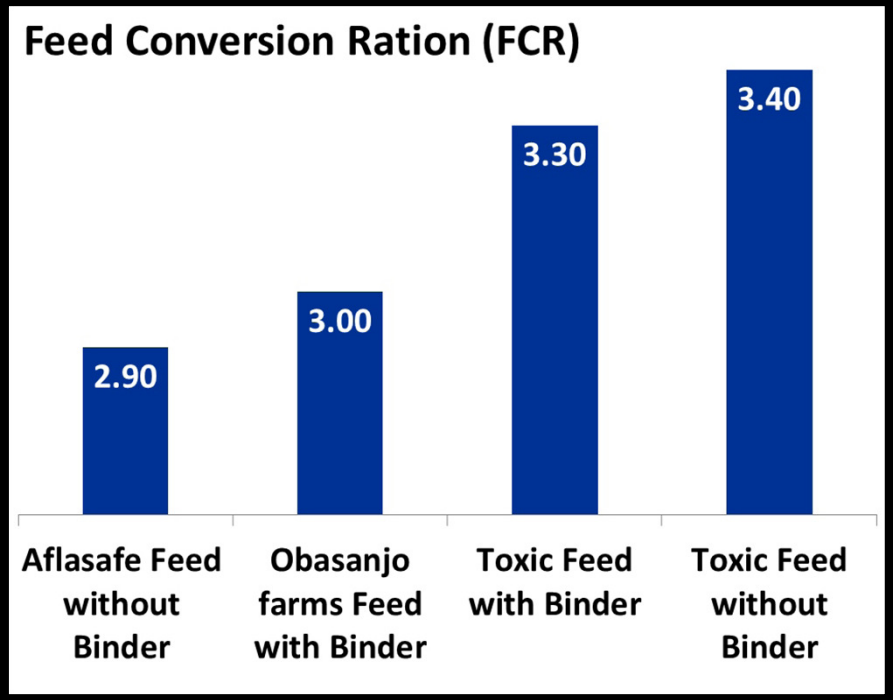
Impact of aflasafe on Poultry





- Poultry producers with farmers' groups on one platform
- Build relationships and create sustainable market
- Behavioural changes and market development

Synergistic Effect of Resistance and Biocontrol in Reducing Aflatoxins at Harvest and after poor storage

Experimental varieties	Aflatoxin reduction (%)		
	Resistance alone	Biocontrol alone	Resistance + Biocontrol
RSYN2-Y	66 (60)	91 (90)	97 (96)
RSYN3-W	88 (46)	74 (94)	97 (97)
SYN3-Y	68 (66)	91 (95)	97 (98)
TZB-SR (Susc.)	58 (1152) ppb	92 (86)	

% Reduction in experimental varieties compared to susceptible variety (TZB-SR) under natural conditions

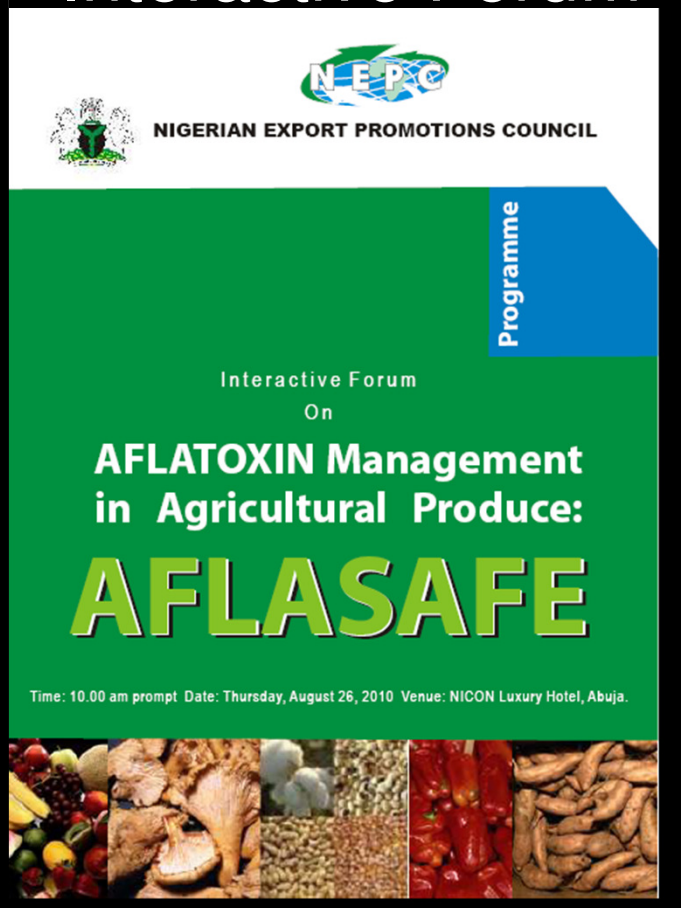
% Reduction in biocontrol treated plots compared to untreated plots of the same variety

% Reduction in varieties with biocontrol compared to susceptible variety (TZB-SR) under natural conditions

Ownership and Advocacy by the Nigerian Government

Billboard

Interactive Forum



A commercialization strategy for distribution and adoption being piloted

Consider Aflasafe as public health intervention for aflatoxin

AgResults

Innovation in Research and Delivery

- **G20: Aflasafe incentivization selected for implementation in Nigeria**
- Aflasafe will be used by smallholder farmers in 200,000 ha

Conclusions

- Aflatoxins in food and feed pervasive in Africa
- Increased awareness + good management + effective regulations + strong institutions = low human health & high market impacts
- Low awareness + low management + inadequate regulations = high human health & low market impacts
- Aflatoxin is a public health issue in Africa
- **Technologies available but must be implemented to reduce aflatoxin burden in African economies and food system**
- Support needed to coordinate and galvanize partnerships

PACA
Partnership for Aflatoxin Control in Africa
Partenariat pour lutter contre l'aflatoxine en Afrique
Parceria para o Controle da Aflatoxina em África
الشراكة من أجل مكافحة الافلاتوكسين في أفريقيا