



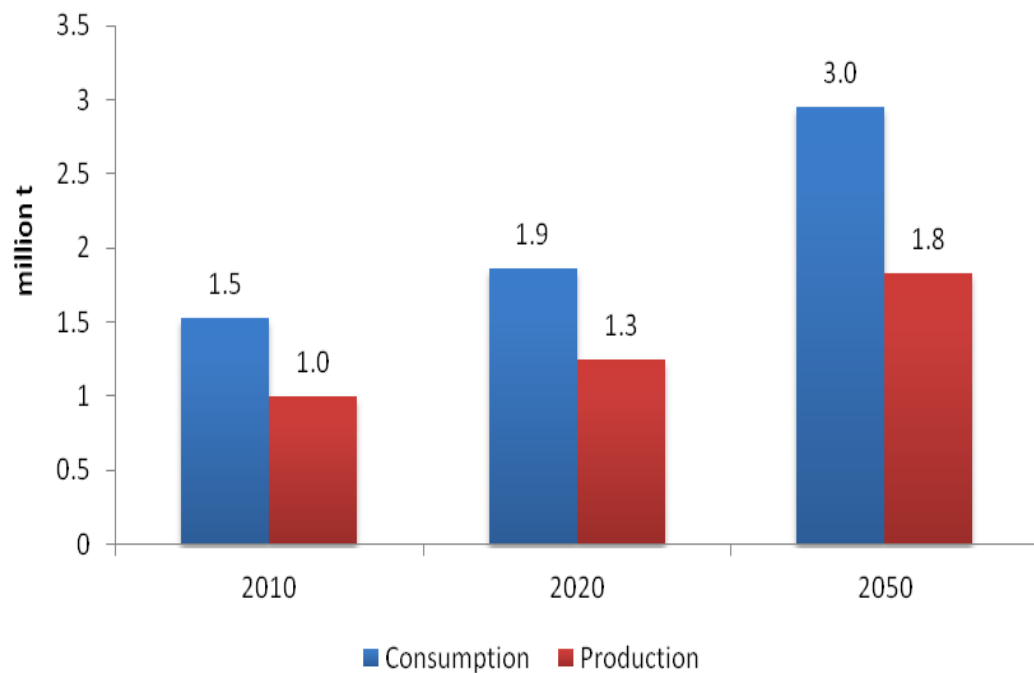
# **AGRICULTURE FOR NUTRITION AND HEALTH (A4NH)- AFLATOXIN**

## **ICRISAT Activities**

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**CGIAR aflatoxins meeting, 9-11 October, 2013, Naivasha, Nairobi, Kenya**

## Opportunities for a food and nutrition secure world

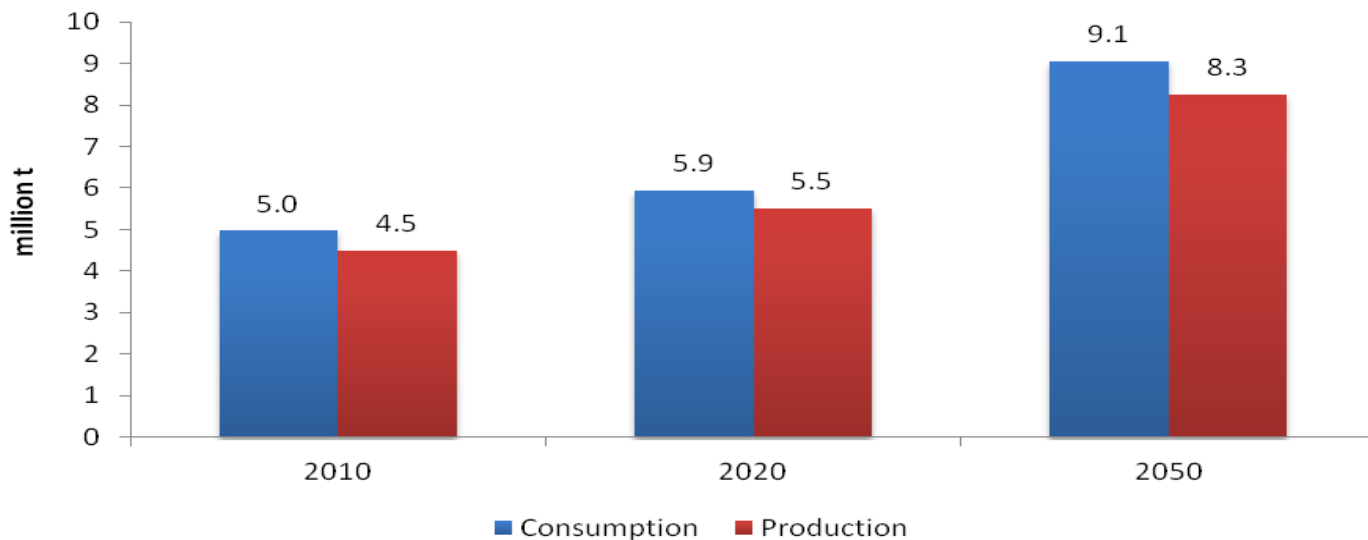


## Groundnut Production, consumption in SSA now and in the future

Source: ICRISAT, 2012

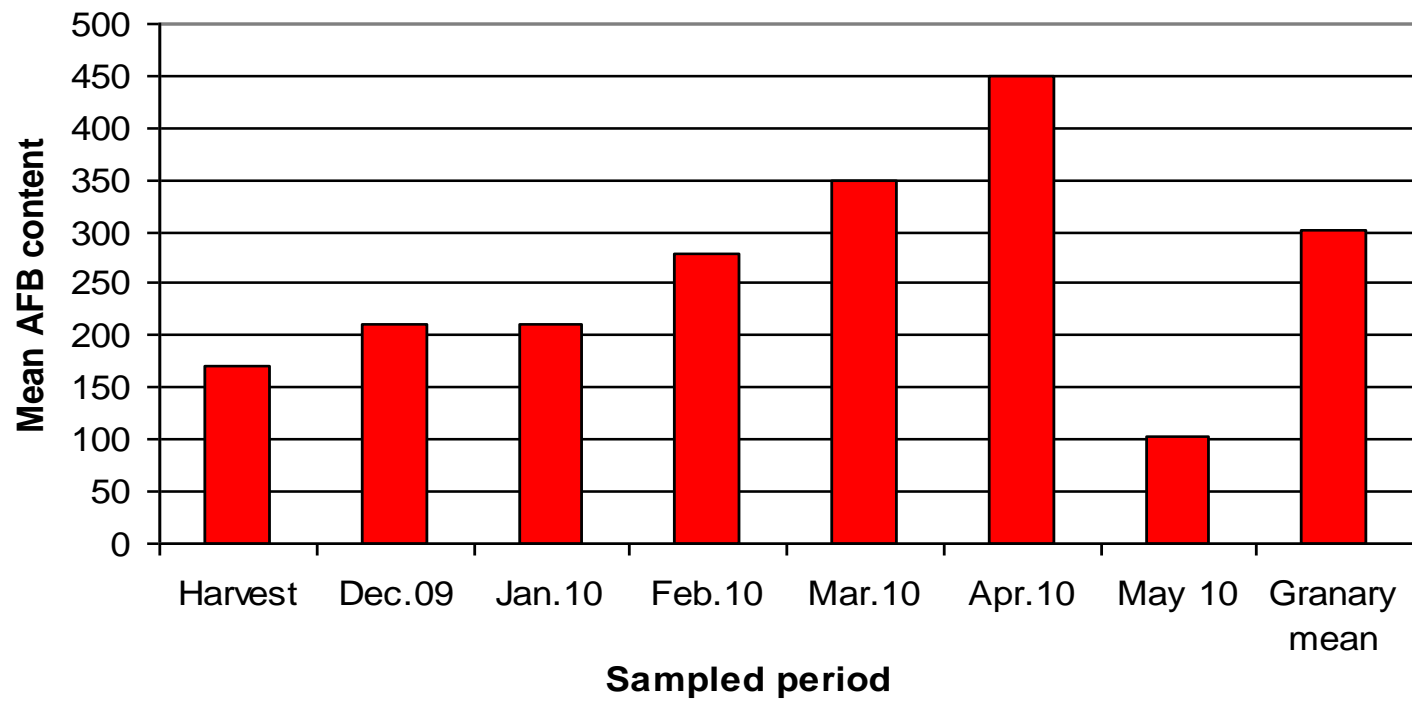
Production and consumption expected to double by 2050

2/3 production comes from rain fed crop, which suffers drought predisposing the crop to aflatoxin contamination



# Aflatoxins contamination in 30 farmers' granaries

Kolokani region in Mali



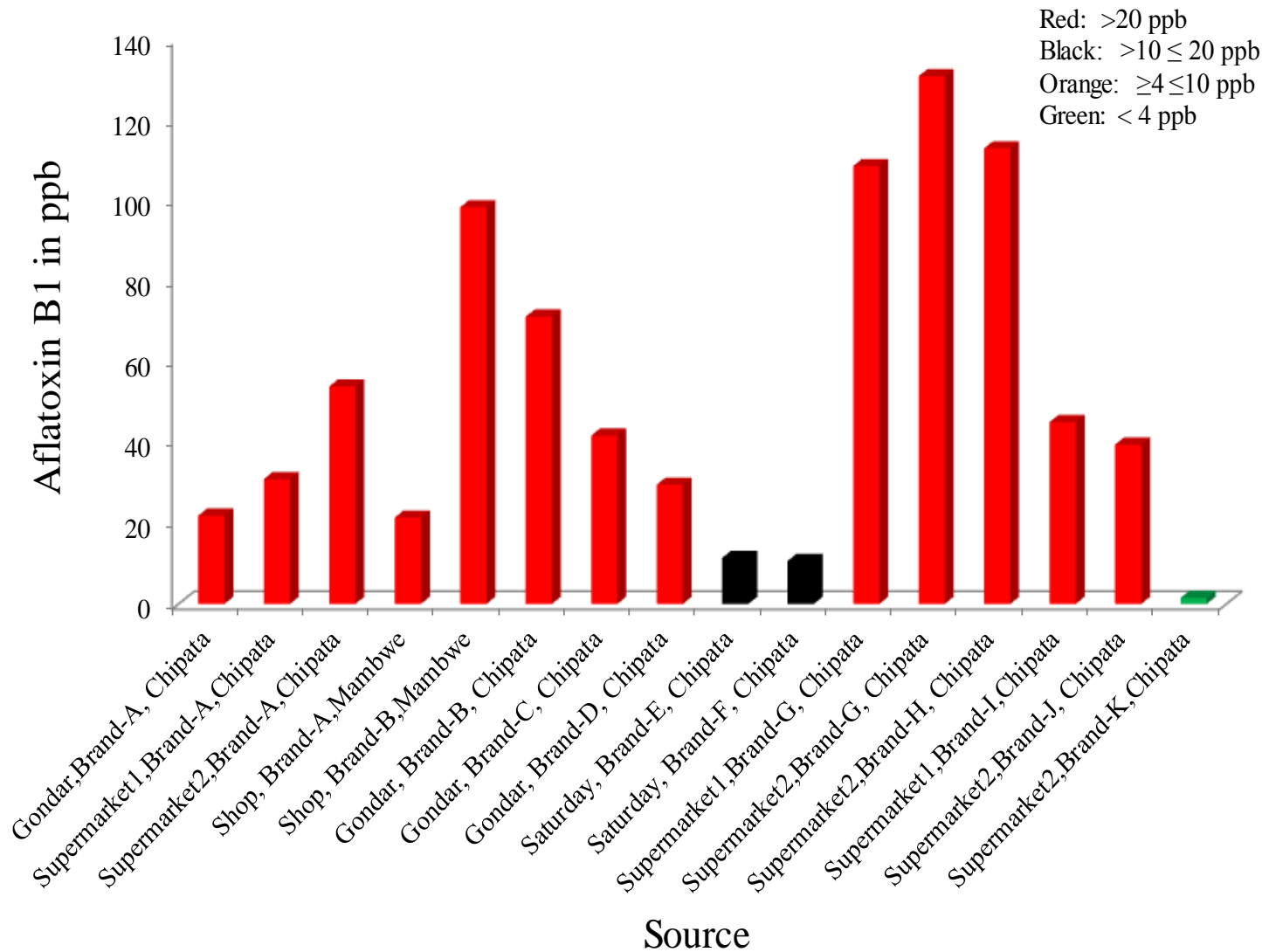
Farmers' fields

Granaries

Traders

Markets

# Mean aflatoxin B<sub>1</sub> in peanut butter, Eastern Zambia



# An Integrated Approach to Manage Aflatoxin Contamination

## *Global Approach*

### **HOST RESISTANCE**

Conventional breeding  
Transgenic approaches i.e. anti-fungal and anti-mycotoxin genes

### **CULTURAL PRACTICES**

Soil amendments  
e.g. gypsum, compost

### **BIO-CONTROL AGENTS**

Trichoderma, Pseudomonads,  
Atoxigenic strains

### **HARVEST AND POST-HARVEST TECHNOLOGIES**

Drying and Storage

### **Technology Transfer / Socioeconomic Issues**

*Regional studies & monitoring  
Public Awareness  
Trade implications  
Advisory panels  
Consultation to Industries  
Strengthening Capacity*

**Assessment / Implementation at  
Regional level**

**Devising appropriate regional  
packages and promotion**

**No-cost**

**Low-cost**

**High-cost**

**Pre- and Post-harvest  
Aflatoxin Management**

# Theme 3: Prevention and Control of Agriculture-Associated Diseases

## Research Activities

1. Promoting cost-effective diagnostic assays for aflatoxin detection in groundnuts and aflatoxin exposure in humans
2. Integrated pre and post-harvest management strategies to mitigate aflatoxin contamination
3. Studies on factors influencing aflatoxin contamination, toxigenic profiling of *A. flavus* and mapping the hot-spot areas
4. Development of a database of aflatoxin prevalence along the groundnut value chain and capacity building of stakeholders

Breeding  
for  
aflatoxin  
resistance  
in CRP  
Grain  
Legumes



# **Research Activity 1:** Promotion of cost-effective diagnostic essays for aflatoxin detection in groundnuts and aflatoxin exposure in humans



## **Research Activity 1: Promotion of cost-effective diagnostic essays for aflatoxin detection in groundnuts and aflatoxin exposure in humans**

- Held International Training Course on “Detection and management of aflatoxin contamination in crops” April 29<sup>th</sup>-May 10<sup>th</sup> at ICRISAT, India
- 9 participants (Niger (2), Zambia (2), Bangladesh (2), Malawi (1), Sri Lanka (1) India (1).
- The ELISA kit was promoted with partners in Mali, Malawi, Niger and Nigeria
- Analysed over 20,000 samples of food products (groundnut, maize , sorghum, rice and smoked fish) from NGOs, private sector, WFP and farmers), including food processors





## **Research Activity 2:** Integrated pre and post-harvest management strategies to mitigate aflatoxin contamination



# Testing and transferring resistant improved varieties to farmers

2500 germplasm lines screened and sources of resistance to pod wall, seed coat and cotyledon identified in cultivated peanut

- Many varieties show high levels of resistance across tests, locations
- Resistance needs to be combined with integrated management

Genotype	Aflatoxin (ppb)
ICGV 89092	0.2
ICGV 91289	0.4
ICGV 00362	0.7
ICGV 86168	0.7
ICGV 02313	0.9
ICGV 91283	1.2
ICGV 06423	1.5
ICGV 99240	1.8
ICGV 07220	2.1
ICGV 91324	2.1
ICGV 01258	2.5
ICGV 91278	2.7
ICGV 93305	2.8
ICGV 91317	3.4
ICGV 89106	3.9
ICGV 91304	3.9
ICGV 89115	4.1



## Activity 2: Integrated pre and post-harvest management strategies to mitigate aflatoxin contamination

- 15 farmer field demonstrations (1 acre each) in five major peanut growing states in India (9 in Andhra Pradesh, 2 in Karnataka, 2 in Tamil Nadu, 2 in Gujarath)
- Showcasing the pre-harvest and post-harvest “Good Agricultural Practices”

## **Demonstration of simple and affordable Good Agricultural Practices(GAP's) to mitigate aflatoxin contamination in groundnut**

Farmer	: Yeruswamy
Village	: Palabhavi
Mandal	: Rapthadu
District	: Ananthapuram
Variety	: K-6
Date of sowing	: 14th July 2013

### **Pre-harvest**

- Farmyard manure @2tons / per acre
- Applying Trichoderma culture to soil @ 1 kg/per Hectare
- Seed treatment with dithane M 45@3g/kg
- Applying gypsum @200kg /per acre
- Care should be taken while doing inter cultivation practices
- Avoid end of season drought with supplementary irrigation
- Harvest the crop at optimum maturity

### **Post-harvest**

- Damage to the pods at the time of harvest should be avoided .
- Do not keep the harvested material on soil for longer time .
- Dry the stripped pods to less than 10% moisture (around 8% is better)
- Sun drying before and /or after pod-stripping should be done .
- Do not dry the diseased / infected produce along with healthy ones .
- Use new / clean gunny or poly bags to store the groundnuts

## Activity 2 (cont) : Farmer Participatory Evaluation (WCA)

- 8 resistant lines (ICGV 91317, 91324, 93305, 94379, 91284, 91278, 91315 & 91279) evaluated at 6 locations in Mali with 325 farmers.
- 3 lines preferred -ICGV 94379, 91317, 91324 for early maturity, pod filling, yield, kernel size, high oil content
- In Mopti, 5 Women groups producing the seed of ICGV 94379 for its early maturity and seed size.



**Research Activity 3:** Studies on factors influencing aflatoxin contamination, toxigenic profiling of *A. flavus* and mapping the hot-spot areas

# Studies on factors influencing aflatoxin contamination, toxigenic profiling of *A. flavus* and mapping the hot-spot areas (Asia)

- Influence of soil characteristics on *A. flavus* populations and subsequent aflatoxin contamination
  - Soil Calcium
  - Soil pH
  - Organic Carbon
- Toxigenic profiling of *A. flavus*
  - Polyphasic approach



# Biological management of aflatoxin contamination with *Trichoderma harzianum*

- Experiment established in Mali
- Permission obtained from the Government of Mali
- Results to be presented at the end of year, 2013





# Soil Characterisation

- Soils samples from 3 agro-ecological zones of Mali collected
- 150 samples processed for characterization of *Aspergillus* spp.
- On-going study



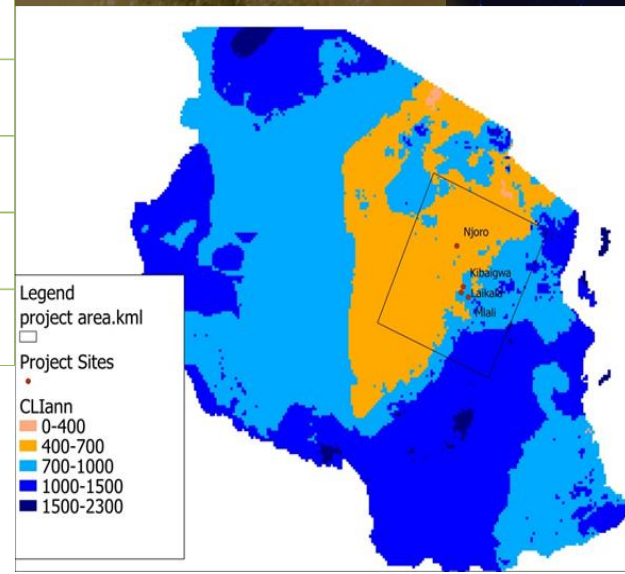
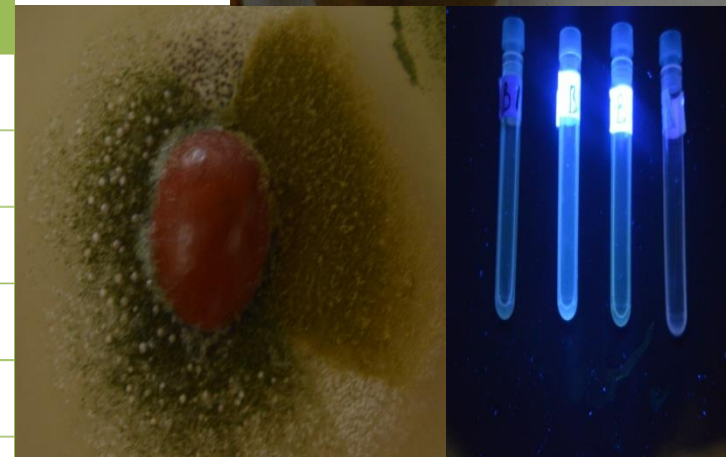
**Research Activity 4:** Development of a database of aflatoxin prevalence along the groundnut value chain and capacity building of stakeholders

## Development of a database of aflatoxin prevalence along the groundnut value chain and capacity building of stakeholders (1)

- Base line survey on farmers level of awareness on aflatoxin contamination
- Study on incentives for enhancing use of GAPs for aflatoxin free peanuts underway
- Involves 1000 farmers covering 4 major peanut growing states in India

# Prevalence of aflatoxin contamination along the value chain documented in Tanzania –A4NH & Africa RISING

Crop	Number of samples	Aflatoxin (ppb)
Groundnut	163	<b>70% upto 4000 ppb</b>
Maize	366	20% upto 340 ppb
Bambara	78	43.5 % 1ppb-411ppb
Pigeonpea	29	0 %
Beans	4	0 %
Millet	35	0 %
Sorghum	64	11% (>10 ppb)
Sunflower	143	13% upto 293 ppb
Groundnut Market samples	28	<b>100% up to 504 ppb</b>
Maize Market Samples	23	26 % (>10ppb)

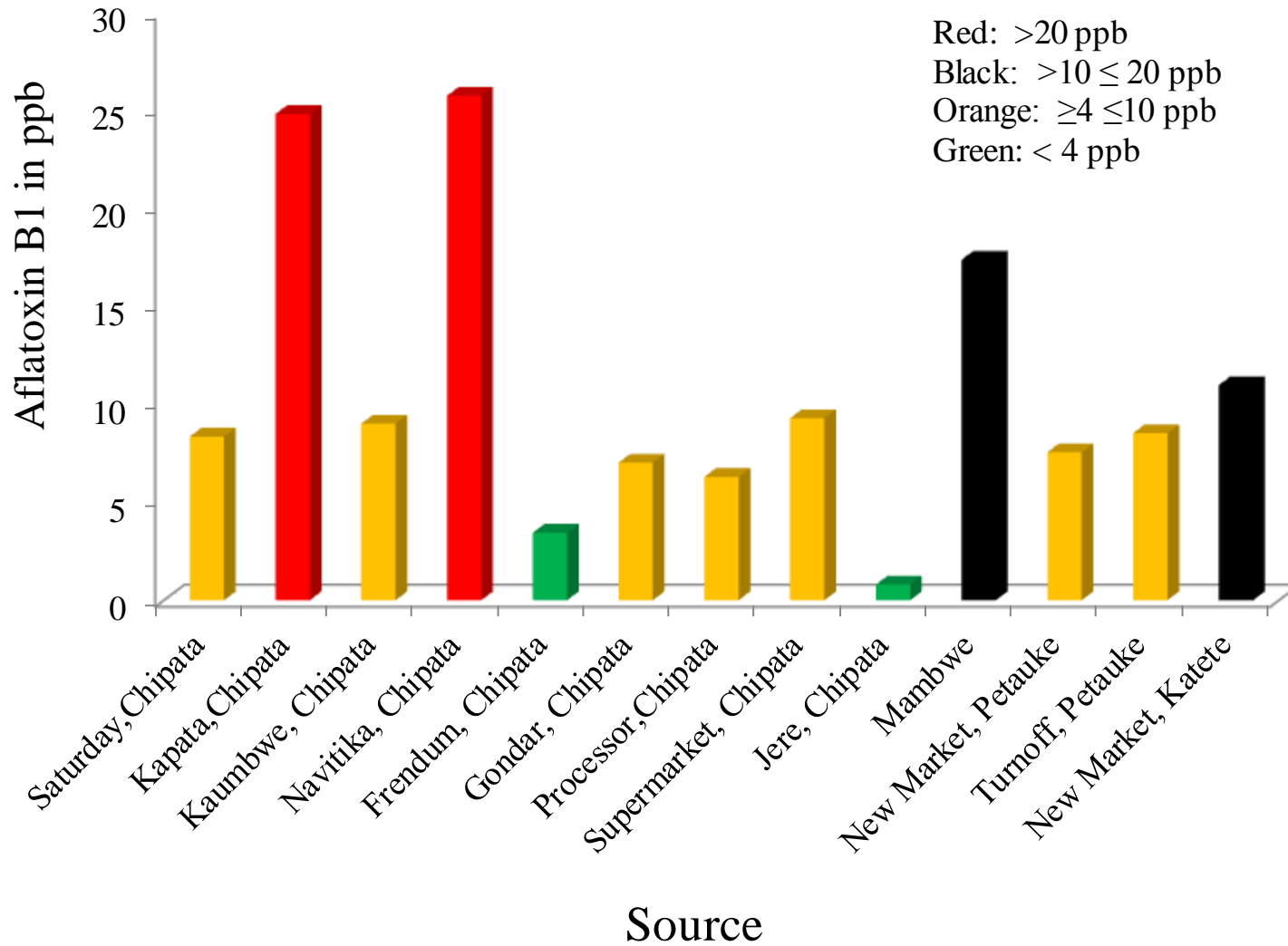


# Measuring Aflatoxin exposure in humans

- 793 blood samples collected from 5 districts of Malawi for aflatoxin biomarker analysis - HBV and HCV data were recorded for all the samples along with demographic data
- 64% samples were positive for biomarker with the concentration ranged from 5 to 600 pg mg<sup>-1</sup> of albumin



# Mean aflatoxin B<sub>1</sub> in market groundnut grain, Eastern Zambia



## Aflatoxin B<sub>1</sub> (ppb) in farmers storage, Eastern Zambia

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	PET	NYI	CHI	MAM
0-4	21	15	43	38
>4 to 20	41	50	32	31
>20 to 100	30	23	23	26
>100 to 1000	7	9	5	-
>1000	1	3	1	-
N	100	100	104	95
Maximum	3,258	4,980	1,077	69
Arithmetic mean	0.9	1.1	0.8	0.7

## Development of a database of aflatoxin prevalence along the groundnut value chain and capacity building of stakeholders (1)

- Available data on the prevalence of aflatoxin contamination in groundnut in Mali compiled and to be uploaded on ICRISAT web site.
- Previous data collected in West Africa (25yrs) has been organised and transformed to be added to this data base by end of year, 2013
- Dissemination products produced to enhance aflatoxin awareness among various stakeholders such as Flyers, interviews on rural radios and national television and CDs





Development of a database of aflatoxin prevalence along the groundnut value chain and capacity building of stakeholders (3)

- Women groups (5 including 129 households) with transformation of groundnut based food (Didègè and Equinut) in Mopti region of Mali
- Staff (44) of 5 NGOs in Mali trained in post-harvest management and sampling techniques



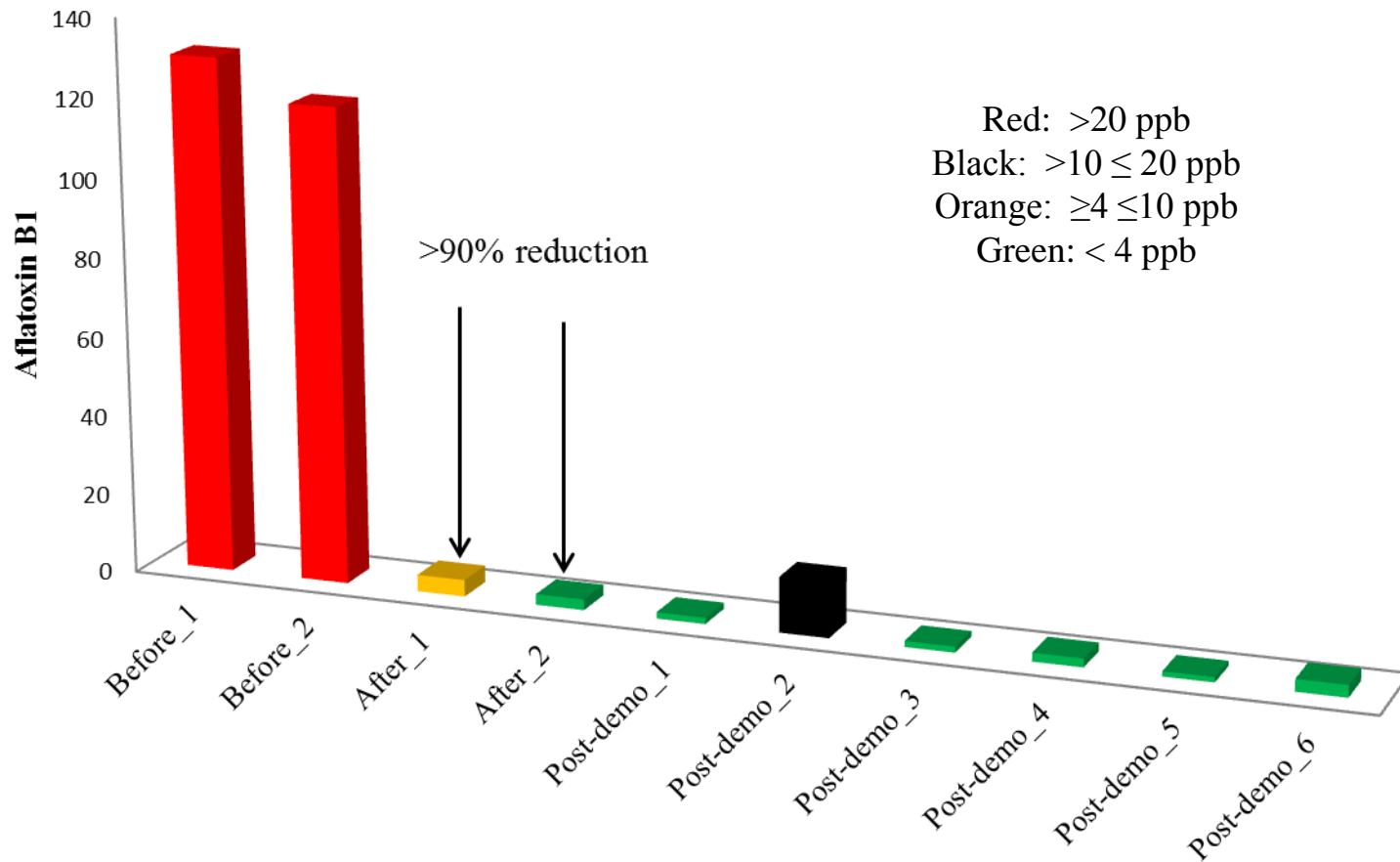
Development of a database of aflatoxin prevalence along the groundnut value chain and capacity building of stakeholders (3)



- 959 farmers in three regions of Mali (Kayes, Koulikoro and Koutiala) on-farm management techniques through demonstration plots
- 1100 farmers in the region of Dosso and Maradi in Niger in integrated aflatoxin management techniques.
- 155 women from 4 groups, and 162 women with Mali Espoir also in aflatoxin management.



# Effect of grading on aflatoxin contamination, EPFC



*Use project outputs to help develop a system of grades and standards in Zambia that will enable farmers to export to regional and international markets*

- Sorting demonstrations at Eastern Province Farmers Cooperative (EPFC) showed that aflatoxin levels can be significantly reduced.
- Coupled with testing, they have to-date exported more than 120 MT to South Africa, a stringent market that produce has to be at  $< 10$  ppb AFB<sub>1</sub>
- ICRISAT will be part of a committee in Zambia that will set the aflatoxin standards- earlier done for Malawi



RESEARCH  
PROGRAM ON  
**Agriculture for  
Nutrition  
and Health**

***Thank you!***



**International Crops Research Institute  
for the Semi-Arid Tropics**

*ICRISAT is a member of the CGIAR Consortium*

