Exploring the Scope of Cost-Effective Aflatoxin Risk Reduction Strategies in Maize and Groundnut Value Chains to Improve Market Access and Health of the Poor in Africa

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- International Center for the Improvement of Maize and Wheat
- International Crops Research Institute for the Semi-Arid Tropics
- University of Pittsburgh
- Uniformed Services University of the Health Sciences
- ACDI/VOCA/Kenya Maize Development Program
- Kenya Agricultural Research Institute
- Institut d’Economie Rurale
- The Eastern Africa Grain Council
Motivation

- Economic losses estimated to be large - dearth of systematic studies that empirically estimate:
  - Economic losses (health, income) for all stakeholders along the value chain
  - Economic impact of interventions
  - Socio-economic factors affecting adoption

- Number of biological studies on control options; adoption hasn’t been on a large scale.
To identify pro-poor cost-effective aflatoxin risk-reduction strategies in order to assess the uptake of these strategies and to suggest interventions that ensure high rates of adoptability along value chains.
Study Areas

- **Mali:**
  - Kita, Kayes, and Koulikoro Districts
    - 70% of groundnuts produced in Western Mali
    - Comprise all groundnut-producing agro-ecological zones

- **Kenya:**
  - Nyanza Province (West)
    - Transect from Kisii to Homabay (high - low elevations)
  - Upper East
    - Transect from Embu to Mbeere (high - low lands)
  - Lower East
    - Transect that includes Machakos and Makueni Districts
Project Objectives

**Economic Impact – Obj. 1**
- Health
- Household level analysis (Income, Gender)
- Trade

**Disease Prevalence – Obj. 2**
- Collection of prevalence data along value chains (with and without control measures) in different ecological zones

**Risk Analysis – Obj. 3**
- Risk maps
- Risk assessment
- Cost benefit analysis
- Cost effectiveness analysis

**Factors Affecting Behavior – Obj. 4**
- KAPP (Knowledge, Attitudes, Perceptions, and Practices)
- Contingent Valuation (Willingness to Pay, Willingness to Accept)

**Endpoints of Interest:**
1) Exposure
2) Market access/income/poverty reduction
3) Health

**Communication and Advocacy – Obj. 5**
**Exposure Assessment**

- Secondary data to quantify the economic impacts on human health consequences—liver cancer/DALYs
- Primary data gathered from this study will be used to assess aflatoxin exposure in Kenya & Mali
  - Aflatoxin levels in food-related work
  - Possible biomarker-related work
  - Best of all: possibly correlating foodborne aflatoxin with HUMAN aflatoxin biomarkers!
1) Qualitative: Semi-structured interviews and focus group meetings (questionnaire):

- Role of maize and groundnuts in people’s livelihoods (diversified by gender)
- Production, storage, marketing practices
- Where farmers got information regarding inputs, improving production practices, disease, market information
- Knowledge about aflatoxin risk
- Interested in how information differed by accessibility

Kenya – 6 villages – 3 east; 3 west; Mali – 6 villages - 2 in Kita, 2 in Koulikoro; 2 in Kayes.
Maize-Kenya:
- Generally aware of aflatoxin, but didn’t know what caused it;
- Wanted to know if it was safe to dry maize directly on the ground;
- Knew neighbors died because of aflatoxin; how could they know if they were exposed;
- Some farmers consumed moldy maize produced on own farm, but would not consume moldy maize from stores

Groundnut-Mali:
- Those close to the road heard of aflatoxin, but basically knew what the extension officer told;
- Far from the roads had no knowledge of aflatoxin;
- Did not consume moldy groundnuts as they tasted bad
2) Quantitative: Structured household surveys
   • (# hh in Kenya 1062 + ; # hh in Mali 1200 +270)
   • 300 Traders

a) To assess the effect of aflatoxin contamination on income, wealth, gender equality at: farm-level or pre-harvest, post-harvest, and marketing

b) To understand knowledge, attitude, perceptions, and practices of value chain actors
   • asked a series of questions regarding what aflatoxin is, causes, ways to prevent it etc and whether actor altered behavior if they knew
c) The contingent valuation method is used to capture farmers’ and other value chain actors’ WTP for “hypothetical” aflatoxin control technologies

**Maize risk reduction methods:**
- Improved seed that reduces the risk of aflatoxin
- Drying maize off the ground (tarpaulin)
- Plastic silos
- Metal silos
- Bio controls


d) BDM Auction among farmers is used to assess the willingness of farmers as consumers to pay a premium for maize that has been certified as aflatoxin-free
1) What is the extent of Aflatoxin contamination along the value chain?
2) How does the risk alter seasonally?
3) How does various practices to reduce the risk alter it?

- Samples will be collected at different intervals in time:
  - Pre-harvest
  - Harvest, handling and processing for storage
  - Storage method (15 to 30 days interval)
  - Markets (every month)
Kenya – maize 2009 Sampling

Pre-harvest

Ph: 15-25

FS: 30-40

FS: 60-70

Legend:
- 0 - 10
- 10 - 100
- 100 - 200
- 200 - 300
- > 300
Most maize not from original stock, but sourced from market
Percent of maize samples from farmer fields with aflatoxin levels above and below 10ppb, (Jan – Feb 2010)
Aflatoxin Prevalence Along the Malian Groundnut Value Chain: Farm-Level Data

**Kolokani Farms**

- Harvest:
  - Aflatoxins range (µg/kg):
    - No. of samples:
      - 0-5: 1678
      - 6-35: 0
      - 36-100: 0
      - 101-300: 0
      - 301-500: 0
      - 501-1000: 0
      - 1001-1678: 0

- Storage:
  - Sampled period:
    - No. of samples:
      - >1201: 0
      - 751-1200: 0
      - 451-750: 0
      - 151-450: 0
      - 36-150: 0
      - 6-35: 0
      - 0-5: 0

**Kita Farms**

- Harvest:
  - Aflatoxins range (µg/kg):
    - No. of samples:
      - 0-5: 0
      - 6-35: 5
      - 36-100: 20
      - 101-200: 20
      - 201-246: 0

- Storage:
  - Sampled period:
    - No. of samples:
      - >1201: 0
      - 751-1200: 0
      - 451-750: 0
      - 151-450: 0
      - 36-150: 0
      - 6-35: 0
      - 0-5: 0

**Kayes Farms**

- Harvest:
  - Aflatoxins range (µg/kg):
    - No. of samples:
      - 0-5: 0
      - 6-35: 10
      - 36-100: 15
      - 101-212: 20

- Storage:
  - Sampled period:
    - No. of samples:
      - >1201: 0
      - 751-1200: 0
      - 451-750: 0
      - 151-450: 0
      - 36-150: 0
      - 6-35: 0
      - 0-5: 0
Aflatoxin Prevalence Along the Malian Groundnut Value Chain: Trader-Level Data

Kolokani Traders

Bamako Traders
Risk maps

- How does risk of Aflatoxin contamination relate to environmental or climatic factors, and how does it vary over time and across geographical areas? (Develop predictive risk maps)

Risk analysis

- How does the prevalence alter as the product moves along the value chain (risk assessment)
- What are the cost and benefits of different technologies to reduce aflatoxin risk? (cost-benefit analysis)
- Which Aflatoxin mitigation strategies provide the best value for money, and are most likely to be accepted by farmers, consumers and other actors in terms of costs and effectiveness? (cost-effectiveness analysis)
Preliminary Predictive Risk Maps - Comparison of Initial Model to the Agricultural Land in Kenya

Need ground-truthing and additional sampling in agricultural areas not found by model
Environmental Agri-ecologic Soils Rains Temperature and humidity Inputs

Preharvest

Harvesting

Drying technique

Treating to prevent

Separating/dilution

Transport to market

Local market

Urban areas

Environmental Inputs Harvesting Drying technique Treating to prevent Separating/dilution Transport to market Local market Urban areas

Gaps - prevalence data 2 seasons; experimental knowledge on effectiveness of risk mitigation measures, used expert elicitation for now; behavioral issues..will people adopt
Consumers lack of knowledge about what aflatoxin is, its consequences, its origin and health effects;

Some stakeholders are aware about the consequences of contamination and exposure but knowledge about reducing risk has not been translated to action;

Lack of good understanding on effectiveness and efficiency (including costs and benefits) of risk reduction measures (most experimental); thus we are using hypothetical risk reduction measures

Lack of understanding consumption (via plate consumption study) and actual aflatoxin levels in blood (biomarker);

Lack of understanding how to ensure adoption of farmers if cost-effective measures are identified

The sample from a farm where 9 members hospitalized with Aflatoxin poisoning; the sample taken for the project had Aflatoxin levels of 400ppb.
Initial inception workshop April 2009

Methodological briefs written

With ACDI/VOCA disseminating results to stakeholders (met 3 times with Ministry in Kenya) and stakeholder workshop held Jan 2011)

Open for others to join, avoid duplication

Transparent, disclosure of interim findings

Collaborative & trans-disciplinary & constructive peer review

Iterative, ongoing adjustments

End-user focused

http://programs.ifpri.org/afla/afla.asp
Current Team:

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