Does Knowledge of Risk Change Behavior? Case of Aflatoxin in Kenya

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On behalf of the team

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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
What are aflatoxins and why are they dangerous?

- Naturally occurring toxic substances
  - Corn, peanuts, tree nuts, cottonseed, spices

- Produced by various species of *Aspergillus fungi* live in certain soils

- Products that come into contact with fungus in soils during harvesting, threshing, and drying
  - Prone to contamination

- Contamination can occur in storage due to pest infestation and the poor conditions that accelerate growth rates of *fungi*

- Chronic exposure leads to liver cancer
  - CDC has estimated 4.5 billion people in developing countries

- Other effects: immune system disorders, stunting in children, acute aflatoxicosis

- Symptoms of Aflatoxicosis
  - High fever
  - GI symptoms
  - Edema of the limbs
  - Rapid progressive jaundice
  - Swollen livers
Aflatoxicosis sickened 317, killed 125 (Kenya) (2004)

<table>
<thead>
<tr>
<th>District</th>
<th>Maize Aflatoxin (ppb)</th>
<th>Maize Aflatoxin (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geom. Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Makueni</td>
<td>52.9</td>
<td>1 – 5,400</td>
</tr>
<tr>
<td>Kitui</td>
<td>35.2</td>
<td>1 – 25,000</td>
</tr>
<tr>
<td>Machakos</td>
<td>17.8</td>
<td>1 – 3,800</td>
</tr>
<tr>
<td>Thika</td>
<td>7.5</td>
<td>1 – 46,400</td>
</tr>
<tr>
<td>TOTAL</td>
<td>20.5</td>
<td>1 – 46,400</td>
</tr>
</tbody>
</table>

Azziz-Baumgartner et al., 2005
ACDI/Voca has observed that in Kenya poor producers are the least likely to adopt aflatoxin risk reduction technologies since they lack the necessary resources, and, thus, they are the group most susceptible to aflatoxin exposure.
Motivation for project

- Number of biological studies on control options; hasn’t been large scale adoption

- 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

- Losses can be reduced through education; awareness and behaviour change

- Aflatoxins not always visible; relying on such practices may be problematic particularly in countries where people are food insecure and less willing to waste food
Multi-disciplinary Research Team (BMGF)

**Economic Impact**
- Health
- Household level analysis (Income, Gender)
- Trade

**Disease Prevalence**
- Collection of prevalence data along value chains in different ecological zones

**Risk Analysis**
- Predictive Risk maps
- Risk assessment
- Cost effectiveness analysis

**Perceptions of aflatoxin and WTP**
- KAP (Knowledge Attitudes Perception Actions)
- Valuation of demand risk reduction measures
- Auctions (consumer demand)

Endpoints of interest: exposure
- Market access/income/poverty reduction
- Health

Communication and Advocacy
Prevalence Levels for Kenya (Mahuku et al - CIMMYT 2012)

Prevalence data collected from different AEZs from 2009-2011 at pre-harvest, in storage (15 to 30 days interval), and in the markets (every month)

Total of 4,414 samples
Maxent Model- A widely-used and accepted ecological niche modeling program

Input:
- Known locations of a species (aflatoxin) in terms of longitude, latitude
- Environmental layers (climate, elevation, land cover, etc)

Output:
- Probability map of species potential distribution
- Information on importance of environmental variables (sensitivity analysis) –humidity and rain
- Statistical evaluation of the model

Predictive Kenya Risk Map (Masuoka et al-USUHS, 2012)
Livelihoods impact:
• Qualitative focus group survey
• Quantitative household surveys
  • Household surveys: Oct 2010 – Jan 2011
  • Community level surveys: Oct 2010 – Jan 2011
• Socio-economic data collection: March 2011 at households where prevalence collected

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Head is Female (%)</td>
<td>18</td>
</tr>
<tr>
<td>Household Head’s Age (Yrs.)</td>
<td>52</td>
</tr>
<tr>
<td>Household Head’s Education</td>
<td>7</td>
</tr>
<tr>
<td>Household Head’s Farming</td>
<td>26</td>
</tr>
<tr>
<td>Experience (Yrs.)</td>
<td></td>
</tr>
<tr>
<td>Total Annual Income (KSH)</td>
<td>200298</td>
</tr>
<tr>
<td>Total Value of Maize Produced</td>
<td>12,873</td>
</tr>
</tbody>
</table>
### Sources of Information on Aflatoxin

<table>
<thead>
<tr>
<th>Source</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>% of Those Who Know Aflatoxin</th>
<th>% Total Sample (511M/832 F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Radio</td>
<td>197</td>
<td>158</td>
<td>39</td>
<td>39.3%</td>
<td>14.7%</td>
</tr>
<tr>
<td>Swahili Radio</td>
<td>118</td>
<td>101</td>
<td>17</td>
<td>23.6%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Extension Officer</td>
<td>65</td>
<td>8</td>
<td>0</td>
<td>13.0%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Neighbor</td>
<td>38</td>
<td>158</td>
<td>39</td>
<td>7.6%</td>
<td>2.8%</td>
</tr>
<tr>
<td>TV</td>
<td>29</td>
<td>22</td>
<td>7</td>
<td>5.8%</td>
<td>2.2%</td>
</tr>
<tr>
<td>English Radio</td>
<td>14</td>
<td>11</td>
<td>3</td>
<td>2.8%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Newspaper</td>
<td>8</td>
<td>105</td>
<td>13</td>
<td>1.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Buyers/Traders</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0.6%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Other Source</td>
<td>37</td>
<td>30</td>
<td>7</td>
<td>7.4%</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

Note: Percentages are of respondents who had heard of aflatoxin (n=501), total sample size (n=1343).
**Knowledge:** the degree of factual understanding of the topic and associated issues.

**Attitude and perceptions:** feelings toward the subject, including judgment of its importance and influence on people’s lives.

**Practices:** current actions taken as a result of the knowledge, attitude and perception toward the issues.
Influence Diagram – Structural Relationships

Household demographic characteristic

Knowledge of causes of aflatoxin contamination

Perception of aflatoxin risk associated with visual attributes

Attitudes towards high levels of aflatoxin contamination

Scale of production

Actions to minimize risk of aflatoxin contamination

Being in regions with past cases
30 Questions Grouped into Broad Categories

- **Knowledge of Attributes of Aflatoxin** exposure (i.e. human health symptoms such as stomach pain, diarrhea, vomiting, etc.)

- **Knowledge of Causes (Moisture)** of Aflatoxin exposure (e.g. wetness in piles of harvested maize, poor storage condition, dampness in storage place, improper drying, etc.).

- **Knowledge of secondary pathways** of Aflatoxin exposure (e.g. dairy, beer made with moldy maize)

- **Attitude (Reaction)** about Aflatoxin safety (i.e. farmers’ attitude towards potential outbreaks in their village).

- **Perception of Risk** (i.e. understanding risks of storing wet maize, buying maize from local markets, insect/pest damage, etc.).

- **Actions (Container)** (i.e. using storage practices that avoid Aflatoxin such as maintaining humidity and cleanliness in storage).
Consumers' Awareness and Knowledge of Aflatoxins

Note: In the high potential areas, more people have heard of it, but still very few understand it.
KAP Indicies by Regions with Outbreaks in 2004

- Knowledge of Attributes
- Knowledge of Causes
- Attitude - Reaction
- Perception of Risk
- Actions - Container

Non-Outbreak Region (N=1125)
Outbreak Region “Drylands” (N=219)
Results - Structural equation modeling

Education -- Pos. & significant effect on perception of risk

Education -- Neg. & significant effect on household’s reaction to extension or public health office regarding a potential risk in the village.

Female HH heads -- Higher knowledge about harmful effects of feeding moldy grains to humans & animals

HH in dry lands -- (where 2004 outbreaks) -- had higher perception of risk but limited knowledge of safety attributes & ways to reduce risk through improved storage practices (actions)

Scale of operation -- size of land cultivated or value of production -- had no effect on farmers’ actions.

Maize selling - no effect in terms of actions to reduce risk (not the case in terms of groundnuts in Mali)
For aflatoxin: individual auction (WTP)

- **Product:** maize grain, in 2 kg bags, clear plastic
- **Type of products**
  - Clean, untested
  - Clean, tested (with no measurable trace of aflatoxin)
  - Contaminated: 5% of moldy, discolored grain
- **Participation fee:** twice the estimated value of the highest quality product
  - KShs 110/person ($1.5)
Procedure individual auctions

- Participants are offered the participation fee
- They are asked to bid on different products
- They draw a number from a random distribution, from 1 to 80 (40)
- If their bid is higher than the random number, they purchase the product at the random price
Kenya – Willingness to Pay
Premium/discount

- Premium for clean maize over contaminated: KSHS 20-30 / 2 kg
- Premium for labeled maize: Kshs 10-15/2 kg
Difficult to identify the level of effectiveness in African situation; need in field results

Levels of effectiveness assume correct application of methods; adoption studies needed

Estimates for cost of risk reduction technologies still in development highly uncertain; better cost estimates and understanding lifecycle of options needed

Most intervention studies done with the assistance of donor; don’t know what types of education methods needed to ensure long term adoption of effective aflatoxin risk reduction strategies beyond an intervention study

Development of low cost testing methods in development ($5-7); Do not know consumers willingness to pay to test maize

Deployment of low-cost testing in rural areas; Do not know feasibility; do we have a substitution?
Women’s group
- **Educate** families, farmers and governments about the health risks associated with mycotoxins & the social and economic costs of reducing this risk

- **Education** ways to reduce the risk of contamination of high-risk commodities with the application of appropriate agricultural, storage, & drying practices

- **Build the local capacity** to support further activities to reduce mycotoxins in agricultural products, monitor mycotoxin levels in crops and the population, and

- **Provide the tools** (data and risk management capacity) for locally-driven policy reform that will ensure food safety and trade opportunities in the region.
- Support implementation of effective aflatoxin control projects
- Integrate aflatoxin programs within existing frameworks: Support the mainstreaming of aflatoxin issues into the CAADP framework and SPS activities at regional and country levels.
- Create an innovative, durable structure and transparent governance system
- Advocate for aflatoxin control and engage leadership across sector
- Establish a PACA network and information sharing platform
- Mobilize resources and develop a funding mechanism for future aflatoxin control projects
New Efforts

- G-20 Project
  - Biocontrol Nigeria
  - Improved Storage mechanisms in Kenya