# Integrating Economics with Risk Assessment to Inform SPS Decisions in a Developing Country Context


Clare Narrod
Sr Research Fellow, Food and Water Safety Team
MTID, IFPRI

## Introduction

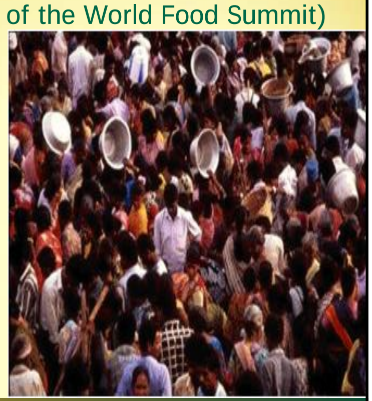
- Food safety is a fundamental component of food security.

  "Food security exists when all people at all times, have physical and economic access to sufficient, **safe** and nutritious food to meet dietary needs and food preferences for an active and healthy life."

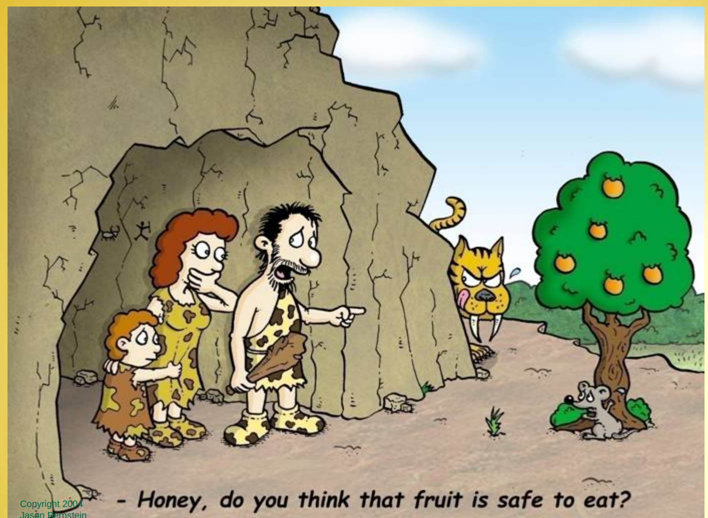
  (FAO, 1996 – Rome Declaration of the World Food Summit)

- Drivers of demand

1. Increasing income and urbanization
2. Technological advancement in detecting and tackling food safety risks (e.g. nanotechnolgy)
3. Institutional changes which require adoption of stricter food safety standards and modern marketing channels (public and private standards)



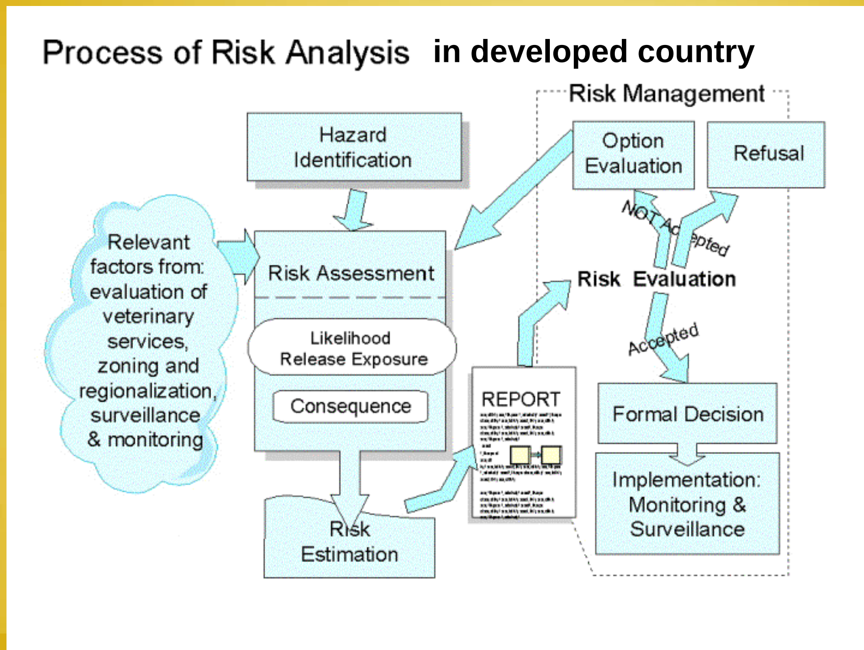
## Food safety: Early days




## Consumer of the future

Facts versus fears: Understanding perceived risk


Figure 5. Drawing by S. Harris; © 1979 *The New Yorker Magazine*.

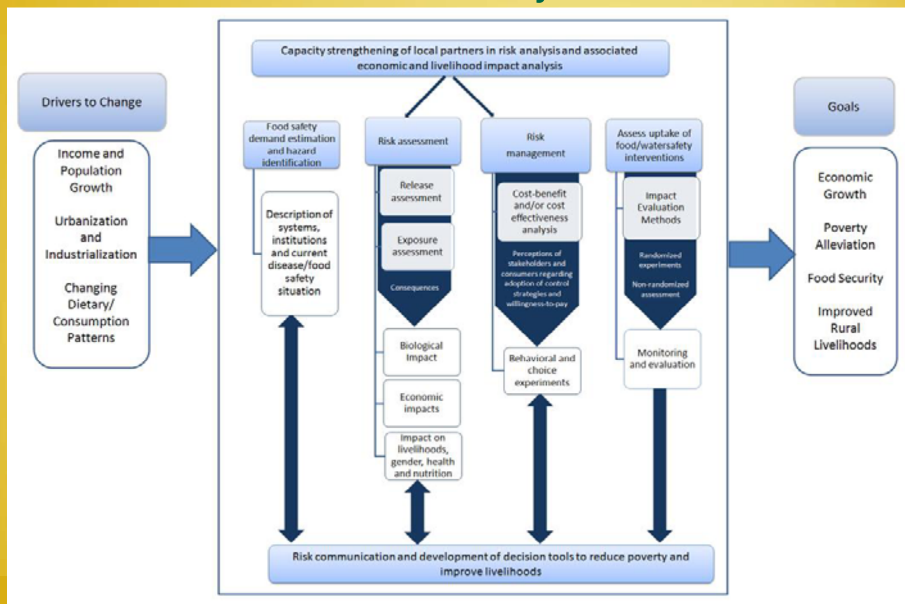



## Challenges for developing countries

1. **The poor <u>consumers</u> cannot afford food safety attributes:** demand for food safety materializes at higher income levels – US$10 a day (Delgado, 2005);
2. **Lack of awareness of health risks from unsafe food and water among developing country consumers** – results not only in the consumers' lack of adoption of measures to minimize the health risks themselves, but also in the absence of a price premium for safer food
3. **Poor producers' compliance with increased food safety standards**

- How to produce safe food
- How to be recognized as producing safe food
- How to identify cost-effective technologies for reducing risk
- How to be competitive with larger producers

## Modified Risk Analysis Framework to Enhance Food and Water Safety




## RESEARCH METHODS (Toolkit)

- Quantitative/qualitative risk analysis (risk mapping, risk assessment, cost benefit/cost effectiveness analyses, dynamic disease spread modeling)
- Value chain and institutional analysis
- Livelihood impact analysis
- Demand and supply estimation
- Partial equilibrium/multi-market sector specific modeling
- CGE (economy wide) modeling
- Experimental and quasi-experimental methods
- Qualitative approaches (participatory poverty assessment, focus group discussions, etc.)
- Revealed and stated preference methods

## Pro-Poor HPAI Risk Reduction Strategies

**Motivation:** Uncertainty about timing, extent, and severity of a potential animal disease outbreak such as HPAI, yet developing countries must make critical decisions about ways to defend against a potential outbreak.

**Disease and control measures:**
Differential economic impacts on different income groups and sectors

The rural poor, whose livelihoods depend in large part from poultry and who consume their own poultry, may disproportionately feel these costs.

1. Provide scientific basis for cost-effective, and 'equitable' HPAI control strategies
2. 'Inject' insights into national, regional and global policy processes
3. Build capacity for evidence-based formulation of disease control policy

Study Countries: Ethiopia, Ghana, Indonesia, Kenya, Nigeria,
Collaborators: IFPRI, ILRI, RVC

## Conceptual Framework

**Disease Risk**
- Risk maps
- Probability models
- Spatial spread models

**Livelihood Impact**
- Economy-wide and Sector level analysis
- Household level analysis (Income, Asset, Gender and Nutrition)

**Institutional Analysis**
- Value chain analysis
- Assessment of effectiveness
- Behavioral Experiments

**Evaluation Risk Management options**
- KAP (Knowledge Attitudes Perception)
- Contingent Valuation (Willingness to pay/ to accept)
- Expert elicitation
- Cost Benefit and Effectiveness Analysis
- Monte-Carlo Simulation

a) biological efficacy of disease
b) economic efficiency
c) social desirability
d) political feasibility

*Communication and Advocacy*

## Preliminary socio-economic findings

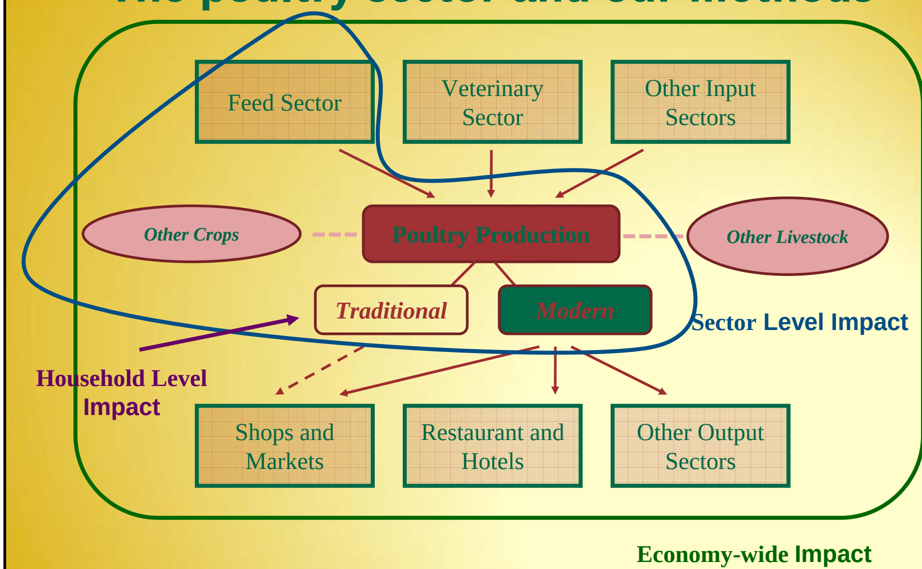
- Livelihood impact –using disease risk (outputs) –risk maps
  - Economy wide – General equilibrium or multimarket models
  - Micro level effects (income and nutritional)
- Evaluation of risk management options
  - Knowledge attitude and perceptions
  - Willingness to accept control measures

## Characterization of HPAI shocks on livelihoods

| Supply Shock | Demand Shock |
|---|---|
| Poultry Production | Poultry Consumption |
| - Generally localized<br>- Studies have shown small supply shock relative to poultry population (less than 2% in most countries<br>**- small increase in price** | - Often discrete<br>- Mostly non-localized<br>- No actual outbreak is needed<br>- Slows down over time<br>**- big decrease in price** |

➢ **Since reduction in prices, the demand shock prevails over supply shock**

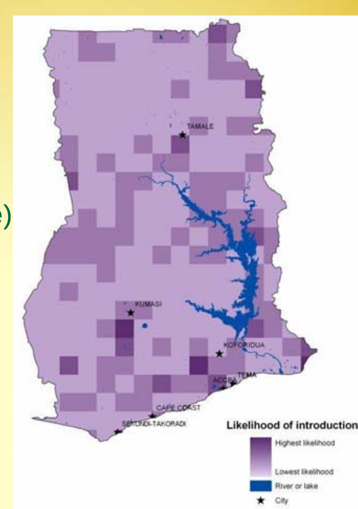
## The poultry sector and our methods




## Scenarios considered using risk maps

1. **Short-Term** (imports fixed, supply elasticities zero) and **Long-Term** (imports free, supply elasticities flexible)
2. **Localization** of production shock (high-risk areas, high and middle or nationwide)
3. 4 different **Production and Consumption shocks:**

| Simulation | Production Shock | Consumption Shock |
|---|---|---|
| 1 | 0 % | 25 % |
| 2 | 10 % | 40 % |
| 3 | 0 % | 40 % |
| 4 | 40 % | 0 % |

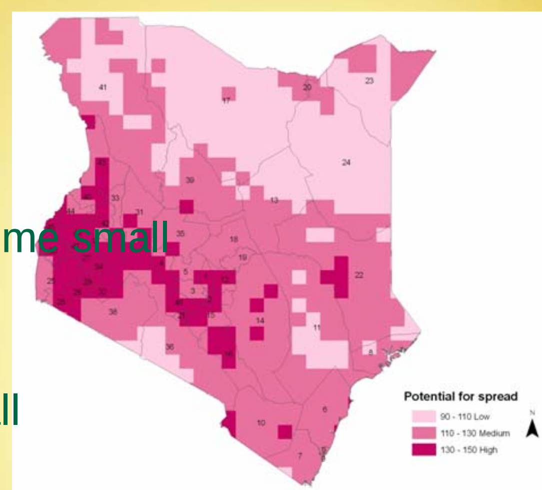


## Economy wide and suprapoultry sector effects

1. Demand shocks driven by consumer panic foremost factor in the reduction of poultry production
2. Household income impact on rural poor not significant; livelihood portfolio diversified by most poultry producers
3. Overall effect to the economy <u>on average</u> is likely to be small including effects on poverty; Regional and cross-sectional variation
4. Given small import of poultry products in Nigeria, the impact on domestic production is larger relative to Ghana
5. Economy wide effects of an HPAI outbreak are expected to be minimal due to the small size of the poultry sector's and weak intersectoral linkages ex) Ethiopia 98% producers traditional farmers

## Household impact scenarios using disease spread risk map

**<u>6 Scenarios</u>:**

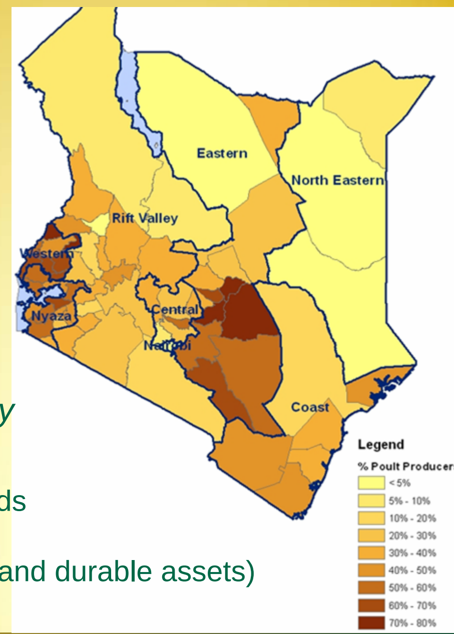



- Loosing all flock:
  - Country-wide
  - High-Risk areas
- Large flocks become small
  - Country-wide
  - Medium-Risk areas
- Small flock lose all
- Price Shock

## Kenya household livelihood analysis

*Proportion of households that keep poultry:*

43 % of **total** households
54 % of **rural** households
15 % of **urban** households



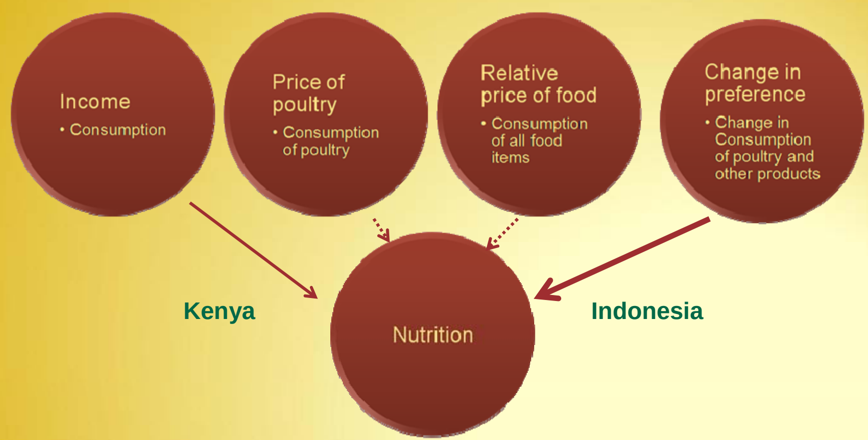

*Households who are more likely to keep poultry have:*

- older and less educated heads
- more women and children
- more wealth (land, livestock and durable assets)
- more income sources

## Households predicted to keep larger flocks <u>on avg.</u> for African study countries

1. Have diversified income portfolios.
2. Are likely to produce crop and other livestock.
3. Provide a small share of overall household income; multiple income sources enables most producers to be resilient against shocks
4. Small-scale poultry producers are unlikely to be significantly affected by HPAI shocks
5. The poorest of the poor in Africa do not produce poultry, on average they have lower incomes than non-producers.
6. Still HPAI shocks could induce <u>some</u> poultry producers to fall below the poverty line.

# Potential impact of HPAI on nutrition




# Nutritional impact

1. Animal source foods play an important role in the nutrition of young children in Indonesia, providing critical micro nutrients such as iron, zinc, and vitamin A
2. IFLS3 (2000) shows 30% of Indonesia children (up to 3 years of age) are classified as stunted, 17% underweight, 11% wasted, and 65% anemic
3. Reduced poultry product consumption from a modeled sustained HPAI shock with no animal source food substitute is shown to have significant detrimental impacts in terms of stunting, height for age, and hemoglobin concentration for children 1-3 (Upper bound -worst case scenario)

## Evaluation of risk management options (CBA/CEA)

- Information to feed into the CBA/CEA coming from survey's
  - KAP analysis to understand the poor's knowledge, attitudes and perceptions towards HPAI and control measures (hh level)
  - Contingent valuation analysis to estimate the poor's willingness to pay (WTP) for different control measures (hh level)
  - Cost of various prevention/ control measures in place (institutional and hh level)
- Decision model using Monte Carlo simulations to compute expected household income given probability of an outbreak and choice of control measures.

## World Bank's Small Scale Avian Influenza Saturation Survey -2007 Yogyakarta KAP Results: Key findings

- Poultry producers had
  - high level of HPAI awareness,
  - limited actual knowledge of HPAI symptoms,
  - variable knowledge of transmission, preventive measures, and disposal of dead birds
- Factors that affected knowledge about HPAI symptoms:
  - education of household head
  - size of household
  - income per capita
  - past knowledge about symptoms of HPAI

## WTA Compensation Results

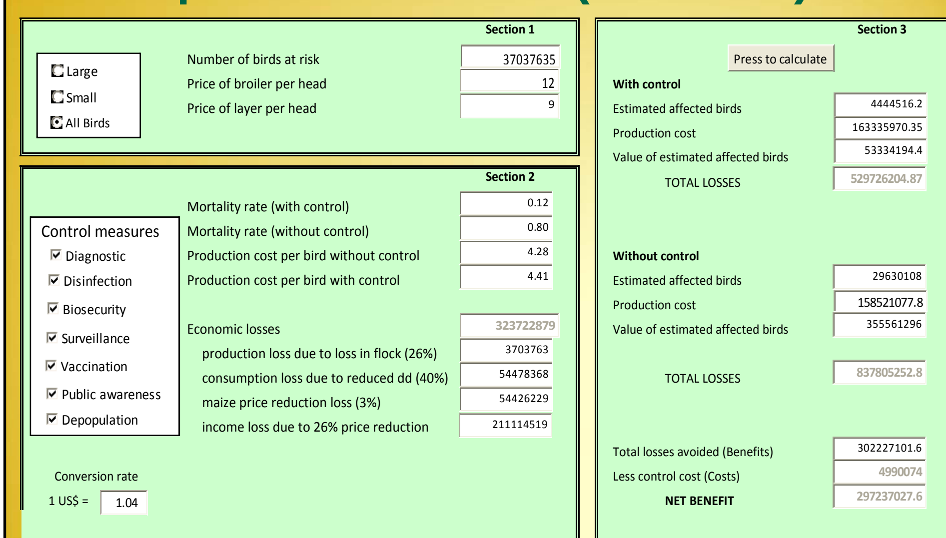
- WTA compensation for one male Kampong chicken in IDR

| Healthy | Risky | Sick | Healthy - Risky price differential | Healthy– Sick price differential |
|---|---|---|---|---|
| 47,657 (23,876) | 46,061 (24,209) | 24,290 (15,534) | 1,595 (660) *** | 23,366 (584)*** |
| * 10,000 IDR= US$1***significantly different at 1% significance level | | | | |

- Poultry keeping households WTA
  - half as much compensation for sick birds vs healthy birds
  - lower compensation if poultry had NCD in the past
  - lower compensation rates if household has uniform flocks

- Level of knowledge, attitudes and perceptions regarding HPAI has little or insignificant impact on WTA compensation

## Spreadsheet Model (Ghana ex)



## Next steps- decision model

Livelihoods models

Damage function

Max income = HH Revenue + off-farm labor - Poultry production costs - Expected costs of disease (probability of the disease X cost if not able to produce)

To compute farmers expected income given probability of an outbreak and choice of control measures

Assess the changes in outcomes from alternative disease management options (improved surveillance, biosecurity, etc)

afla control

Improving lives in Africa

**Exploring the Scope of Cost-Effective Aflatoxin Risk Reduction Strategies in Maize and Groundnut Value Chains in Africa**

**Aflatoxin** is a naturally occurring mycotoxin produced by two types of mold: *Aspergillus flavus* and *Aspergillus parasiticus*.

- Aflatoxins grows mostly in humid areas on crops such as peanuts, wheat, corn, beans, and rice
- CDC estimates that over 4.5 billion people living in developing countries may be chronically exposed to Aflatoxin through their diets.
- Exposure to aflatoxin can also aggravates the health condition of HIV/AIDS affected patients in smallholder populations who subsist on simple legume and cereal-based diets and milk from traditional livestock (see e.g., WHO, 2005).

Study Countries: **Kenya and Mali,** 2008-2011

Collaborators: IFPRI, CIMMYT, ICRISAT, ACDI/VOCA ,CRS, University of Pittsburgh, USUHS, KARI, IER, EAGC

## Aflatoxicosis sickened 317, killed 127, in Kenya in March 2004

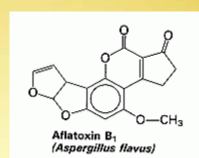
**Symptoms of Aflatoxicosis**

- High fever
- Gastrointestinal symptoms
  - Stomach pain
  - Vomiting
- Edema of the limbs
- Rapid progressive jaundice
- Swollen livers

Jaundiced sclera

## Chronic exposure

- Result in cancers, liver diseases, abortion, immune suppression, interference in micronutrient metabolism, liver cirrhosis and retarded growth.
- Type 1 human liver carcinogen
  - Synergistic with hepatitis B (HBV): up to **60X** greater liver cancer risk
    - ~400 million people worldwide have chronic HBV infection




# Liver cancer

## Significance:

Hepatocellular carcinoma (HCC, liver cancer): 3rd leading cause of cancer deaths worldwide

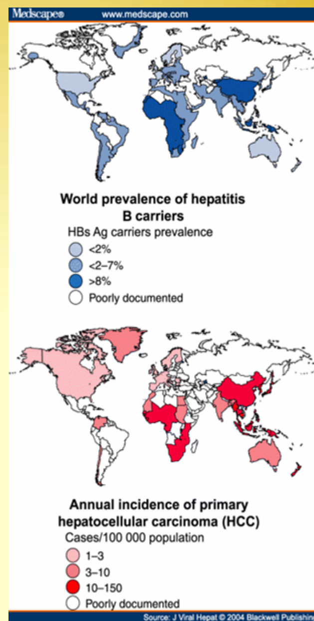
~560,000 new cases/yr

~500,000 deaths/yr

HCC rate 16-32X higher in LDCs

## Risk factors of HCC:

Chronic hepatitis B or C (HBV, HCV), ***aflatoxin exposure***, alcoholism, tobacco, obesity




# Possible interventions

- Agricultural (preharvest, postharvest)
  - Conventional breeding
  - Transgenic breeding
  - Irrigation
  - Biocontrol
  - "Good agronomic practices"
  - Improved drying, storage, transportation
  - Ammoniation

- Dietary
  - Enterosorption (clays, chlorophyllin)
  - Chemoprevention (Oltipraz, triterpenoids, isothiocyanates)
  - Anti-inflammatory agents (NSAIDS, green tea polyphenols, allicin)
- Clinical
  - HBV vaccination

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.

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