FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Applying Risk-Based Approaches in Food Safety

Feed the Future Innovation Lab for Food Safety

June 14, 2023

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Cornell University

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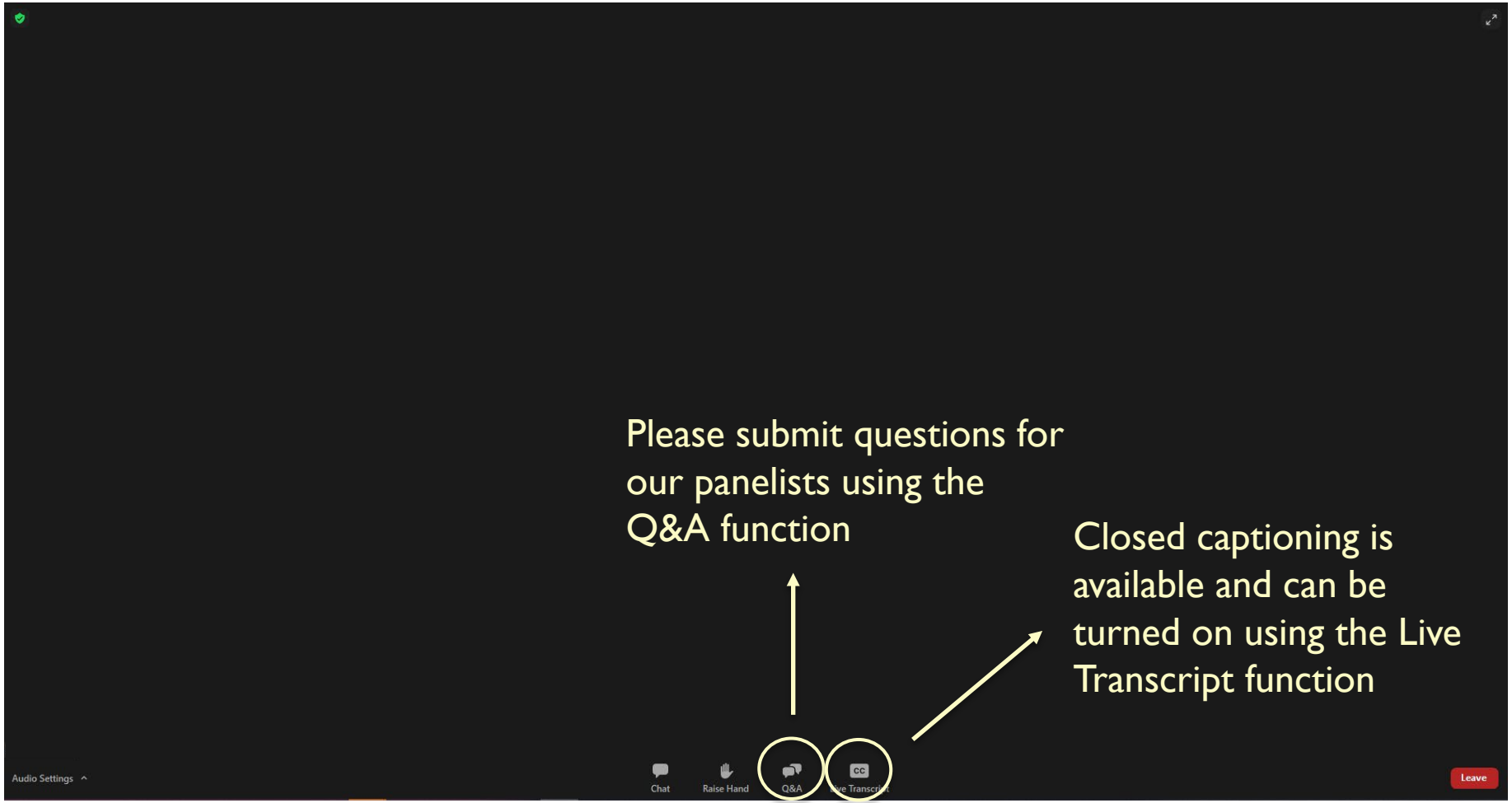
WELCOME



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AGENDA

- **Welcome and Introduction – 5 min.**
  Haley Oliver, FSIL Director, Purdue University
- **Risk Assessment in Latin America – 20 min.**
  Fernando Sampedro, University of Minnesota
- **Risk Prioritization Case Study – 20 min.**
  Hung Nguyen, International Livestock Research Institute
- **Q&A – 15 min.**

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SPEAKER

Implementation of Risk-Based Inspection and Surveillance Systems in Latin America

Fernando Sampedro, Ph.D.
Professor, Environmental Health Sciences
School of Public Health
University of Minnesota

Implementation of risk-based inspection and surveillance systems in Latin America

Fernando Sampedro, PhD
University of Minnesota

Outline

- Current food safety challenges in the LATAM region
- Risk-based inspection models
- Implementation examples in countries

How do we protect public health with the available resources

Current challenges

- Increase small food enterprises
- Tight budgets
- Old laboratories
- Lack of systems harmonization
- Lack of trust among ‘neighbors’

Current information gaps

LIMITED SURVEILLANCE data for pathogens in food

UNDER-REPORTING of foodborne illnesses

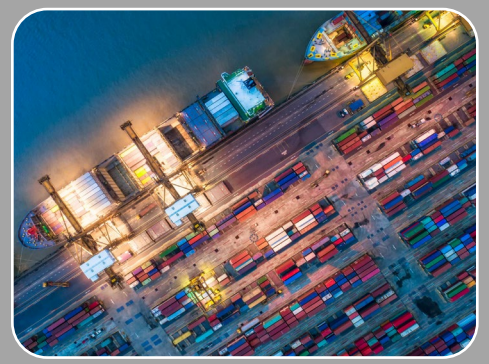
OLD CONSUMPTION surveys

Risk-based inspection

Adjust the **frequency** and **type of inspection** according to risk

Domestic

- Food category RISK
- Establishment RISK



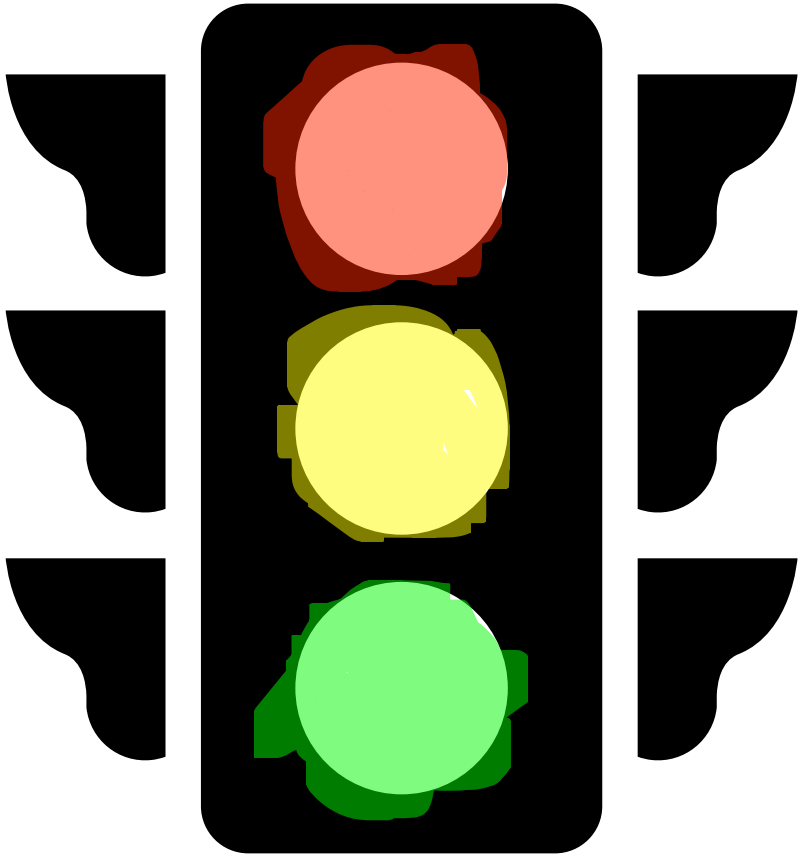
Import-export

- Tariff Heading RISK
- Importing Country RISK
- Importer RISK

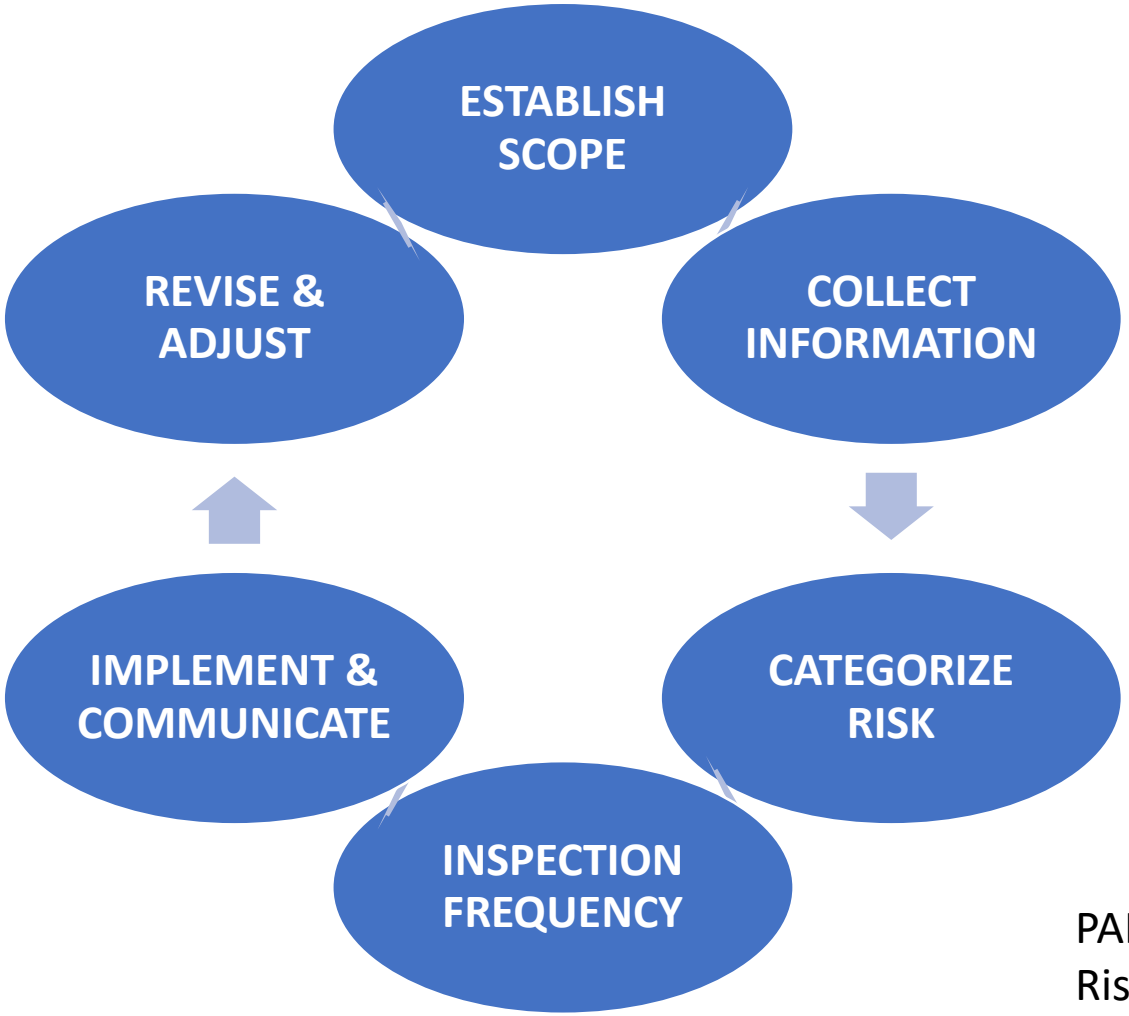
Risk-based inspection goals

Risk Algorithm

- Assigns the risk level and type of inspection
- Real-time after each inspection
- Includes alerts, recalls and laboratory samples

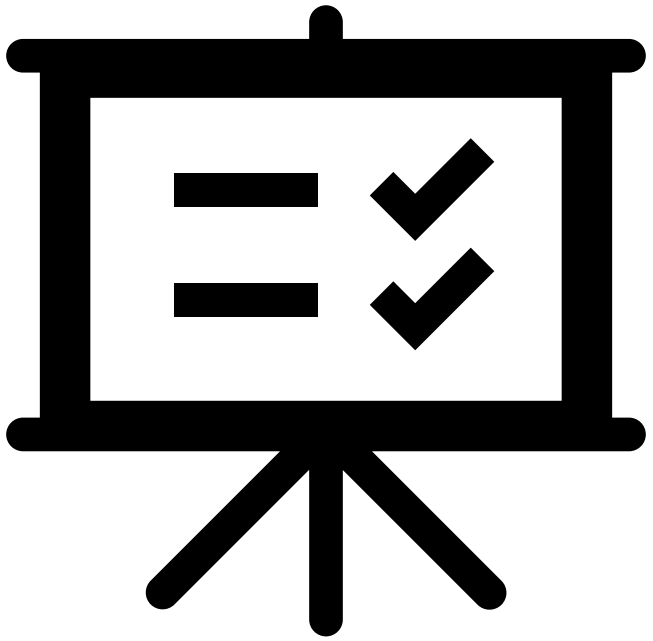


Domestic risk-based inspection steps



PAHO MANUAL 2023
Risk-based food inspection manual
Food Producing Establishments

Establish Scope



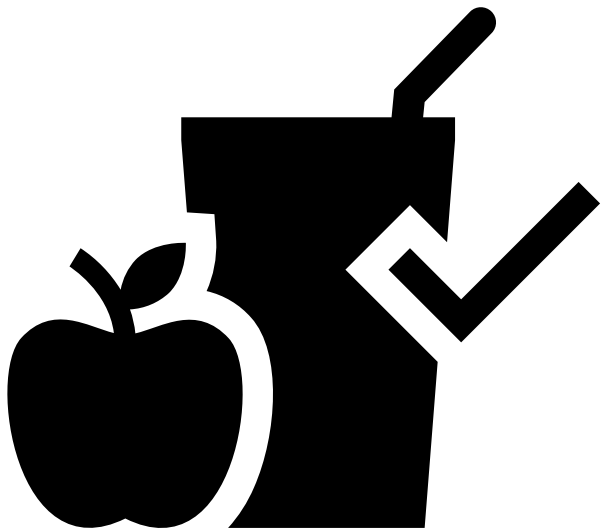
- Progressive implementation
- Pilot experience in 1 or 2 priority food chains
- Type of facilities to be covered
  - By the volume of production
  - By the number of employees

Collect information (facilities)

Information on establishments

- Register of companies
- Location
- Type of foods commercialized
- Annual production
- History of inspections and non-compliances
- Scope of commercialization (local, national or export)
- Private Schemes

Collect information (food)

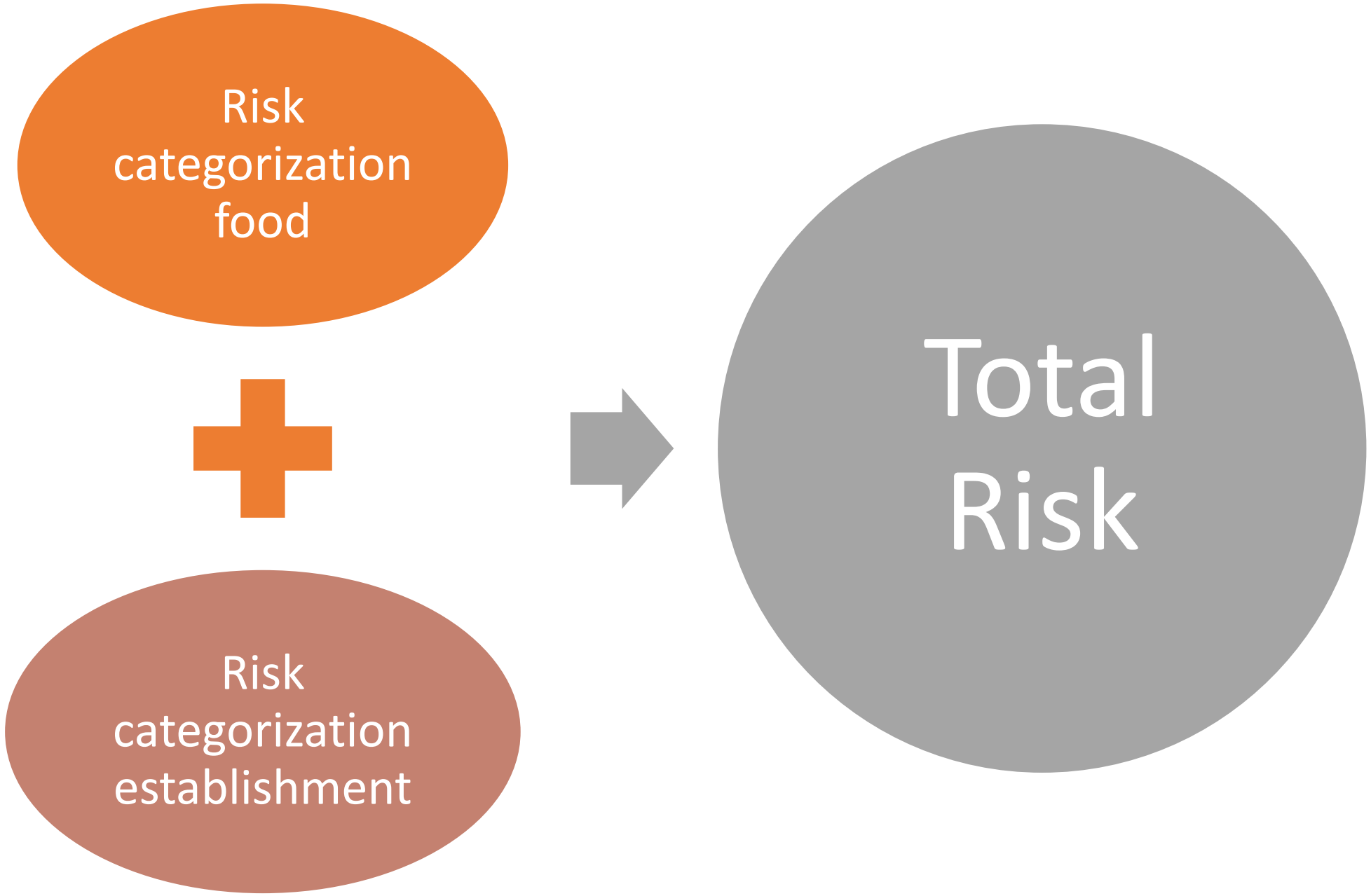


Food categories

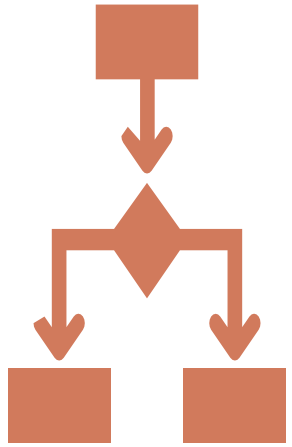
- Definitions of foods commercialized
- Foodborne diseases and outbreaks in the country
- Hazards identified by food
- Market recalls, international alerts
- Per capita consumption

Example of dairy categories

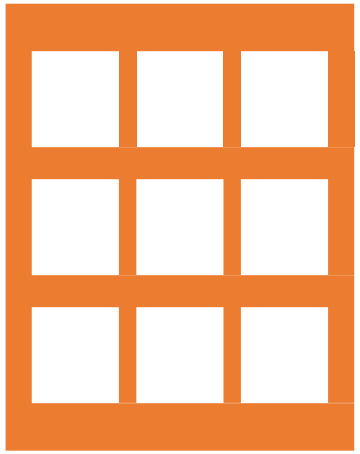
Group 1	Pasteurized milk, ultra-pasteurized milk, UHT milk, evaporated milk, sterilized milk, pasteurized milk cream, UHT milk cream, sterilized milk cream, fluid ice cream
Group 2	Milk powders, instant milk powders, cream powders, cheese whey powders, buttermilk powders, whey protein concentrate, cheese powders, ice cream powders, powdered ice cream mixes, food preparations based on powdered dairy products
Group 3	Milk powders with dry additives
Group 4	Condensed milk, dulce de leche, milk caramel
Group 5	Butter, butter oil
Group 6	Yoghurt, fermented or cultured milk
Group 7	Processed or melted cheese without post heat treatment aggregates and UHT processed cheese


Risk categorization food
Risk categorization establishment
Total Risk

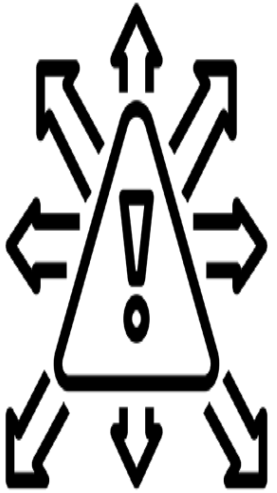
Risk Ranking Tools



Decision trees



Risk matrices



MCDA

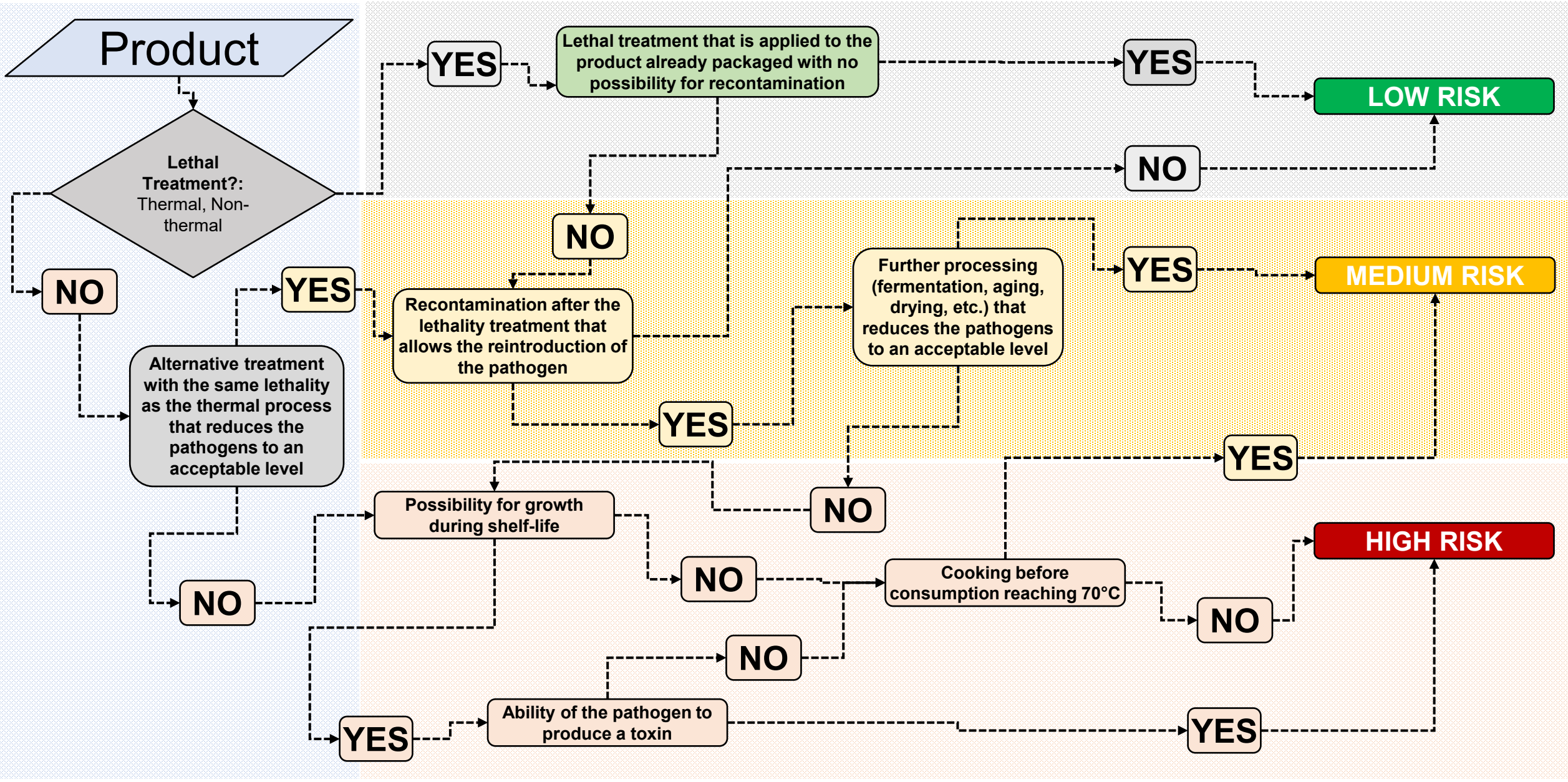
Decision trees

High number of food products

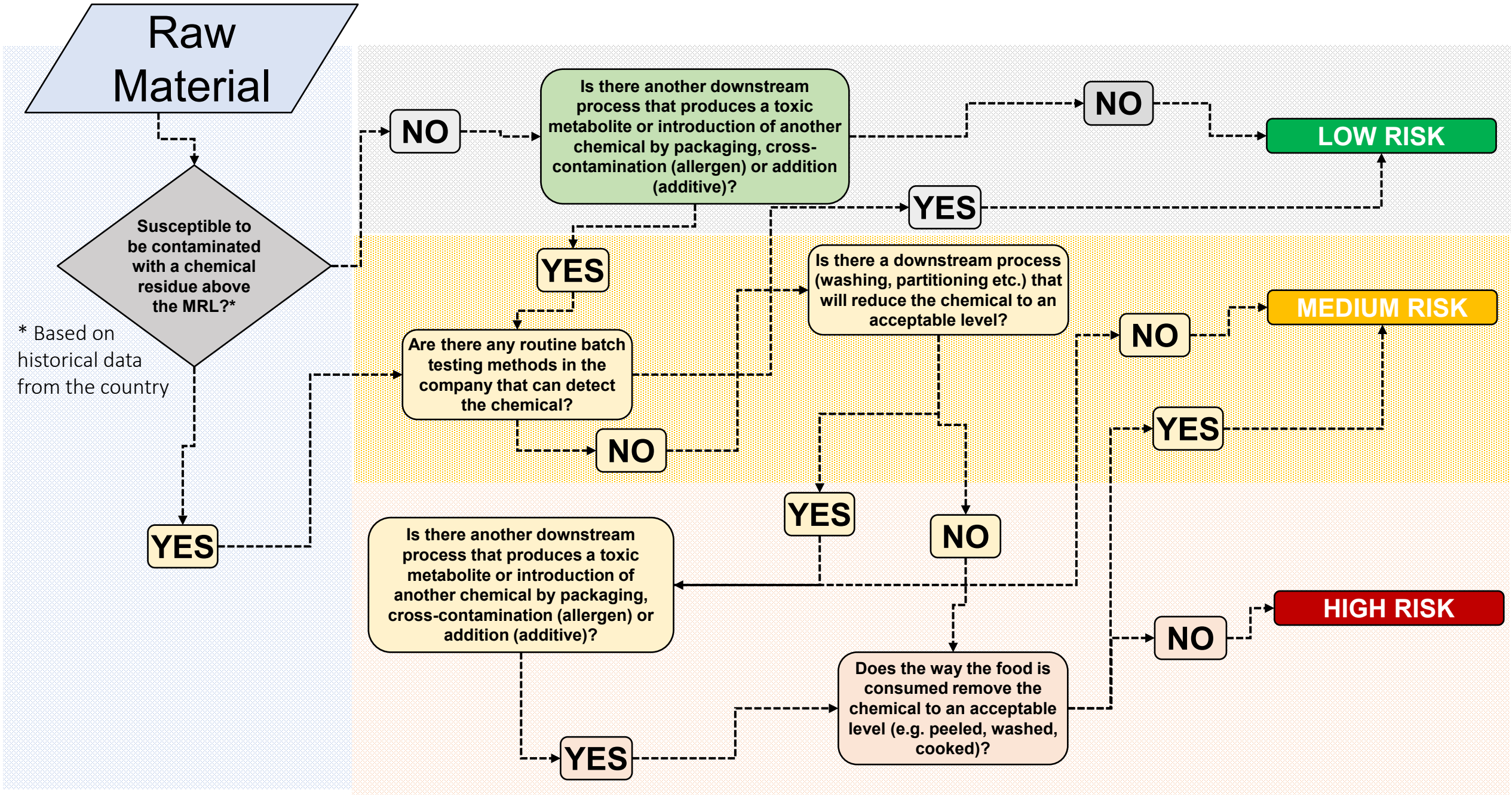
Qualitative tool, limited data

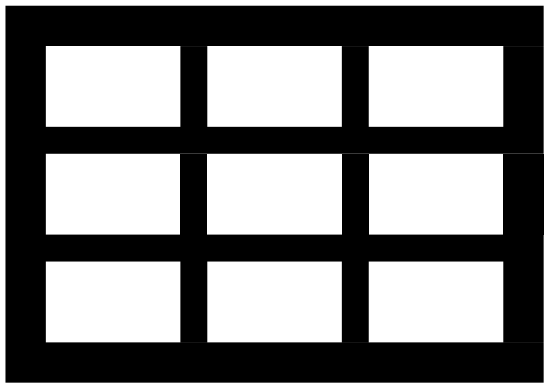
Filter out the low-risk products

Biological Hazard-Decision Tree



Chemical Hazards-Decision Tree

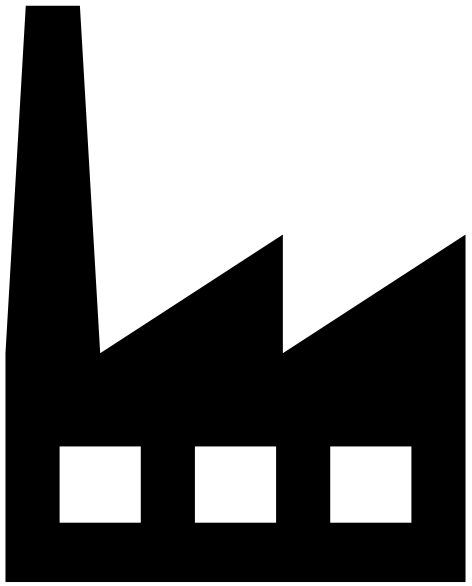




Multifactorial Risk Matrix

1. Define risk factors
2. Assign scores to each factor (e.g. 1-7)
3. Define the relative weight of each factor (%)
4. Add the scores and their relative weights to calculate the level of risk

Risk factors establishment



- Degree of regulatory compliance (GMP or HACCP)
- Volume of production and/or number of employees
- Scope of marketing (e.g., local, national)
- Target population of the food (e.g., baby food)
- Degree of food handling
- Plant layout and personnel flow
- Number of non-conforming samples (surveillance plan)
- History and degree of resolution of nonconformities
- Traceability and recall plan
- Allergen control
- Signs of product fraud or adulteration
- Hygienic zoning and environmental control of surfaces

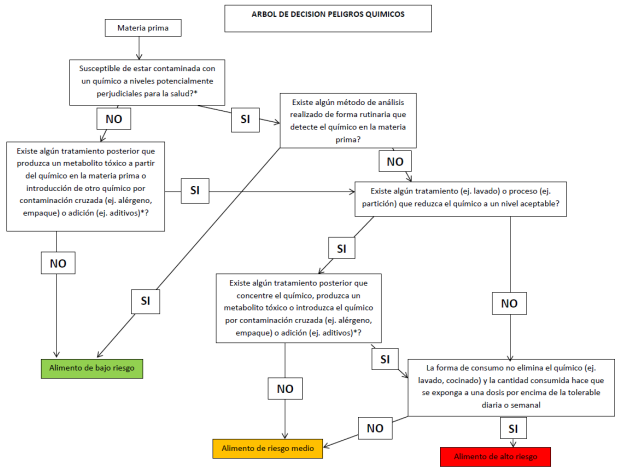
Example of establishment risk matrix

Risk factor	Risk scoring	Relative Weight
Production volume	• Large (+2,000,000 lt/month) (7 pts) • Medium (800,000-2,000,000 lt/month) (5 pts) • Small (200,000-799,000 lt/month) (3 pts) • Micro (< 200,000 lt/month) (1 pts)	15%
Food safety management system	• Has pre-requisites (GMP, SSOP, SPS) (7 pts) • Previous item + HACCP (verified) (5 pts) • Previous item + Export authorization (3 pts) • Previous item + International private standard (1 pt)	20%
Compliance with GMPs or HACCP	• 70 - 80% (7 pts) • 81 - 89% (5 pts) • 90-95% (3 pts) • > 95% (1 pt)	20%
Product handling	• More than two handling points after heat treatment or equivalent treatment (7 pts) • Two handling points after heat treatment or equivalent treatment (5 pts) • One handling point after heat treatment or equivalent treatment (3 pts) • The system is closed and therefore there is no possibility of recontamination (1 pt)	5%

Quantitative checklist

ITEM	REQUIREMENTS	COMPLIANCE SCORE	VALUE	CATEGORY	FINDINGS
Location	a) Located in a place where there are threats to the safety or suitability of food and adequate safety or suitability of food, and adequate protective measures have not been taken to prevent contamination.	Full compliance (100%)	=1*1=1	Major	
	b) If even though protective measures have been taken, a threat to food safety or suitability still exists	Partial (50%)	=0.5*1=0.5		
Surroundings	a) Adequate maintenance of roads, loading, unloading and parking areas, avoiding contamination that can be dragged into the plant through air currents, personnel traffic, contamination adhered to personnel clothing, puddles, chemical spills, etc.	Full (100%)	=1*1=1	Major	
	b) Adequate storage of disused equipment and parts; no trash, waste and nonconforming products, stagnant water, maintenance of green areas; clean drainage and gutters, treatment and disposal of solid and liquid waste.	None (0%)	=0*1=0		
TOTAL			**50**	**75% compliance**	

Risk Categorization Food



PRODUCT RISK	VALUE
HIGH	4
MODERATE	2
LOW	1

Risk categorization establishment

RISK ESTABLISHMENT	VALUE
I	1
II	3
III	5
IV	5
V	7
VI	5
VII	3
VIII	5
TOTAL	34

Risk= Food Risk Score X Establishment Risk Score

INSPECTION FREQUENCY

Inspection Frequency

Total RISK	Inspection FREQUENCY
Less than X1	Annual
Between X2 and X3	Every 9 months
Between X4 and X5	Every 6 months
More than X6	Every 3 months

- Each country must define inspection frequencies (quarterly, semi-annual, annual, biannual)
- It is important to comply with the inspection schedule

Revise, Adjust and Communicate

- Risk level assigned should be reviewed
  - Changes made to the plant
  - Inspection history
  - Outbreaks and cases of FBD
  - International alerts
  - Emerging hazards
- Transparency and communication of inspection plan
  - Improved confidence and industry awareness of standards

Strategic PLAN-Risk-based Inspection

Risk factors: Import-Export

Tariff category

- Inherent food safety risk

Country of origin

- International alerts (FDA, RASFF)
- Surveillance and control programs
- Trade agreements

Importer

- Non-compliances per year
- Import volume

Origin facility

- HACCP
  Official inspection at origin
- Number of positive lab results

Examples from countries

Honduras

- Risk-based inspection models
  - RTE meat and dairy establishments
  - Fresh produce, shrimp and dairy farms
  - Third-party laboratories
- Risk-based surveillance system
  - Foodborne pathogens and veterinary drugs
- Use of third-party schemes into the inspection models

Costa Rica

- Risk-based inspection models
  - RTE meat, dairy and seafood establishments
- Risk-based surveillance system
  - Veterinary drugs
  - Heavy metals
  - Additives
  - Pesticides in fresh produce
- Online inspection platform
  - Real-time inspection data and frequency adjustment

Other Countries (Work in progress)

- Guatemala
  - Risk-based inspection model for RTE meat products and dairy facilities
  - Risk-based inspection model for dairy farms
- Dominican Republic
  - Risk-based inspection model for dairy facilities

Future work

- Harmonization and equivalency of inspection systems
- Increase trust
- Establish strategic goals aligned to public health metrics
- Increase funding for consumption surveys and baseline studies

Supporting Agencies

THANK YOU!

Fernando Sampedro, PhD

Email: fsampedr@umn.edu

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SPEAKER

Risk Prioritization Case Study

Hung Nguyen, Ph.D.
Co-Leader, Animal and Human Health Program
International Livestock Research Institute

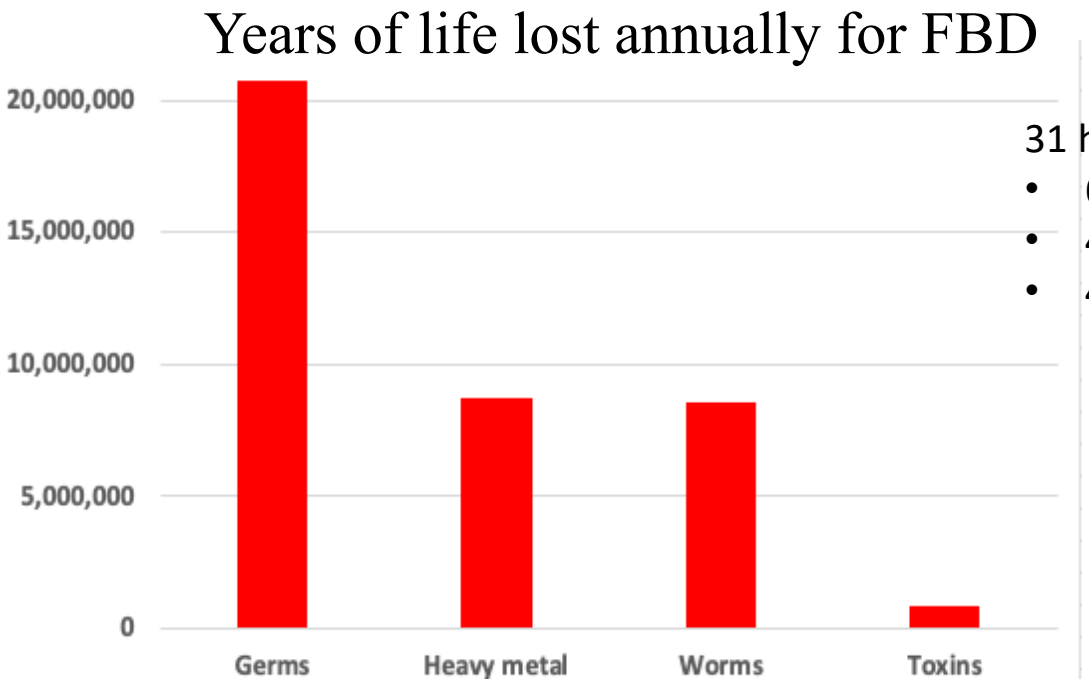
Food Safety Risk Prioritization: Case Studies from Asia

Hung Nguyen - Co-leader, ILRI Animal and Human Health Program, Kenya

Sinh Dang – Postodoc, ILRI Animal and Human Health Program, Vietnam

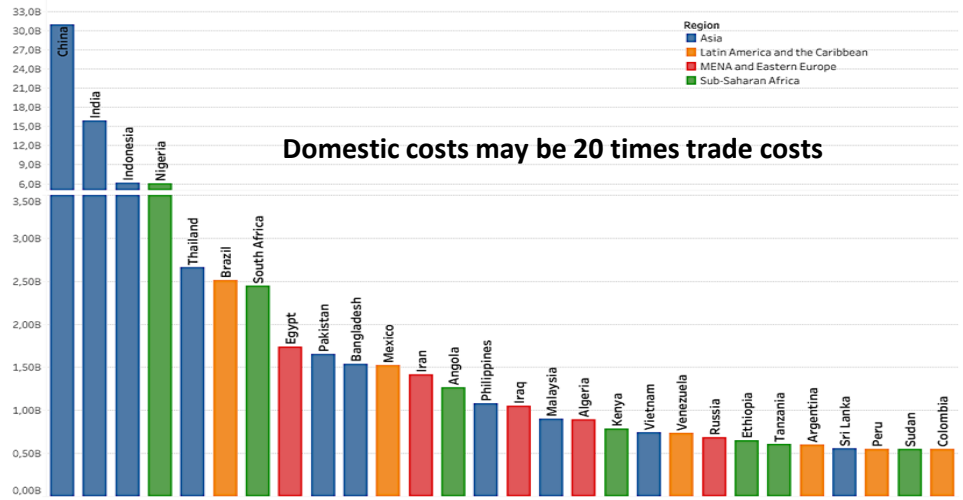
Delia Grace – Professor at NRI, and Joint Appointed Scientist with ILRI, UK

Context of foodborne diseases

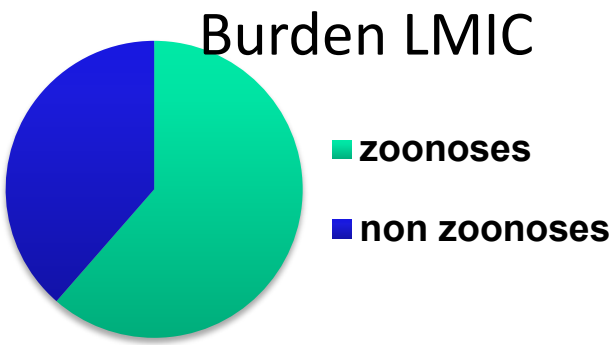


31 hazards

- 600 mio illnesses
- 480,000 deaths
- 41 million DALYs



Havelaar et al., 2015
Gibb et al., 2019



Cost estimates for 2016 : > US$ 115 billion	
Productivity loss	95
Illness treatment	15
Trade loss or cost	5 to 7

Food value chains and informal markets

Reliance on regulations without institution building will not make food safe

100% of milk in Assam doesn't meet standards

98% of beef in Ibadan, **52%** pork in Ha Noi, unacceptable bacteria counts

92% of Addis milk and **46%** of Nairobi milk had aflatoxins over EU standards

36% of farmed fish from Kafr el sheikh exceed one or more MPL

30% of chicken from commercial broilers in Pretoria unacceptable for *S. aureus*

24% of boiled milk in Abidjan unacceptable *S. aureus*

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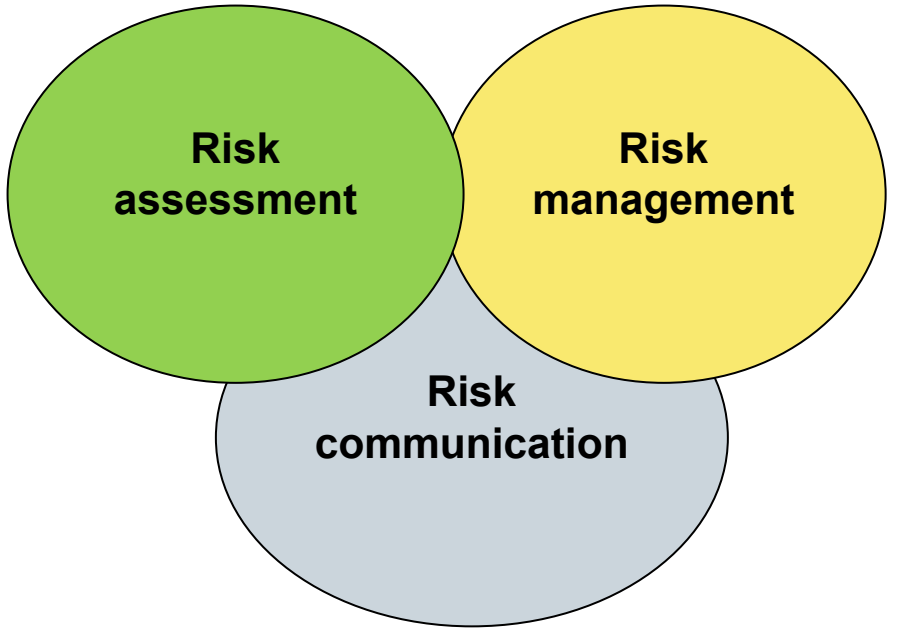
Approaches and solutions to food safety in LMICs

- Generate evidence: hazards and risks
- Develop solutions to improve food safety: technological and institutional innovations
- *Focus: informal markets, animal source food (ASF: meat, milk and eggs) but also vegetables, pathogens but also aflatoxin and chemical hazards*
- *Consideration: gender, nutrition, animal welfare*

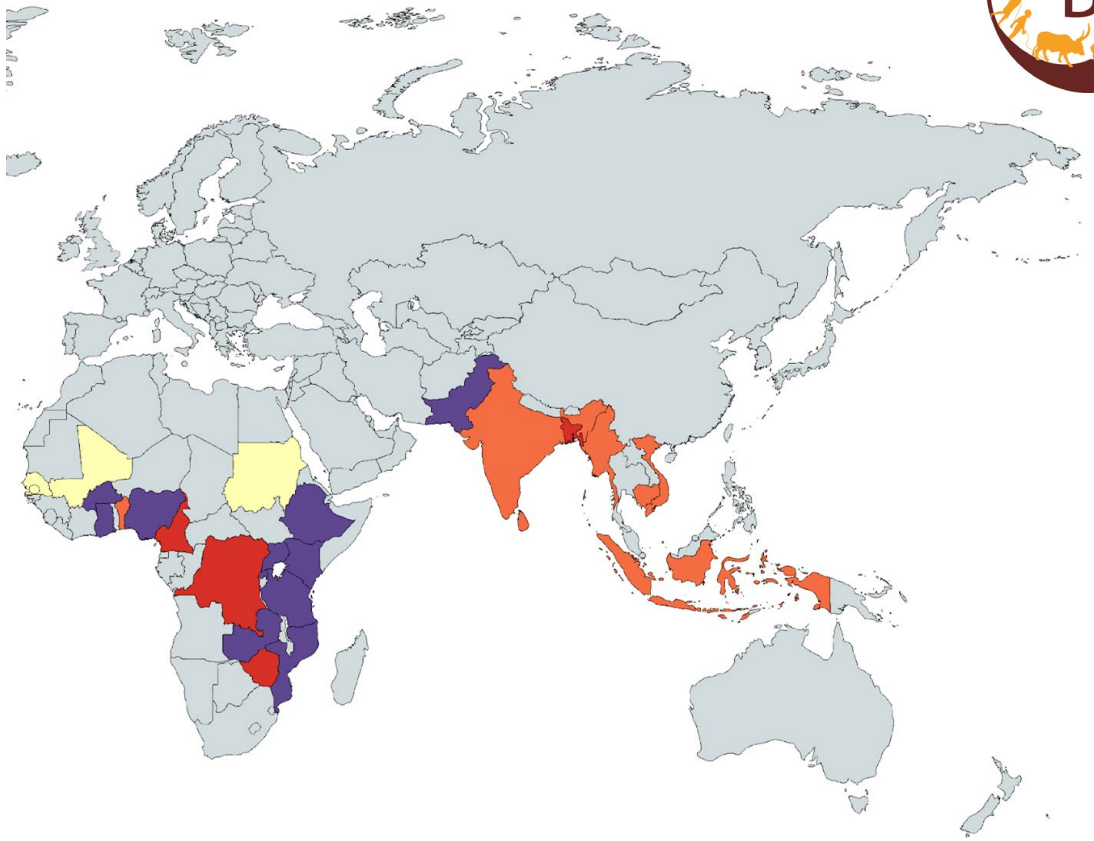


Risk analysis framework
Risk-based approach

Our Food safety work

Hung Nguyen

Delia Grace



- ~ 15 scientists
- ~ 5 post docs
- ~ 10 PhDs
- ~ 12 MSc

BUILD Boosting Uganda's Investment in Livestock Development

OHRECA One Health Centre Africa

GBADs

COHESA Capacitating One Health in Eastern and Southern Africa

CGIAR Protecting Human Health Through a One Health Approach

Federal Ministry for Economic Cooperation and Development

giz

BILL & MELINDA GATES foundation

USDA

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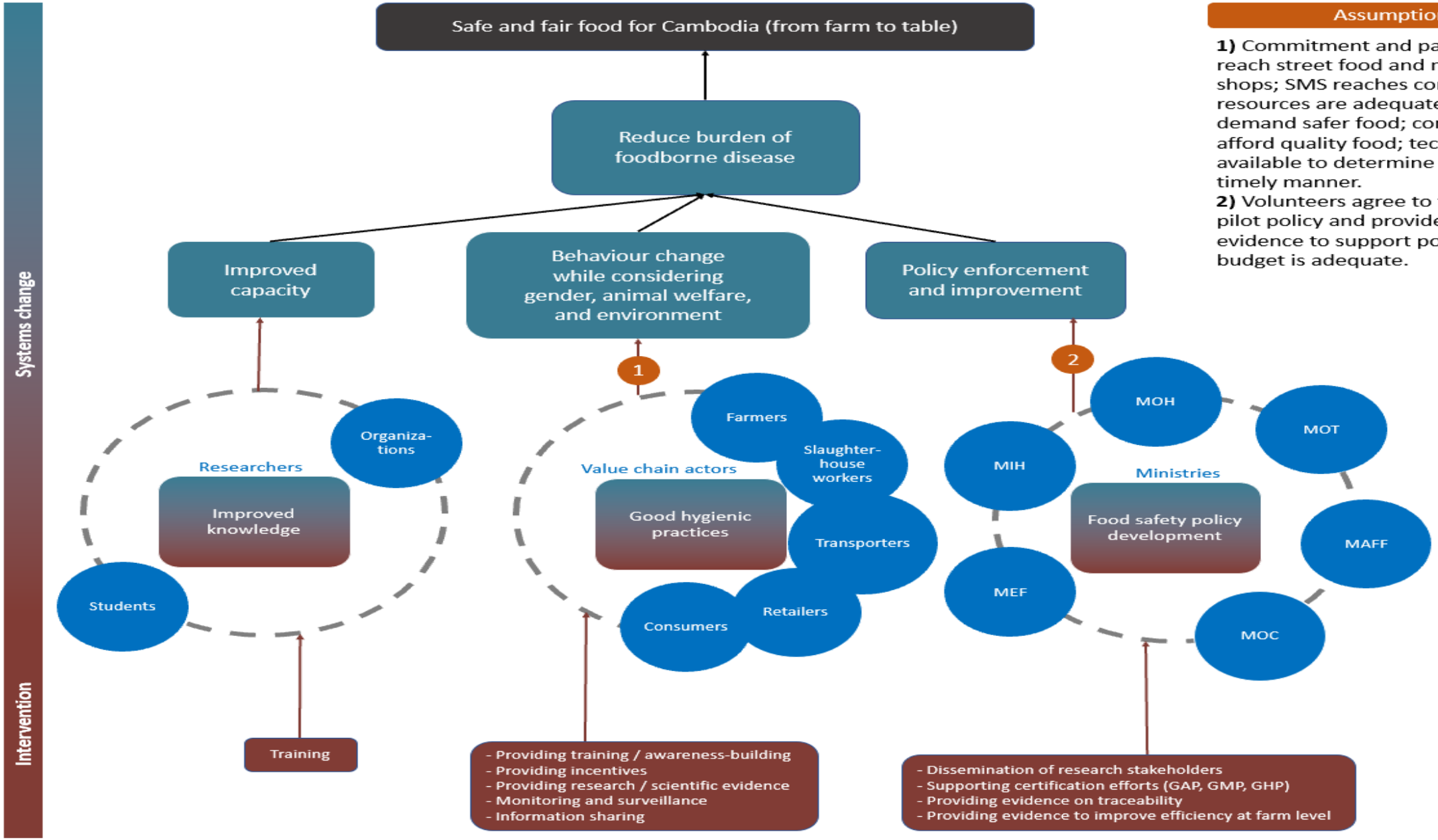
Theory of Change



Assumptions

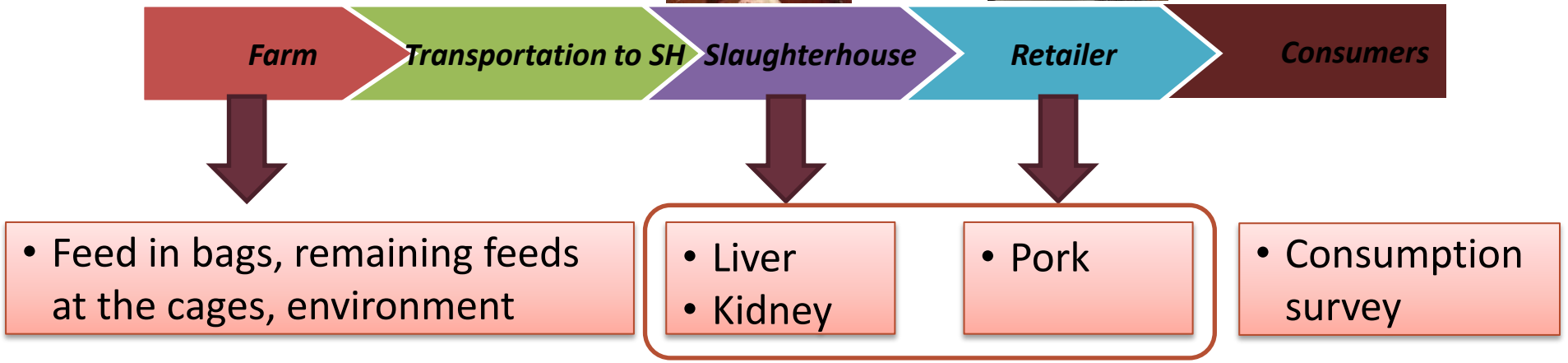
1) Commitment and participation; can reach street food and mobile meat shops; SMS reaches consumers; human resources are adequate; consumers demand safer food; consumers can afford quality food; technology is available to determine food safety in a timely manner.

2) Volunteers agree to take part in a pilot policy and provide feedback; evidence to support policy is adequate; budget is adequate.

PigRISK: Pork safety in Vietnam (2012-2017)

Microbial and Chemical Risk Assessment

- *Salmonella* risk pathways developed for producers, slaughterhouse and consumers, quantitative microbial risk assessment (QMRA) risk for consumer
- Chemical risk assessment: antibiotic residues, banned chemicals, heavy metals



1,275 samples (farms, slaughterhouse, market) collected during 1 year

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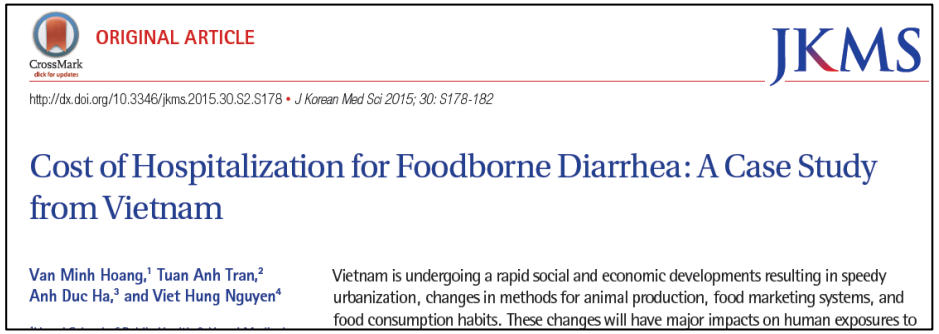
QMRA for salmonellosis

Age and gender groups	Estimated annual salmonellosis incidence rate (Mean (90% CI)) (%)
Children (under 5 years old)	11.18 (0 – 45.05)
Adult female (6-60 years old)	16.41 (0.01 – 53.86)
Adult male (6-60 years old)	19.29 (0.04 – 59.06)
Elder (over 60 years old)	20.41 (0.09 – 60.76)
Overall	**17.7 (0.89 – 45.96)**


ORIGINAL ARTICLE

JKMS

http://dx.doi.org/10.3346/jkms.2015.30.S2.S178 • J Korean Med Sci 2015; 30: S178-182

Cost of Hospitalization for Foodborne Diarrhea: A Case Study from Vietnam

Van Minh Hoang,[1] Tuan Anh Tran,[2] Anh Duc Ha,[3] and Viet Hung Nguyen[4]

Vietnam is undergoing a rapid social and economic developments resulting in speedy urbanization, changes in methods for animal production, food marketing systems, and food consumption habits. These changes will have major impacts on human exposures to

- **94 million people**
- Cases of foodborne diseases by *Salmonella* in pork at 17%: **16 million get sick**
- **$ 107:** cost of hospitalization/FBD case

Dang Xuan Sinh et al, 2016, IJPH

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Safe Food, Fair Food for Cambodia (2018-2021)

*A nationwide multi-hazard survey in markets in Cambodia found the prevalence in meat (**pork and chicken) of Salmonella was 43% and of Staphylococcus aureus was 31%.***

*The cost of illness of **foodborne diarrhea was $63 USD per case**.*

Sample type	N. Specimen	N. positive both *Salmonella* and *S. aureus*	*Salmonella* positive	*S. aureus* positive
Chicken	186	38 (20.4%)	84 (45.2%)	78 (41.9%)
Cuttingboard chicken	62	6 (9.7%)	26 (41.9%)	12 (19.4%)
Cuttingboard pork	62	1 (1.6%)	19 (30.6%)	7 (11.3%)
Pork	186	33 (17.7%)	85 (45.7%)	58 (31.2%)
Grand Total	**496**	**78 (15.7%)**	**214 (43.1%)**	**155 (31.3%**

Cost	National Hospital (n=44)	Referral Hospital (n=60)	Regional Hosp. (n=100)	Community Clinic (n=62)	Overall (n=266)
Direct medical cost					
[usd]	125.77	9.42	27.85	4.19	34.38
Direct non-medical cost					
[usd]	40.64	8.36	26.33	0.30	18.58
Indirect cost					
[usd]	21.43	6.38	10.89	3.08	9.80
Total cost [usd]	**185.88**	**24.16**	**65.07**	**7.57**	**62.76**

Interventions: the 3 legged stool

Incentives

Moral, Social, Material

Nudges

Motivate & facilitate behaviour change

Policy, infrastructure

ENABLING ENVIRONMENT

Build capacity & motivation of regulators

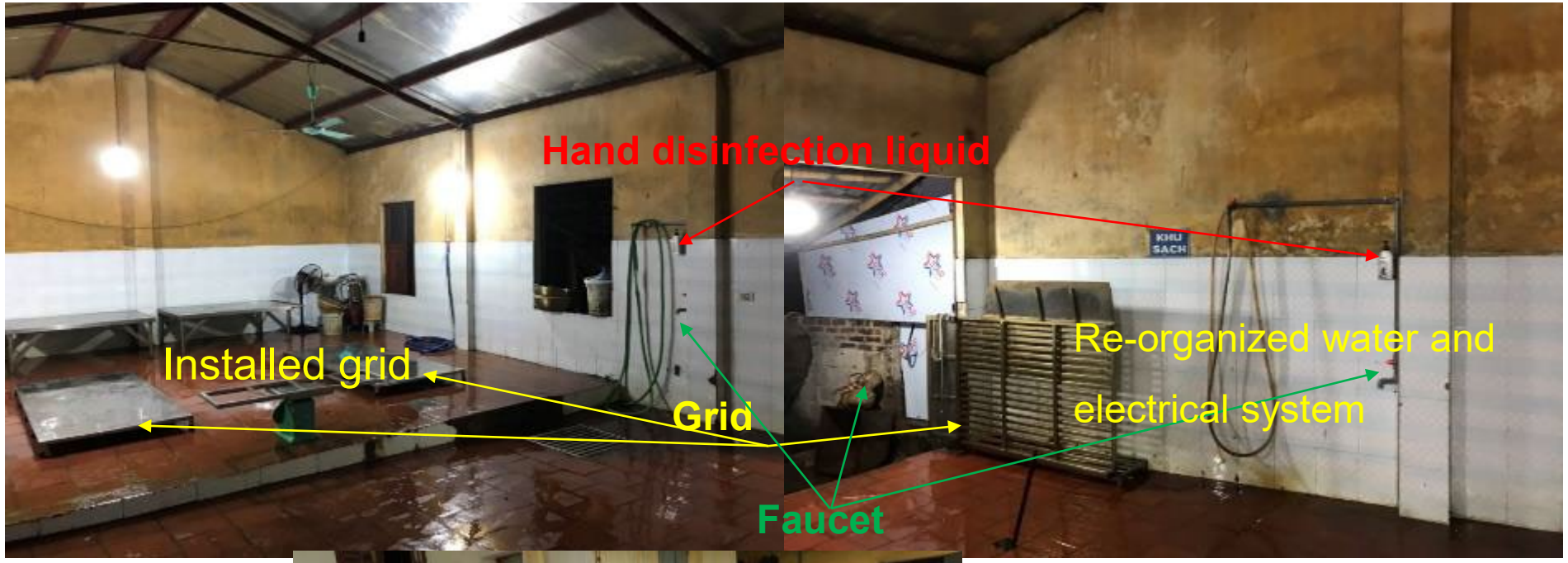
Inform, monitor & legitimize VC actors

Technology & training

Capacitate VC actors

Innovation

Food safety intervention at slaughter in Vietnam



Training for SH owners & workers

Photo credit: Sinh Dang Xuan/Chi Nguyen ILRI 2020

Food safety intervention at slaughterhouse and retail (2018-2022)

Approach:

- Participatory risk-assessment
- Supportive formative research with model retailers
- Risk communication

Key content*:

-Grid slaughter
-Frequent washing (and disinfection)
-Training
-Separation clean/dirty
-Branding

Key content:

-Easy to clean surface
-Frequent washing (and disinfection)
-Separation (fresh/cooked)
-Training
-Hygienic cutting board
-Branding

Handbooks

*only Vietnam

ILRI CGIAR

MARKET VENDORS IN CAMBODIA

Trial retailers:

- 84% of the trial retailers had a good knowledge of safe meat handling compared to the control group (44%)
- The KAP scores of retailers in the intervention significantly improved.

Control: Vendors who practices and operate their selling as usual

Current surface (carton board)

Trial: Vendor who get our incentive and used

Signpost And Training certificate

Washing detergent

Easy to clean table surface

Apron

Tray

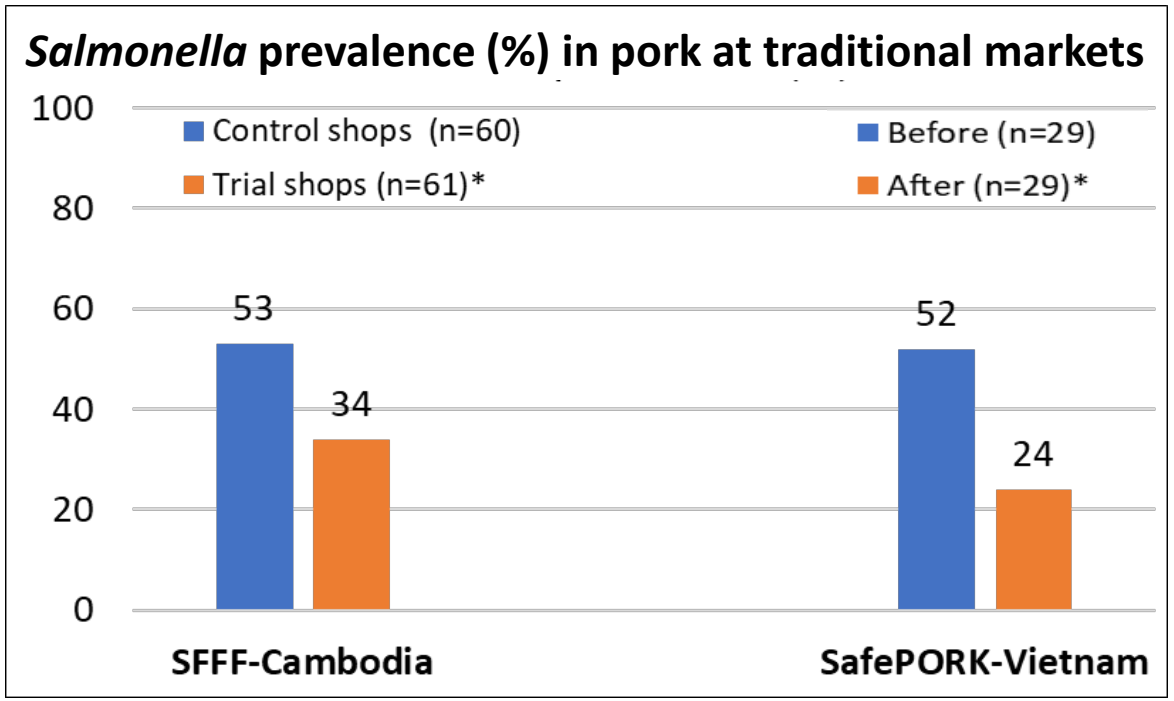
Impact of bacterial reduction from simple interventions at SH & MK

Before

After

***Total bacterial count* in pig slaughterhouses and marketed pork**

Pig slaughterhouse in Vietnam	**Baseline**	**Middle**	**Endline**
Floor (LogCFU/cm^2)	6.0	4.4*	4.6*
Worker hand (LogCFU/hand)	7.2	7.1	7.0
Pig carcass (LogCFU/cm^2)	4.5	4.2	4.4
Pork shop in SFFF-Cambodia	**Control (n=180)**		**Trial (n=180)**
Marketed pork (LogCFU/g)	6.9		6.3*



+ Missing ingredient: Enabling Environment

International Livestock Research Institute

Training course report

Food safety risk assessment for informal value chains in Bangladesh

Dhaka, Bangladesh
22–24 October 2018

Global Food Security 19 (2018) 24–30

Contents lists available at ScienceDirect

Global Food Security

journal homepage: www.elsevier.com/locate/gfs

Research and training partnership to assist policy and capacity building in improving food safety in Vietnam

Hung Nguyen-Viet[a,b,*], Delia Grace[g], Phuc Pham-Duc[b], Sinh Dang-Xuan[b], Toan Luu-Quoc[b], Fred Unger[a,g], Seth de Vlieger[a,g], Ngoc Pham-Thi[c], Nhiem Duong-Van[d], Long Nguyen-Hung[e], Luan Tran-Dinh[f], Tran Thi Tuyet-Hanh[b]

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[b] Center for Public Health and Ecosystem Research, Hanoi University of Public Health, Hanoi, Vietnam
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Next generation of food safety workers
Capacity building in meat inspection in Vietnam, Laos, Cambodia

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Cost benefit analysis

Net benefit of seller = Premium price x Pork sale – Cost of intervention x Pork sale

8.98 USD/year (93%>0)

0.077 USD/kg

1,196 USD/year (61.2% >0)

14,936 USD/case

6.3%/year

Net benefit of consumer = Cost of salmonellosis for each severity x Prevalence of severity x Reduction of salmonellosis probability – Premium price x Pork consumption

UPPSALA UNIVERSITET

Global One Health: Quadripartite and OHHLEP

Food and Agriculture Organization of the United Nations
UN environment programme
World Health Organization
World Organisation for Animal Health
Founded as OIE

ONE HEALTH JOINT PLAN OF ACTION (2022-2026)

WORKING TOGETHER FOR THE HEALTH OF HUMANS, ANIMALS, PLANTS AND THE ENVIRONMENT

FIGURE 3: THE SIX OH JPA ACTION TRACKS

Action track 1: Enhancing One Health capacities to strengthen health systems

Action track 2: Reducing the risks from emerging and re-emerging zoonotic epidemics and pandemics

Action track 3: Controlling and eliminating zoonotic, neglected tropical and vector-borne diseases

Action track 4: Strengthening the assessment, management and communication of food safety risks

Action track 5: Curbing the silent pandemic of Antimicrobial Resistance (AMR)

Action track 6: Integrating the Environment into One Health

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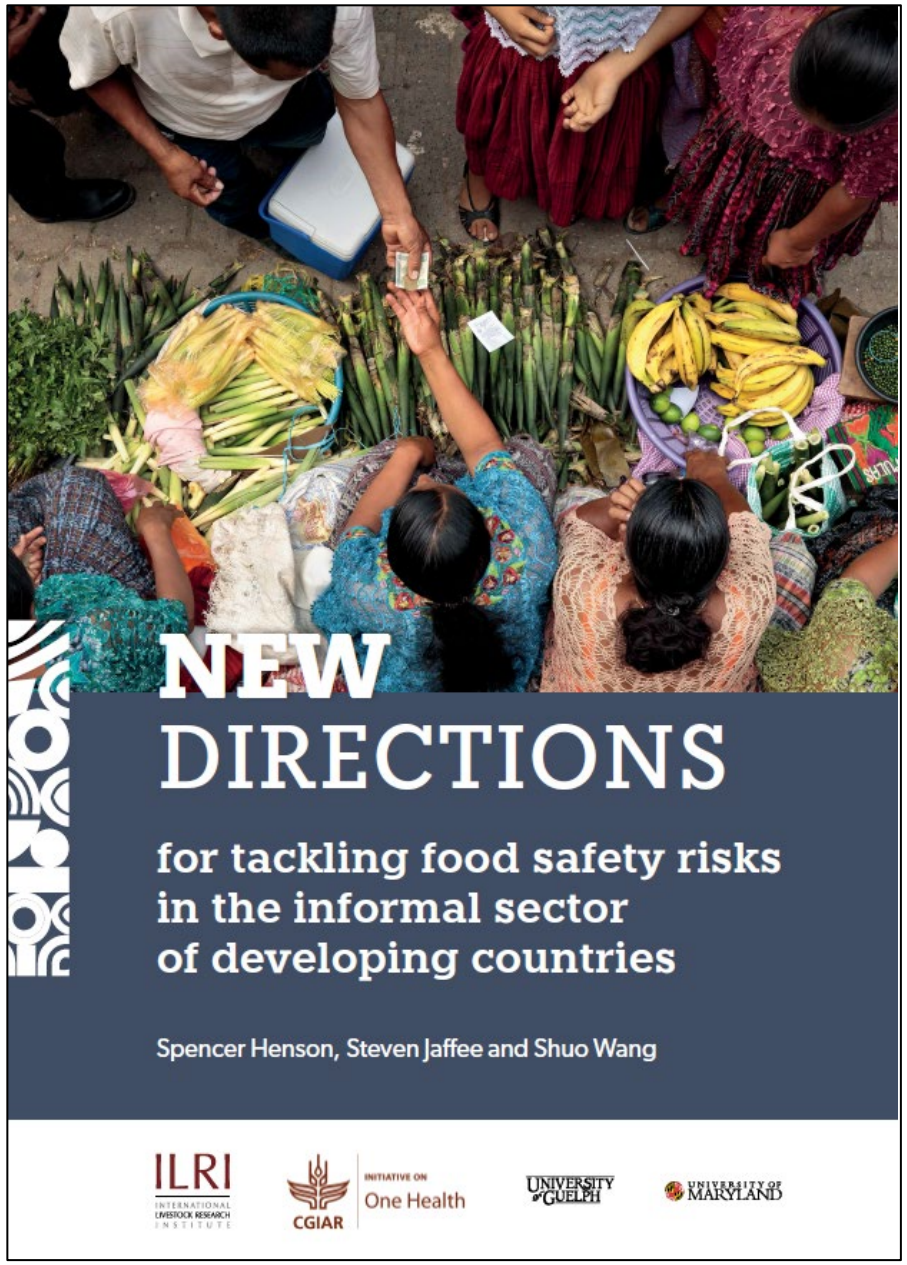
World Food Safety Day
7 June 2023



WHO GLOBAL STRATEGY FOR FOOD SAFETY 2022–2030

"Safe food is a primary determinant of human health. It is a basic human right to have access to safe, nutritious and healthy food. To guarantee this right, governments must ensure that available food meets safety standards".

African Union

Food Safety Strategy for Africa 2022 - 2036

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Key messages

1. **Food safety in informal/wet markets**: high level of microbial contamination along the value chains and high public concern
2. **Risk based approach (hazard vs. risks)** helps identify targeted interventions and key stakeholders to improve food safety
3. **Interventions: 3-legged stool/ECM** to improve food safety, it works!
4. **Capacity building:** trainings at different levels are key to improve food safety
5. **Strong engagement of high level 'taskforce'**, and other actors (animal health workers, market managers, retailers) made intervention implementation successful

better lives through livestock

ilri.org

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

CONTACT US

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Let's continuing the conversation on risk-based approaches for food safety.

We'd like to hear from you to understand the countries, value chains, and market sectors where there is enthusiasm for this approach.

Feed the Future Innovation Lab for Food Safety

USAID FROM THE AMERICAN PEOPLE

PURDUE UNIVERSITY

Cornell University

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Applying Risk-Based Approaches in Food Safety

Panel Discussion

Fernando Sampedro

Hung Nguyen

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THANK YOU

A link to the recording and presentations will be emailed to attendees.

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