



# Tiny Microbes with Big Business Impact: The Economic and Health Implications of Food Safety

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**Nika Larian, Kelley Cormier, Lise Korsten, Haley Oliver,  
Cindy Jenks**

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# Speakers



**Dr. Kelley Cormier**,  
Food Safety Division Chief,  
Center for Nutrition,  
USAID RFS



**Dr. Haley Oliver**, Director,  
Feed the Future Innovation  
Lab for Food Safety



**Cindy Jenks**, General  
Manager, Pick n' Pay, S.  
Africa



**Dr. Lise Korsten**, Professor  
of Microbiology and Plant  
Pathology, University of  
Pretoria



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



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HERE

# Perspective of a retailer facing implications of food safety and current experience of managing food safety risks within supply chains

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Cindy Jenks



**AGRILINKS**



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# Significant Food Safety Challenges Facing South Africa

- Load Shedding
- Water Quality



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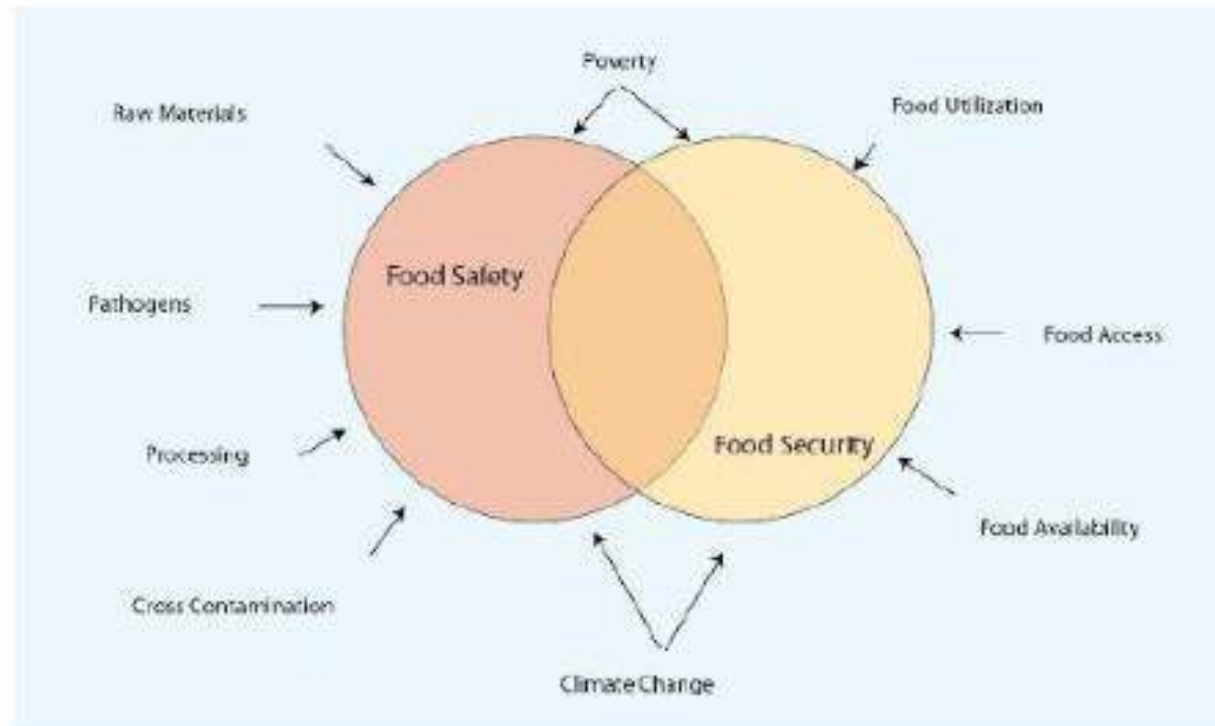
# Significant Food Safety Challenges Facing South Africa

- Poor Hygiene
- Lack of Sanitation



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# The Link Between Food Safety and Food Security



Source: Food Safety and Food Security. Nature Education Knowledge 3(10):9

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# The Link Between Food Safety and Food Security

## Food Safety

- Monitoring of Quality
- Training
- Creating a culture of Food Safety



## Food Security

- Infrastructure costs
- Impact on small suppliers
- Food Waste



LINKS





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# Thank You

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Cindy Jenks

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# Feed the Future Food Safety Innovation Lab

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Research for Development; Haley F. Oliver, PhD



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## FEED THE FUTURE INNOVATION LAB FOR FOOD SAFETY (FSIL)



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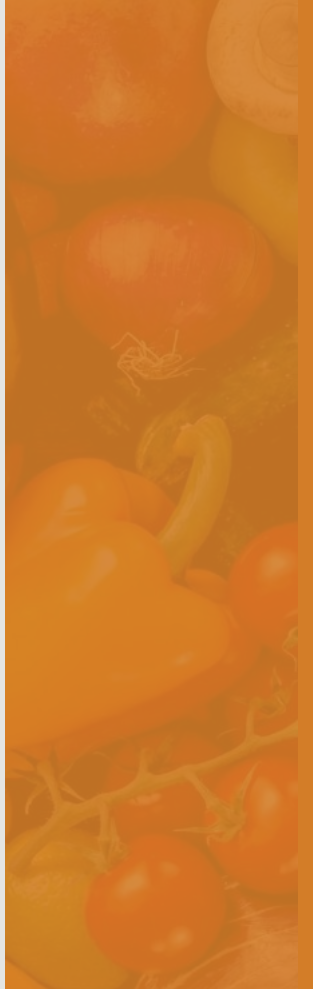


Cornell University



## OVERVIEW

- The Food Safety Innovation Lab (FSIL) is jointly managed by Purdue and Cornell Universities and engages academic, government, and private sector partners.
- FSIL leverages global food safety expertise in locally led projects that address the root causes of foodborne illness.
- By identifying food safety knowledge gaps and developing data-driven food safety practices and policies, FSIL projects create systemic change that strengthens household and community nutrition, food security, and economic opportunity.
- Countries with current or planned activities include Bangladesh, Cambodia, Kenya, Nepal, Nigeria, and Senegal.







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## WHY FOOD SAFETY?

### Foodborne illnesses:

- Contribute to malnutrition
- Can have lifelong negative health effects
- Are preventable
- Are an economic burden

### Food safety:

- Removes barriers to economic growth
- Has a global impact



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# RESEARCH & ENGAGEMENT ACTIVITIES



## AWARENESS

Increase awareness of food safety issues, impacts, and measures to reduce food safety risks.



## RESEARCH

Build local research capacity and conduct research on regional food safety challenges.



## POLICY

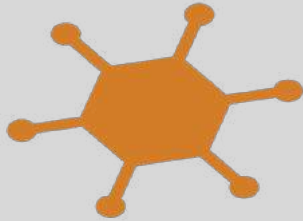
Develop policies that enable conditions for food safety research, translation, and practice.



## TRAINING

Accelerate translational research technologies and practices.

## FOOD SAFETY IS MULTIDIMENSIONAL



### Microbiology & Toxicology

Assessing the risk of foodborne disease from pathogens and contaminants.

Identifying critical control points, effective practices, and data-driven policies.



### Social & Behavioral Science

Understanding motivations for and obstacles to the adoption of food safety practices.

Developing effective outreach programs to strengthen food safety practices.



### Supply & Demand Economics

Assessing the demand for safer food and the costs/benefits to producers and communities.

Informing market-led food safety policies.



## FOOD SAFETY IS MULTIDIMENSIONAL



### Cambodia

Measuring the capabilities, opportunities, and motivations of vegetable producers, distributors, and vendors to adopt food safety behaviors.



### Bangladesh

Assessing consumer demand for safer fish and poultry and quantifying the economic benefits of improved food safety on the welfare of consumers.

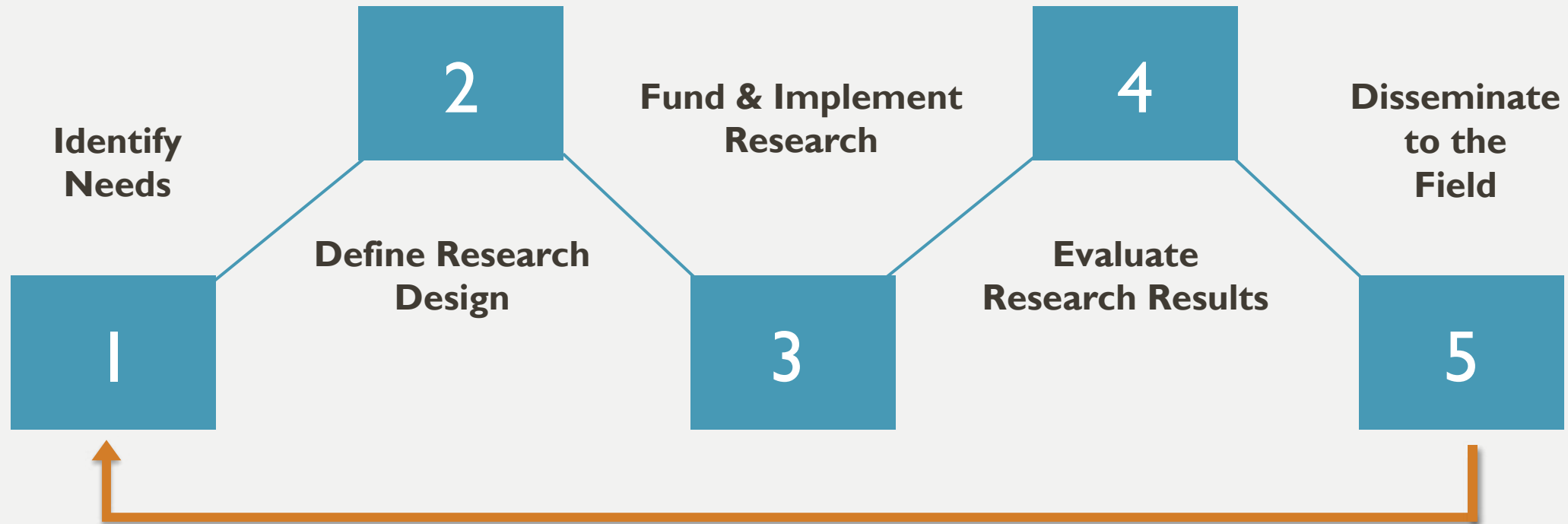


### Nepal

Understanding consumer and producer food safety behaviors and identifying factors that drive the supply of and demand for safer salad vegetables.

# IMPLEMENTATION STRATEGY

A FOUNDATION FOR MONITORING, EVALUATION, & LEARNING



Through iterative research portfolio assessment, results from awards inform future funding opportunities and refinement of the FSIL research portfolio.

# FOOD SAFETY INNOVATION LAB COLLABORATORS



*In Search of Better Health*



CONSEIL NATIONAL DE DEVELOPPEMENT DE LA NUTRITION



University of Nairobi



THE OHIO STATE UNIVERSITY



PennState





## MANAGEMENT TEAM



*Dr. Haley Oliver*

**Director**

Professor of Food Science  
Purdue University



*Dr. Randy Worobo*

**Associate Director**

Professor of Food Microbiology  
Cornell University



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*Julie Hancock*

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*Dr. Amanda Garris*

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*Liz Alexander*

**Project Manager**

Purdue University

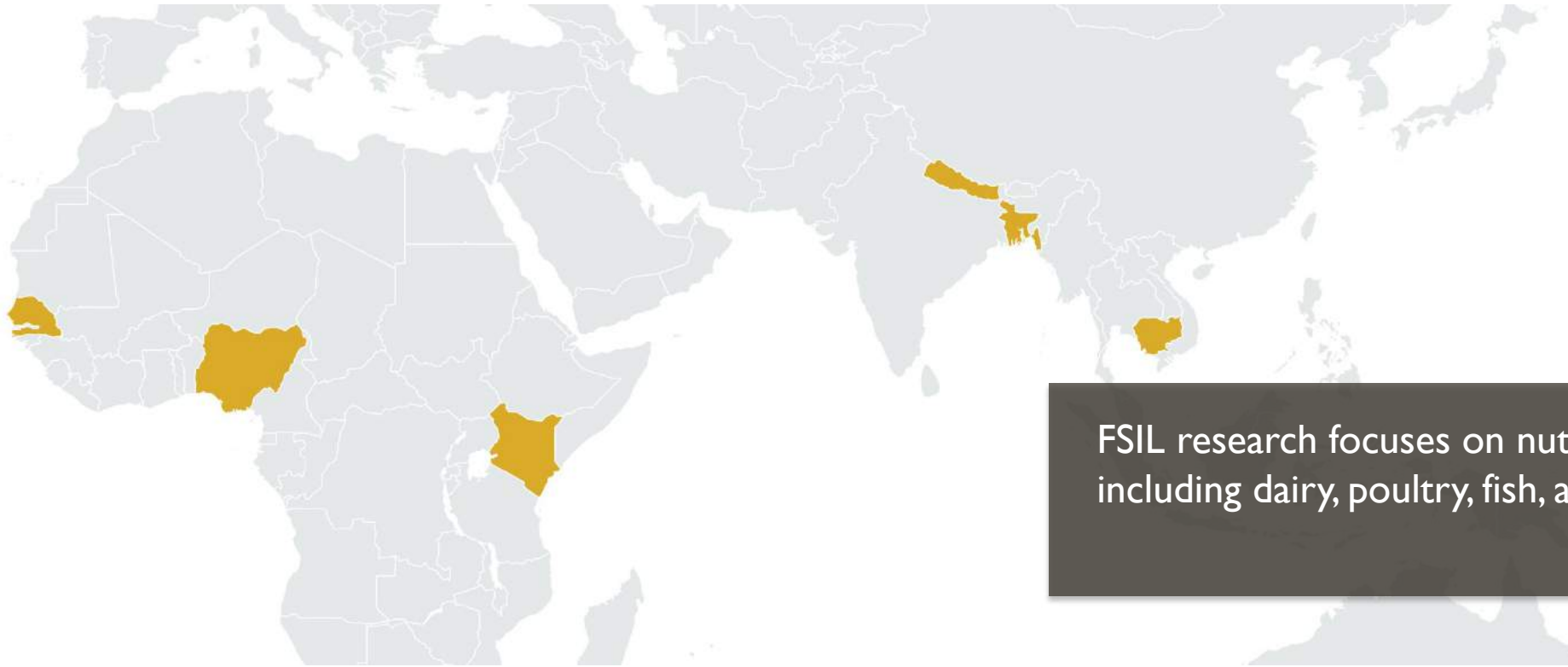


*Allison Staley*

**International Post Award Business Manager**

Purdue University

## ACTIVE RESEARCH PORTFOLIO



FSIL research focuses on nutrient-dense, perishable foods, including dairy, poultry, fish, and vegetables.





Enhancing food safety  
in fish and chicken  
value chains  
of **Bangladesh**





Reducing foodborne  
pathogen  
contamination of  
vegetables in  
**Cambodia**





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Chakula Salama:  
A risk-based approach to  
reducing foodborne disease and  
increasing production of safe  
foods in **Kenya**



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FLORIDA



University of Nairobi



*In Search of Better Health*





Enhancing resilience of the dairy value chain by leveraging public-private partnerships in **Senegal**





Market-led food safety in **Nepal**:  
Harnessing production incentives  
and consumer awareness





Strengthening household and community food safety in **Nigeria**

## CONNECT WITH FSIL



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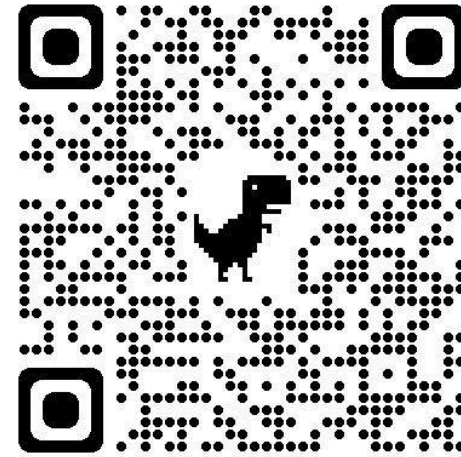
[@FoodSafetyIL](https://twitter.com/FoodSafetyIL)



[linkedin.com/company/foodsafetyil/](https://www.linkedin.com/company/foodsafetyil/)



[ag.purdue.edu/food-safety-innovation-lab/](http://ag.purdue.edu/food-safety-innovation-lab/)





# TINY MICROBES WITH BIG BUSINESS IMPACT: THE ECONOMIC AND HEALTH IMPLICATIONS OF FOOD SAFETY

Agrilinks Food Safety Month June 2023 Webinar

**Prof Lise Korsten**

Co-Director Centre of Excellence Food Security,

University of Pretoria, South Africa

[lise.korsten@up.ac.za](mailto:lise.korsten@up.ac.za)



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UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

# Downstream Impact of Conflict on Food Safety

## Terms of Sale

Throughout history, trade has been accompanied by what linguists call *Wanderwörter*—words borrowed from one language to another across vast distances, often along trade routes.

### whis-key /hwɪ-ski/

By the early eighteenth century, the Scots Gaelic *uisge beatha* (a translation of the Latin *agua vitae*, "water of life") was anglicized and shortened to whisky (in Scotland) or whiskey (in Ireland). In Mandarin, the characters used to approximate the pronunciation—*wei, shi*, and *ji*—can be translated as power, scholar, and avoid at all costs.

TOMATO

### to-ma-to /tə-'mɑ-tə/

After Spanish conquistadors brought the fruit to Europe in the sixteenth century, derivations on the Nahuatl *tomatl* spread throughout much of the world. Italian, however, dubbed it *pomodoro*, "golden apple," a term they lent to Russian and Uighur.

### CO-CA /kə-'kɑ/

The Andean plant known as *koika* by the Quechua was introduced across Europe by the Spanish, who called it *coca*. In 1886, American pharmacist John Pemberton used the word in the name of his new beverage. Coca Cola: the abbreviation. Coca Cola was trademarked in 1905.

### ivo-ry /'vɪ-rɪ/

The word for ivory in many European languages derives from the Egyptian word *ibw*, dating to the second millennium BC. The Spanish and Portuguese words, however, come from the Arabic *nab al-īl*, "elephant's tooth."

### col-ton /kɑ-'tɒn/

Variations on the Arabic *al-qutn* spread across North Africa and the Mediterranean with the Umayyads in the eighth century. A second derivation, from the Persian *pehm*, spread to Anatolia as well as down the eastern coast of Africa.

### tea /te/

Tea traveled along two separate routes from China to Europe in the seventeenth century: overland from Mandarin-speaking northern China, where it was known as *chi*; and by sea from Southern Min-speaking south-east China, where it was known as *ti*.

## Food Security Risk Index 2013



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Pests  
Pathogens  
Power

People  
Planet  
Profit

Food  
Sovereignty

# Climate Change impact on Food Safety

Food  
Sovereignty

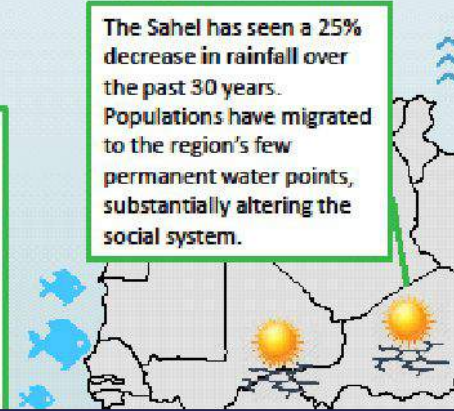
Fishery  
impact  
drop  
50%

Maize  
down  
35%  
Drought

## Selected Effects of C

Fish catches off the coast of West Africa are likely to drop by as much as 50% by 2050 due to rising ocean temperatures. Fish accounts for half of the

The Sahel has seen a 25% decrease in rainfall over the past 30 years. Populations have migrated to the region's few permanent water points, substantially altering the social system.



Ukraine War-  
Food & Fertiliser  
shortage  
Trade disruptors

Crop yield  
drop 20%



Food safety is everyone's business



Climate  
change is  
increasing  
the risk of  
foodborne  
diseases



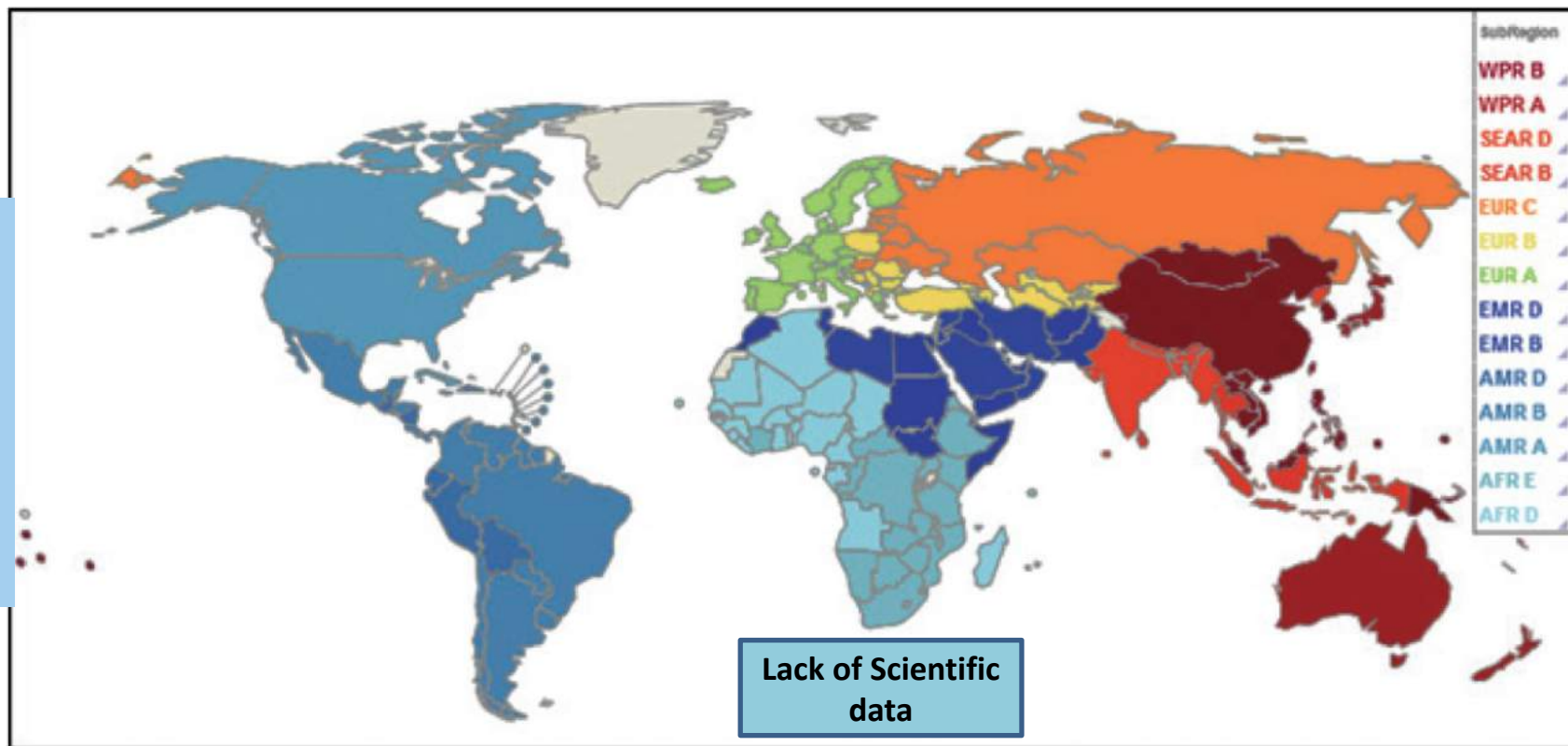
Water

Cholera



# What does it take to ensure safe food for all in a food security context

**Figure 1:** Categorization of subgroups under WHO regions for estimation of global burden of foodborne diseases



Source: FERG Report (2015)

Food and Agriculture Organization  
of the United Nations

Food safety is everyone's business

**There is no food security  
without food safety**



Food and Agriculture  
Organization of the  
United Nations

# Evidence-driven decision making and strategic investments to prioritize food safety to improve food security

- 20 countries submitting food safety index
- 2<sup>nd</sup> Malabo Biennial Review (2019)
- 25 member states developing plans to increase investment in food safety.

Top 10 African Countries for food safety investments

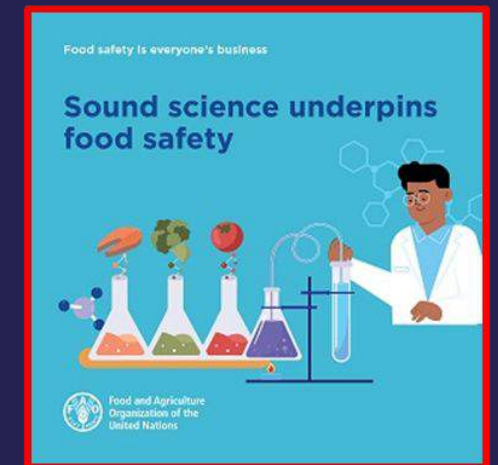
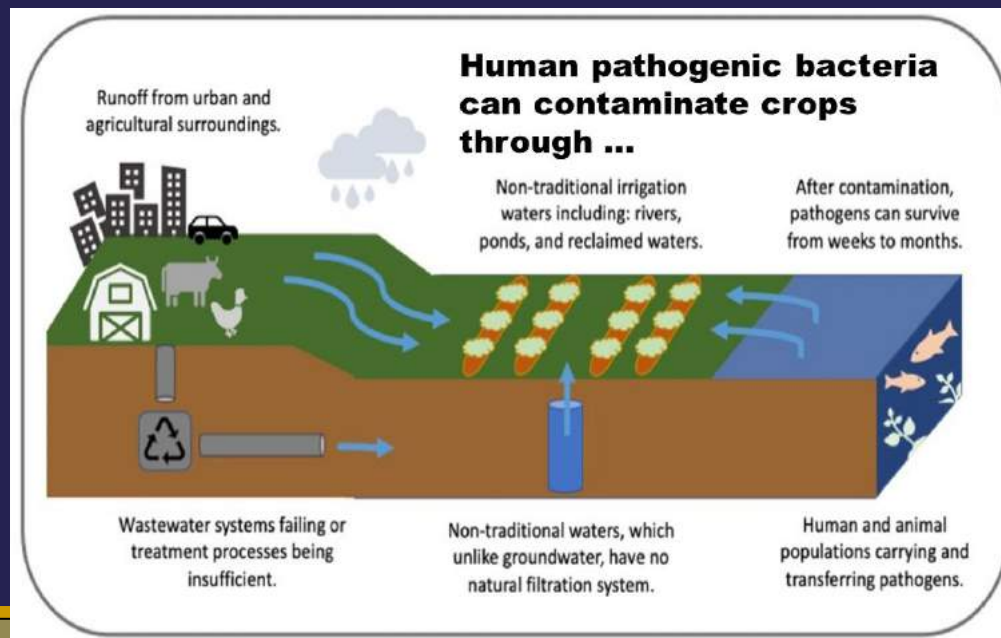


## Mapping the road to safer food



# The importance of research in the field of food safety

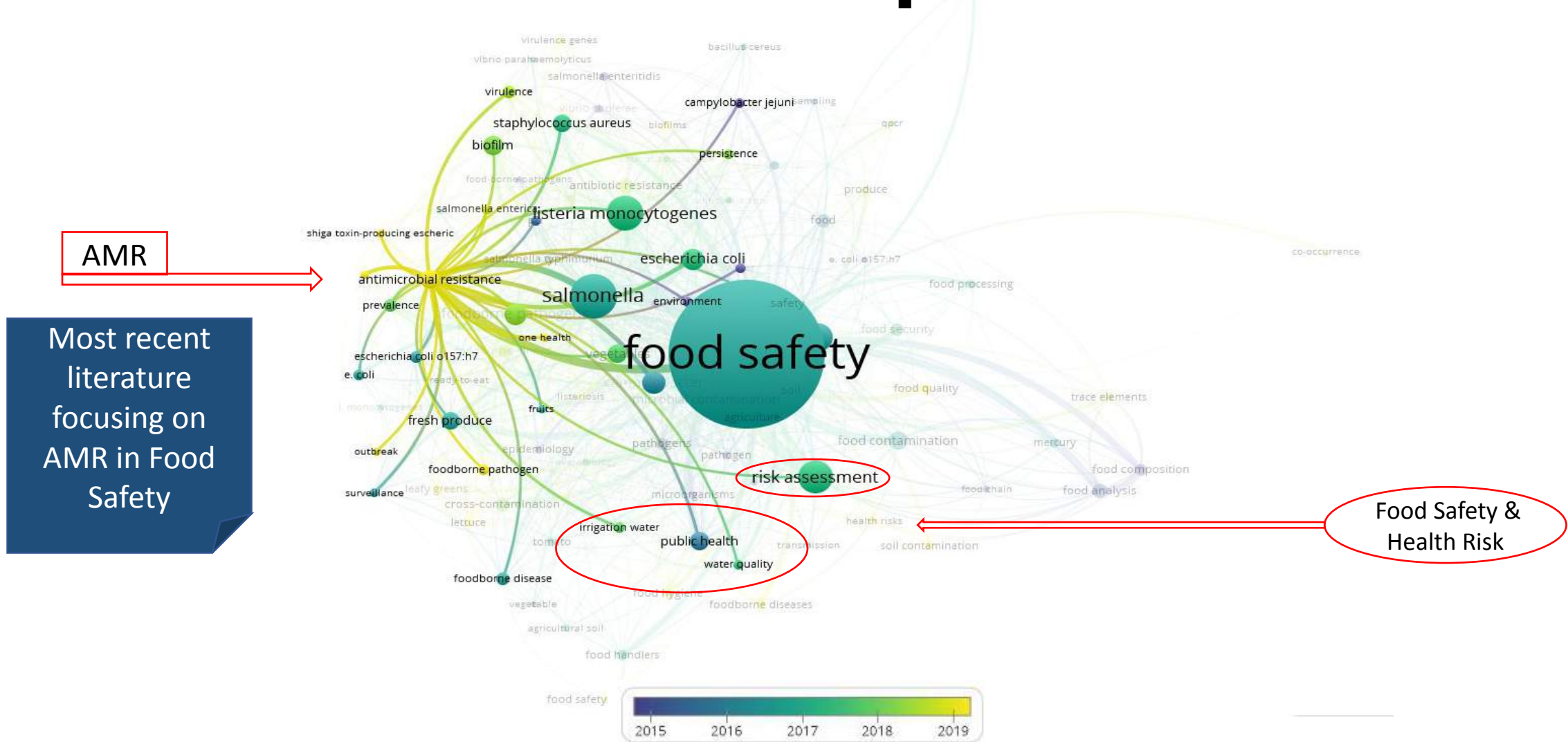
1. Generating Data for decision making
2. Method optimization for detection and surveillance
3. Directing policy through research findings







# Review of the current published information



**Figure 2:** The keywords co-occurrence network of *Vibrio cholerae* in fresh produce supply chains- related publications. The keyword “antimicrobial resistance” was highlighted to indicate the increased co-occurrence of foodborne pathogen and antimicrobial resistance keywords in water and fresh produce related publications.



# Review of the current published information

1. Fruit & Vegetable link

2. Close association with water and food safety

3. Salmonella & Vibrio link



**Figure 3:** The keywords co-occurrence network of *Vibrio cholerae* in fresh produce supply chains- related publications. The keyword “*Vibrio cholerae*” was highlighted to indicate the co-occurrence of *Vibrio cholerae* and food safety in water and fresh produce related publications.



# “Vibrio cholerae outbreak in the Hammanskraal area is a serious environmental and human health concern”.

Food safety  
issue?

Mail & Guardian

ENVIRONMENT / 2 JUN 2023

## SA hit by a 'tsunami of sewage'

By Sheree Bega



Plastic and other waste pollution along the Hennops River. The sewage pollution of the river affects the water quality of the Rietvlei and Hartbeespoort dams. File photo: Delwyn Verasamy/M&G

- Detection of cholera on irrigated fresh produce
- *During sporadic cholera outbreak situations such as the current outbreak in South Africa, the priority should be early detection and appropriate management of people who have been infected.*
- *In addition, active disease surveillance must take place to monitor transmission patterns.*



# Antimicrobial Resistance in the Food System



## Antimicrobial resistance now a leading cause of death worldwide, study finds

Lancet analysis highlights need for urgent action to address antibiotic-resistant bacterial infections



A researcher holds up two culture plates growing bacteria in the presence of discs containing various antibiotics. The one on the right has a strain that is resistant to all antibiotics tested. Photograph: Science History Images/Alamy

- Foodborne and waterborne diarrhoeal diseases kill an estimated 2 million people annually

- AMR Facts: 1.2 million died in 2019 due to antibiotic-resistant bacterial infections.



# Duality of the South African food systems



1. Formal Sector Supply Chain: Commercial Farmers/ Major Processors/ Big Retail



2. Informal Sector Supply Chain: Small scale farmers



# First report ESBL/AmpC-producing Enterobacteriaceae commercial spinach production from the farm to retail

Total 288 samples :  
14.58%  
contaminated

## Irrigation water

12.5 % (9/72) river water



15.28% (11/72) water samples

2.7 % (2/72) borehole water

## At harvest

1.5% (2/132)



12.12% (16/132) harvested- and processed spinach

1.5% (2/132)

## Processing in formal retailer facilities

3.8% (5/132)



5.3 % (7/132)

## Retail

11.6% (7/60)



25% (15/60) retail samples

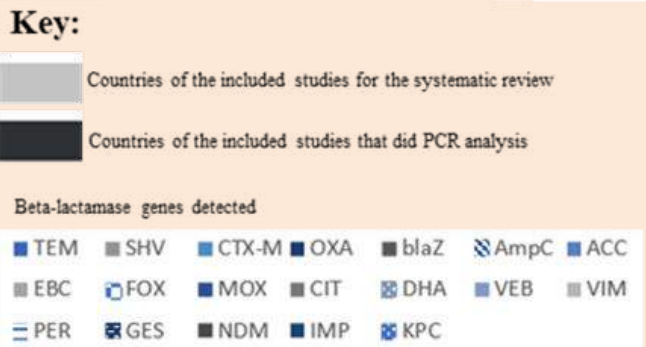
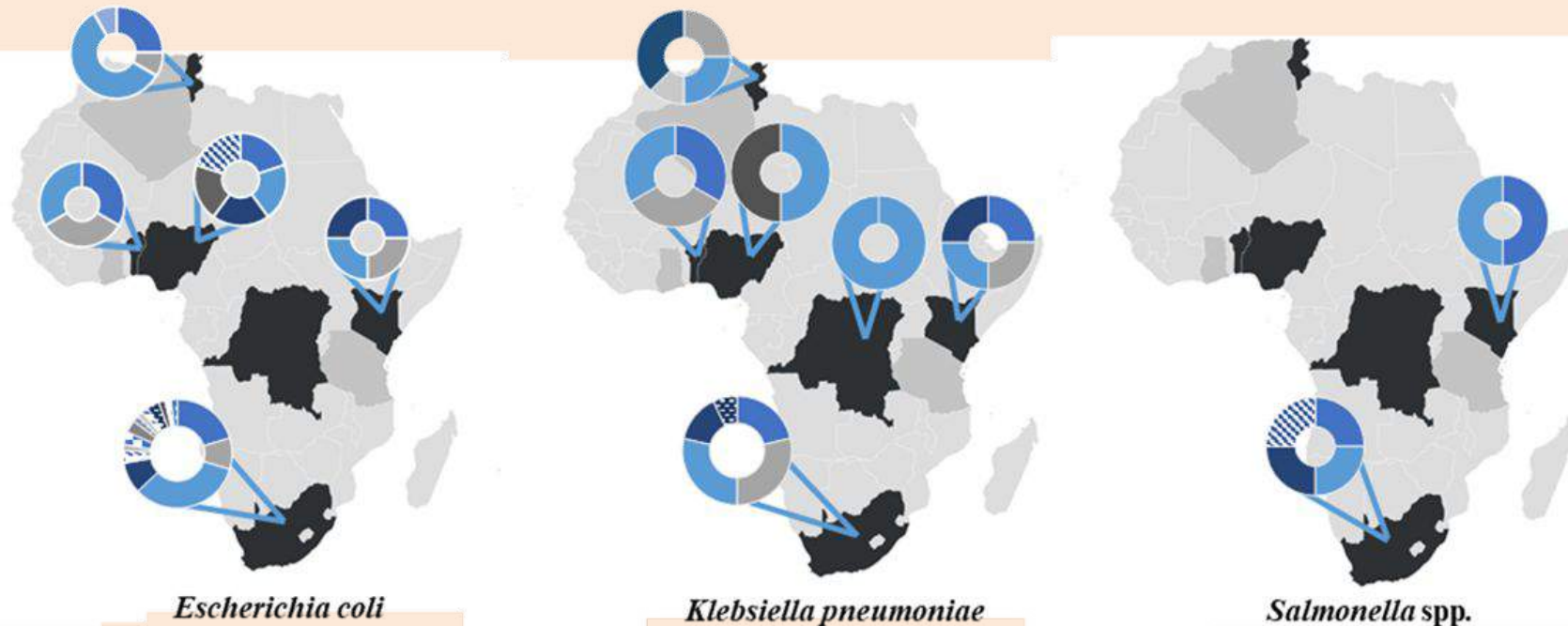


13.3 % (8/60)

Enterobacteriaceae isolates: Dominant species - *Serratia fonticola* (45.86%), *Escherichia coli* (20.83%), and *Klebsiella pneumoniae* (18.75%)

**98% multidrug resistant**

# Antimicrobial resistance in the water-plant-food nexus: Should we be concerned?



Beta-lactamase genes detected in *Escherichia coli*, *Klebsiella pneumoniae* and *Salmonella spp.* isolated from water, soil and/or fresh produce samples in different African countries between 2010-2022.

- 80.95% of the studies, AMR in irrigation water samples.
- Analysis of bacterial phenotypic AMR profiles were reported in 95.24% of the studies
- MAR indexes of potential human pathogenic bacteria (*E. coli*, *K. pneumoniae* and *Salmonella spp.*) were  $\geq 0.2$ , representing a potential human health risk.
- **Only 2 studies used WGS for molecular characterisation**



Economic impact of unsafe food that must be discarded, undermining efforts to increase the availability, access, and affordability of safe and nutritious food.

- The moral vs legal issue - When to discard food?:
  - Quality vs safety standards
  - Product recalls
  - Rejected food at ports of entry
  - Past sell by date?
  - “Left over” food in a restaurant?
  - “Food” in a waste dump?
  - “Declared unfit for human consumption”

