ILRI Food Safety and Zoonoses
India and Bihar

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Why food safety and zoonoses?

1. Everyone needs to eat and wants to be healthy

2. Food-borne disease is common, costly and preventable

3. A new disease emerges every 4 months, $\frac{3}{4}$ are zoonotic
What do we work on?

• Which livestock agendas are important in this program?
  – Safe food
  – Zoonotic diseases
  – Emerging infectious diseases
  – Animal health
  – Intensification and disease
    – Climate change and disease
    – Gender and health
    – Food safety and nutrition
FSZ program geography

– East Africa, West Africa, Southern Africa, South Asia, Southeast Asia
– Kenya, Ethiopia, Tanzania, Uganda, Senegal, Zambia, Nigeria, Ghana, Mozambique, Cote d’Ivoire, Rwanda, Malawi
– Vietnam, Laos, Thailand, China, Indonesia, Cambodia
– India, Bangladesh
– Egypt
71% “out-posted”
53% female
33% developing country
25% Asian

1 human nutritionist
1 food technologist
1 biologist
1 animal scientist
1 medical epidemiologist
12 veterinary epidemiologists
81 graduate fellows (54% f)
What we know

1. Most food is sold in informal markets

2. Most health burden is due to biological hazards; chemical hazards and mycotoxins cause concern but there is less evidence for large health burdens

3. Most risky foods are un-boiled dairy products, vegetables grown in contaminated water or cross-contaminated from meat, and under-cooked meat

4. GAP for farmers successful at small-scale and for export; large-scale but domestic GAP less successful (Farmer Field Schools)

5. Training and certification of vendors successful at small-scale and some success at scale in Kenya and Assam
Change in global and regional demand for food: Livestock and other commodities

Modified from Alexandratos and Bruinsma (2012)
Big productivity gaps
-largely due to poor animal health

Some developing country regions have gaps of up to 430% in milk productivity

Steinfeld et al. (2006)
Agriculture imposes large burdens on human health

Three million deaths a year are agriculture associated. One quarter of all deaths from infection are agriculture associated. Almost all of these occur in developing countries.
Agriculture imposes large burdens on human health

Zoonoses and FBD kill 2.2 million a year

- 2.4 billion people sick
- 2.2 million people dead
- more than 1 in 7 animals affected

Zoonoses & FBD cost $84 billion a year

- $9 billion in lost productivity
- $25 billion in animal mortality
- $50 billion in human health costs
Evidence for food safety

- 90% of animal products are produced and consumed in the same country or region.
- 500 million smallholders produce 80% of food in poor countries. 43% of the workforce are women.
Compliance: Formal often worse than informal
Food-borne diseases

• Food-borne diseases are very important
• 1.4 million children die every year of diarrhoea
• The majority is food and water-associated
• Animal-source food over-represented as a cause
Risks and benefits with dairy

Pathogens from the cow and from the milk

• *Mycobacterium bovis*
• *Brucella* spp.
• *Bacillus anthracis*
• *Salmonella*
• EHEC

• *Streptococcus* spp.
• *Staphylococcus aureus*
• *Clostridium* spp.
• *Listeria* spp.
Risks and benefits associated with dairy: What else is in the milk?

- Antibiotic residues
  - Frequently detected
- Pesticides
  - High percentage of milk samples
- Mycotoxins (aflatoxins)
  - Detected in many milk samples, sometimes high levels
Aflatoxins- Food safety outside the ASFs

- Acute outbreaks can claim 100s of lives (Kenya outbreak 2004-05, 150 known fatal cases)
- 4.5 billion people chronically exposed (estimate by US CDC)
  - Cancer
  - Immunosuppression
  - Stunting
Food safety work in India

• Focus on the dairy value chain

• Agriculture-associated diseases
Project 1: The Assam study

Concerns about milk quality in Assam

Training to promote knowledge and hygiene amongst producers and traders

The objectives was to evaluate the improvements in knowledge

<table>
<thead>
<tr>
<th>Year</th>
<th>Producer</th>
<th>Traders</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>405</td>
<td>175</td>
<td>580</td>
</tr>
<tr>
<td>2012</td>
<td>161</td>
<td>226</td>
<td>387</td>
</tr>
<tr>
<td>Total</td>
<td>566</td>
<td>401</td>
<td>967</td>
</tr>
</tbody>
</table>
**Can diseases be transmitted from dung?**

<table>
<thead>
<tr>
<th></th>
<th>Believe diseases can be transmitted from dung</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producers</strong></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>2.7% (11/404)</td>
</tr>
<tr>
<td>2012</td>
<td>37.2% (60/161)***</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>69.8% (37/53)***</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>21.3% (23/108)</td>
</tr>
<tr>
<td><strong>Traders</strong></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1.1% (2/175)</td>
</tr>
<tr>
<td>2012</td>
<td>47.1% (106/225)***</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>63.9% (78/122)***</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>27.2% (28/103)</td>
</tr>
</tbody>
</table>

*Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012*
Can diseases be transmitted by milk?

<table>
<thead>
<tr>
<th></th>
<th>Believe diseases can be transmitted from milk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producers</strong></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>13.0% (52/401)</td>
</tr>
<tr>
<td>2012</td>
<td>35.4% (57/161) ***</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>64.2% (34/53) ***</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>21.3% (23/108)</td>
</tr>
<tr>
<td><strong>Traders</strong></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>9.1% (16/175)</td>
</tr>
<tr>
<td>2012</td>
<td>41.5% (93/224) ***</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>64.8% (79/122) ***</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>13.7% (14/102)</td>
</tr>
</tbody>
</table>
Which diseases can be transmitted?

<table>
<thead>
<tr>
<th></th>
<th>Tuberculosis</th>
<th>Food poisoning/gastrointestinal disease</th>
<th>General disease symptoms (fever, cough, cold)</th>
<th>Worms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>3.5% (14/405)</td>
<td>18.3% (74/405)</td>
<td>0.3% (1/405)</td>
<td>4.7% (19/405)</td>
</tr>
<tr>
<td>2012</td>
<td>8.7% (14/161)**</td>
<td>36.0% (58/161)***</td>
<td>11.2% (18/161)***</td>
<td>9.3% (15/161)*</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>18.9% (10/53)***</td>
<td>64,2% (34/53) ***</td>
<td>20.8% (11/53)***</td>
<td>9.4% (5/53)</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>3.7% (4/108)</td>
<td>22.2% (24/108)</td>
<td>6.5% (7/108)***</td>
<td>9.3% (10/108)</td>
</tr>
<tr>
<td><strong>Traders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>4.0% (7/175)</td>
<td>9.7% (17/175)</td>
<td>0% (0/175)</td>
<td>2.9% (5/175)</td>
</tr>
<tr>
<td>2012</td>
<td>13.7% (31/226)***</td>
<td>42.9% (97/226)***</td>
<td>11.5% (26/226)***</td>
<td>4.0% (9/226)</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>23.8% (29/122)***</td>
<td>61.5% (75/122)***</td>
<td>20.5% (25/122)***</td>
<td>6.6% (8/122)</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>1.9% (2/104)</td>
<td>21.2% (22/104)**</td>
<td>1.0% (1/104)</td>
<td>1.0% (1/104)</td>
</tr>
</tbody>
</table>

Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012
What do you use most often to wash your hands?

- **Traders**
  - Untrained: 74% answered soap
  - Trained: 92% answered soap (p<0.001)

- **Producers**
  - Untrained: 53% answered soap
  - Trained: 92% answered soap (p<0.001)
Some specks of dirt in the milk are not harmful

- Traders
  - Untrained: 37.5% agree
  - Trained: 28% agree

- Producers
  - Untrained: 58% agree
  - Trained: 77% agree (p=0.046)
You can tell if milk is safe to drink

• Traders
  • Untrained: 96% agree
  • Trained: 89% agree

• Producers
  • Untrained: 96% agree
  • Trained: 77% agree (p<0.001)
Improving production – not always rocket science

- Follow up in 2014
- Trained farmers reported less diseases and higher milk production ($p<0.001$)

<table>
<thead>
<tr>
<th></th>
<th>Average milk production in liters per cow and day 2 years ago/before ILRI training</th>
<th>Average milk production in liters per cow and day now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained farmers</td>
<td>7.0 (range 2.5-10)</td>
<td>7.8 (range 3-15)</td>
</tr>
<tr>
<td>Untrained farmers</td>
<td>7.3 (range 2.5-14)</td>
<td>6.8 (range 2.5-14)</td>
</tr>
</tbody>
</table>

- No difference in *Brucella* prevalence
Project 2: Peri-urban milk production

- Can we affect the incidence of bovine tuberculosis?
- Can we affect the prevalence of antibiotic residues?

- Evaluate the risks
- Identify risk practices
- Pilot interventions
Risk mitigation at the human-livestock interface

• It is possible to change people’s perceptions and habits but difficult to assess the effect

• Farmers at high risk for zoonoses

• Milk is a risk product

• Assess the risks, mitigate the risks, increase the profits
Tuberculosis can be caused by 2 types of bacteria: *Mycobacterium tuberculosis* and *Mycobacterium bovis*.

- Chronic disease in both humans and animals
- Fatal
- Difficult to treat
- Best method is to stop the spread
Antibiotic residues

- Unregulated antibiotic
- Risk for antibiotic residues in the milk: there is no testing and no control
- The problem: residues or resistance
Study design

1. Estimate the burden
   - Estimate the prevalence of *Mycobacterium bovis*, *Brucella abortus*, *Coxiella burnetii*, *Listeria monocytogenes* infection among livestock in smallholder dairy farms in peri-urban areas
   - Describe and quantify antibiotic use and associated levels of milk production, including testing of pooled milk samples for antibiotic residues

2. Design an intervention and pilot it!
Study sites

Ludhiana

Udaipur

Guwahati

Bhubaneshwar

Bangalore

Image Source: http://www.coachingindians.com/i/india_political.jpg
Project 3: Animal health in Bihar

• Bihar is one of the poorest and least developed states
• Common farm size: 1-3 dairy cows or buffaloes
• 3-5 litres of milk
• Little is known about the limitations to the dairy production
Scoping study about the animal health problems

- Collecting morbidity and mortality data
  - Including mastitis and antibiotic resistance
- Production and cost estimates
- Serology for selected diseases
  - Brucellosis, leptospiroosis, Q fever, haemorrhagic septicaemia
  - Special focus on brucellosis
    - Evaluation of rapid tests
    - Molecular testing
Finding the best bet interventions

- Identify the limitations
  - Risk factors
- Identify what is feasible
- Pilot
- Evaluate sustainability and long-term effects
Other potentially upcoming projects

- Pig production in Meghalaya
- Small ruminants value chain
better lives through livestock

ilri.org