Challenges in intensifying India smallholder dairy production: Health risks and productivity gaps

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Presentation outline

• Background
  • The livestock revolution
  • The white revolution of India
  • Pros and cons

• Our studies
  • Objectives
  • Results
  • Conclusions

• The steps forward
7 billion and counting

- More and more people to feed
- More and more are not producing food
  - The rest need to produce more
- Over 50% urban
  - Production has to move close to urban areas
The livestock revolution

- 1970-Mid 1990s
- Demand-driven, in difference to green revolution
Not only demands
Food security and sustainability

Bridging the gaps between demand and supply – global level

• FAO projections to 2030, demand for meat will increase by 3.7% and milk 2.7%
• 60% more food than is produced now will be needed
• 75% of this must come from producing more food from the same amount of land
• The higher production must be achieved while reducing poverty and addressing environmental, social and health concerns
• This greater production will have to be achieved with temperatures that may be 2–4 degrees warmer than today’s
Why increasing demands?

- Increased demands for animal-source food
- Growing middle classes
- Continued urbanization
- Globalization
- More and more people
- Changing preferences

Continued urbanization → Increased demands for animal-source food
Growing middle classes → Increased demands for animal-source food
Globalization → Increased demands for animal-source food
More and more people → Increased demands for animal-source food
Changing preferences → Increased demands for animal-source food
Gains in meat consumption in developing countries are outpacing those of developed countries.
Change in global and regional demand for food: Livestock and other commodities

Modified from Alexandratos and Bruinsma 2012
FAO statistics 2012

- Milk, whole fresh cow
- Rice, paddy
- Meat indigenous, cattle
- Meat indigenous, pig
- Meat indigenous, chicken
- Wheat
- Soybeans
- Sugar cane
- Eggs, hen, in shell
- Maize
- Potatoes
- Milk, whole fresh buffalo
Big productivity gaps
-largely due to poor animal health

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

Milk
(kg/cow/yr)

<table>
<thead>
<tr>
<th>Region</th>
<th>1980</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>411</td>
<td>397</td>
</tr>
<tr>
<td>Latin America</td>
<td>1021</td>
<td>1380</td>
</tr>
<tr>
<td>South Asia</td>
<td>517</td>
<td>904</td>
</tr>
<tr>
<td>Industrialized Countries</td>
<td>4226</td>
<td>6350</td>
</tr>
</tbody>
</table>
Industrialization

- Increased profits
- Growth of off-farm income
- Reduction in greenhouse gases per unit of animal-source food produced
- Intensive units can maintain higher biosecurity
- Separates animals from humans
- Increased incomes may render people less vulnerable to disease.
Example: Green house gases

GHG per kg of animal protein produced

Herrero et al 2013
The white revolution of India

Why?

• >1 billion people
• Many vegetarians
The white revolution of India

- The leading milk producer (since 2001)
- The biggest fleet of cows and buffaloes in the world

![Pie charts showing milk production by region from 1970-1973 and 2010-2013.](chart)
The white revolution

![Graph showing the growth of milk cow, milk buffalo, and total livestock from 1962 to 2012.](image-url)
Milk consumption in India

- Milk consumption 46 kg per capita in 1983 - 62 kg per capita in 1997-106 kg in 2011-12
- Estimated total annual consumption of 60 million megatons
- India consumed 13% of the milk in the world
Food-borne diseases

- Food-borne diseases are very important
- 1.4 million children die every year of diarrhea
- The majority is food and water-associated
Risks and benefits with urban dairy

Good and bad

- Milk is nutritious
- Closeness to the market, farm inputs & services
- Lesser cost & time for transportation
- It is an opportunity to provide food for the family and an income

- Local markets for live/dead animals
- Poor sanitation & inadequate space for farm waste disposal
- Living in close proximity to the animals kept
- High density of people and animals
Risks and benefits with urban dairy

Pathogens from the cow and from the milk

- Anthrax
- Mycobacterium bovis
- Brucella
- Salmonella
- EHEC
- Streptococcus spp
- Staphylococcus aureus
- Clostridium spp
- Listeria spp
Risks and benefits with urban dairy- What more is in the milk

- Microbial load
- Adulterants
Risks and benefits with urban dairy- What more is in the milk

- Antibiotic residues
  - Frequently detected
- Pesticides
  - High percentage of milk samples
- Mycotoxins- aflatoxins
  - Detected in many milk samples, sometimes high levels
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>
Training on hygiene

• Training & monitoring on hygienic milk production and handling
• Producers and trainers in Kamrup district
• Local partners: Dairy Development Department (DDD), Assam Agricultural University (AAU), Greater Guwahati Cattle Farmers Association and a local NGO
• Media and information campaigns
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>
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>

Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012
## Is the milk completely safe after boiling?

<table>
<thead>
<tr>
<th></th>
<th>Believe milk is completely safe after boiling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Producers</strong></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>96.0% (380/396)</td>
</tr>
<tr>
<td>2012</td>
<td>93.1% (148/159)</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>86.8% (46/53)*</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>96.2% (102/106)</td>
</tr>
<tr>
<td><strong>Traders</strong></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>89.1% (156/175)</td>
</tr>
<tr>
<td>2012</td>
<td>93.8% (212/226)</td>
</tr>
<tr>
<td>Trained (2012)</td>
<td>91.8% (112/122)</td>
</tr>
<tr>
<td>Untrained (2012)</td>
<td>96.2% (100/104)*</td>
</tr>
</tbody>
</table>

*Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012
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 is 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)
It is good for the cow if you add water to the milk

- Traders
  - Untrained – 72% agree
  - Trained – 53% agree ($p<0.001$)

- Producers
  - Untrained – 76% agree
  - Trained – 64% agree ($p=0.052$)
In practice

• Traders
  • No difference in if milk was free from dirt (3.5% were not)
  • 82% of trained traders had clean clothes, compared to 50% of untrained (p<0.001)

• Producers
  • No difference in the number of milk containers were free from dirt (92% were not)
  • No difference in if milk was free from dirt (2.5% were not)
  • 79% of trained producers had clean clothes, compared to 68% of untrained (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
Moving forward

• Continue monitoring
• Continue evaluation of the training
  • Mastitis frequency
  • Antibiotic use, residues and resistance
  • Animal health, welfare and productivity
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
Mycobacterium bovis

- Tuberculosis can be caused by 2 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 small holder 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!
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 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
  - Brucella, leptospira, q-fever, haemorrhagic septicemia
- Special focus on Brucellosis
  - Evaluation of rapid tests
  - Molecular testing
Finding the best bet interventions

- Identifying the limitations
  - Risk factors
- Identifying what is feasible
- Pilot
- Evaluate sustainability and long term effects
Conclusions!

- Dairy very important in India and in spite of large efforts, productivity is suboptimal
- Milk products contribute to human morbidity
- Still much to do and a need for a one health perspective!
Thank you for your attention

Any questions?
Acknowledgements

• Partners: Dairy Development Department (DDD), Assam Agricultural University (AAU), Greater Guwahati Cattle Farmers Association, Health & Family Welfare Department, Guwahati Municipal Corporation (GMC) and Animal Husbandry & Veterinary Department
• All members of the research team in the field
• The participants in Assam