One Health approaches to different problems:

Work at the International Livestock Research Institute

Johanna Lindahl

One Health Sweden

8 April 2015, Uppsala, Sweden

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

SLU

Today's talk

1. What is ILRI?
2. Why an international livestock research institute?
3. One health, Ecohealth and health
4. One health projects at ILRI

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A history of international livestock research

- International Laboratory for Research on Animal Diseases
- International Livestock Center in Africa
- Merged in 1994 - ILRI

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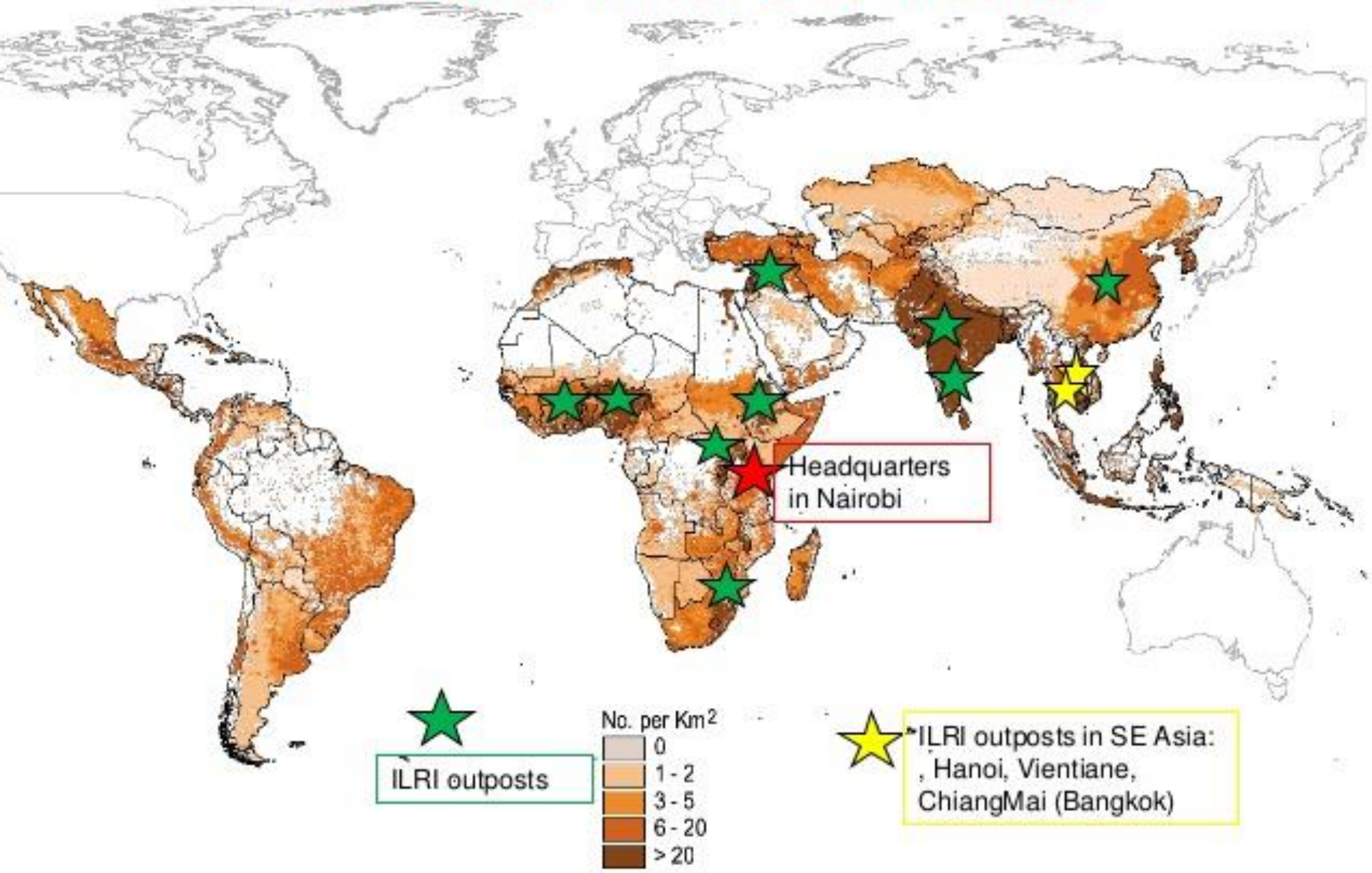
ILRI and where it works



CGIAR

- Consultative Group for International Agricultural Research- 1971
- CGIAR Consortium of International Agricultural Research Centers- 2011
- Today 15 centers

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Active CGIAR Centers	Headquarters location
Africa Rice Center (West Africa Rice Development Association, WARDA)	Bouaké, Côte d'Ivoire / Cotonou, Benin
Bioversity International	Maccarese, Rome, Italy
Center for International Forestry Research (CIFOR)	Bogor, Indonesia
International Center for Tropical Agriculture (CIAT)	Cali, Colombia
International Center for Agricultural Research in the Dry Areas (ICARDA)	Beirut, Lebanon
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Hyderabad (Patancheru), India
International Food Policy Research Institute (IFPRI)	Washington, D.C., United States
International Institute of Tropical Agriculture (IITA)	Ibadan, Nigeria
International Livestock Research Institute (ILRI)	Nairobi, Kenya
International Maize and Wheat Improvement Center (CIMMYT)	El Batán, Mexico State, Mexico
International Potato Center (CIP)	Lima, Peru
International Rice Research Institute (IRRI)	Los Baños, Laguna, Philippines
International Water Management Institute (IWMI)	Battaramulla, Sri Lanka
World Agroforestry Centre (International Centre for Research in Agroforestry, ICRAF)	Nairobi, Kenya
WorldFish Center (International Center for Living Aquatic Resources Management, ICLARM)	Penang, Malaysia


Germany
Ukraine
France
Spain
Kazakhstan
Mongolia
China
South
Afghanistan
Iraq
Iran
Pakistan
Algeria
Libya
Egypt
Saudi Arabia
Mali
Niger
Sudan
Chad
Ethiopia
Thailand
Indonesia
DR Congo
Angola
Namibia
Botswana
Madagascar
South Africa
Brazil
Bolivia
Chile
Argentina
Venezuela
Colombia
North Atlantic Ocean
South Atlantic Ocean
Indian Ocean
2
2

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CGIAR research programs

Climate Change, Agriculture and Food Security(CIAT)

Forests, Trees, and Agroforestry (CIFOR)

GRiSP - A Global Rice Science Partnership (IRRI)

Aquatic Agricultural Systems (WorldFish)

Maize (CIMMYT)

Roots, Tubers and Bananas (CIP)

WHEAT (CIMMYT)

More Meat, Milk and Fish by and for the poor (ILRI)

Water, Land [illegible] Ecosystems

Agriculture for Nutrition and Health (IFPRI)

Dryland Cereals (ICARDA)

Dryland Systems (ICARDA)

Humidtropics (IITA)

Policies, Institutions, & Markets (IFPRI)

Grain Legumes for Health & Prosperity

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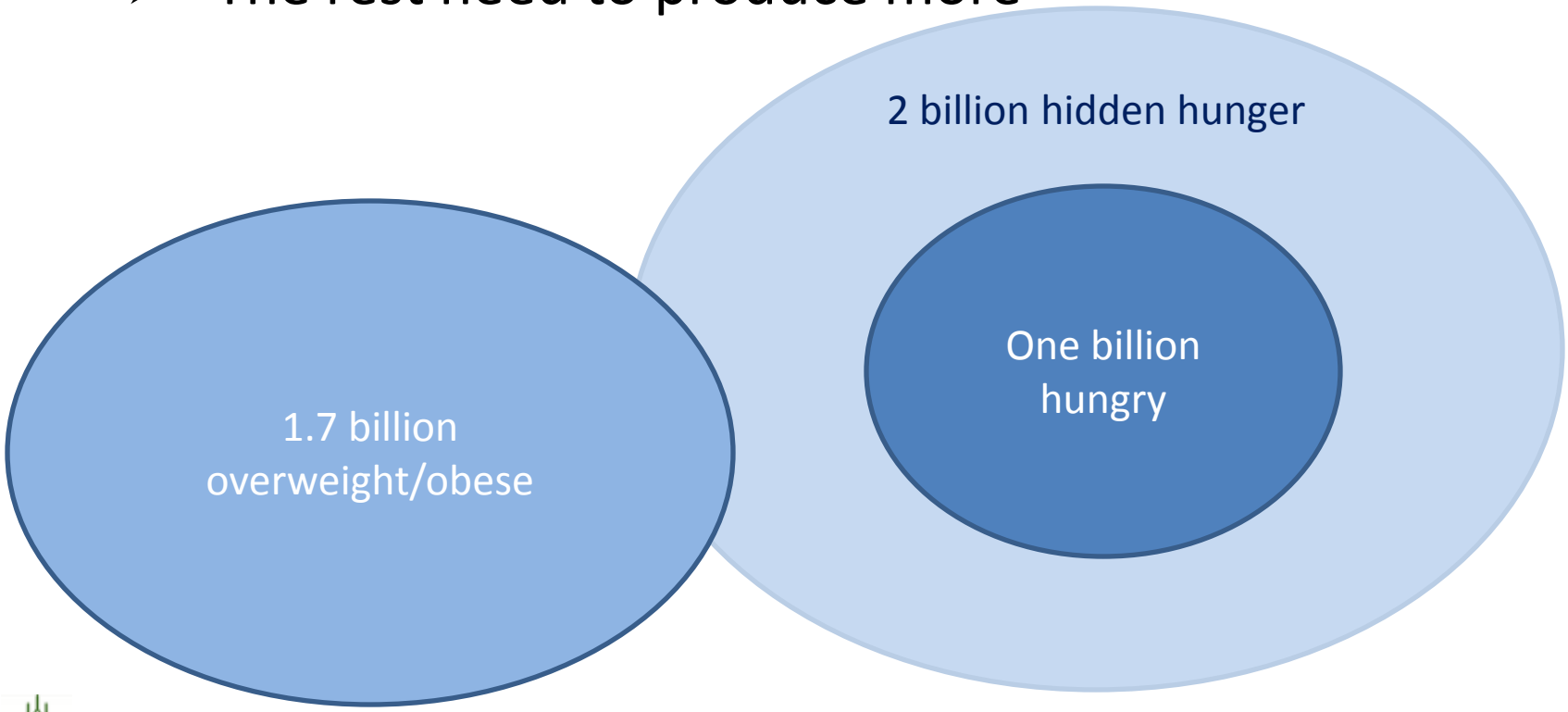
7 billion reasons for more agricultural research

- More and more people to feed
- More and more are not producing food
  - ➢ The rest need to produce more



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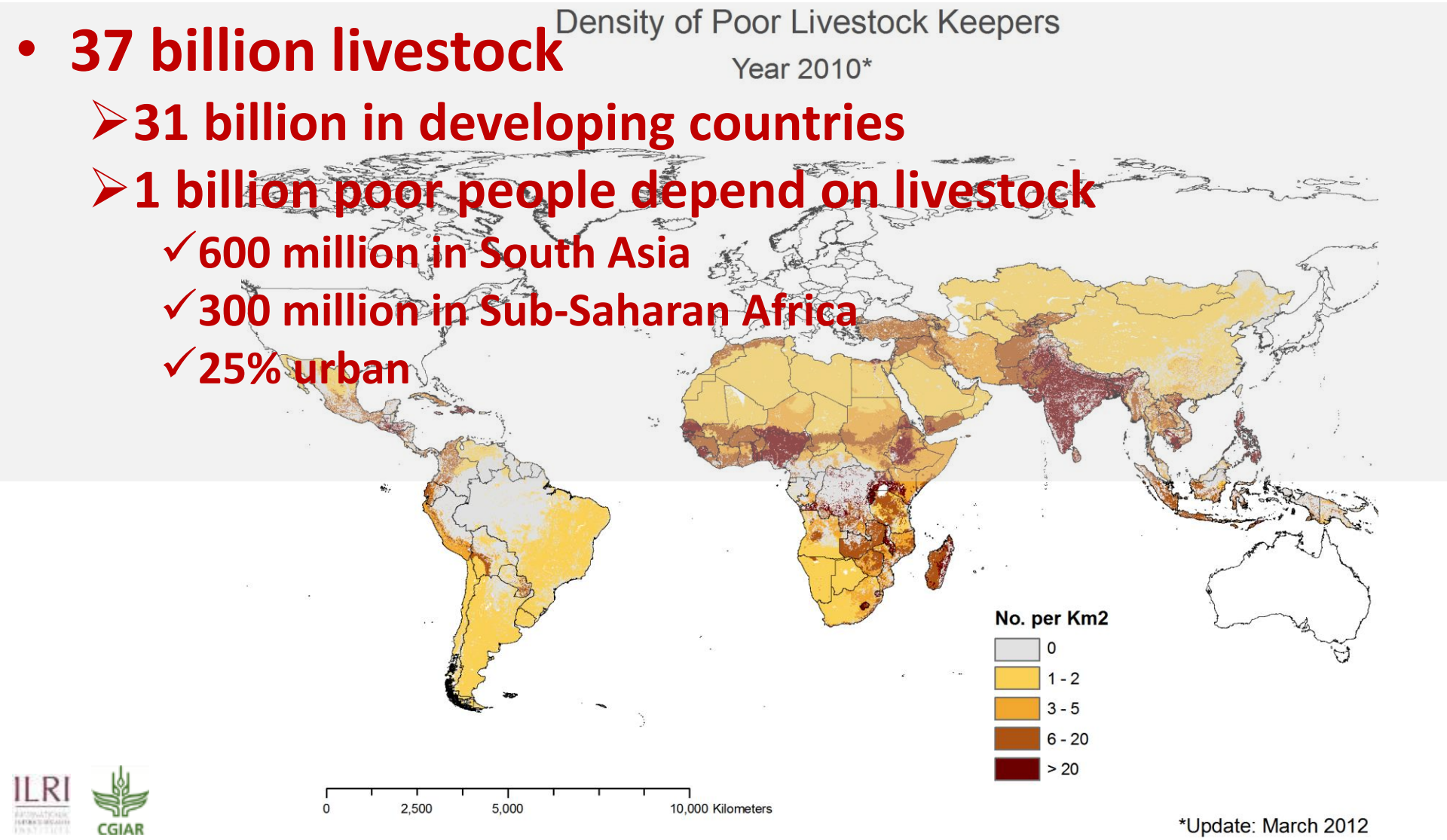
7 billions people…

- **37 billion livestock**
  - ➢ **31 billion in developing countries**
  - ➢ **1 billion poor people depend on livestock**
    - ✓ **600 million in South Asia**
    - ✓ **300 million in Sub-Saharan Africa**
    - ✓ **25% urban**



Bridging the gaps between demand and supply – global level

- 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

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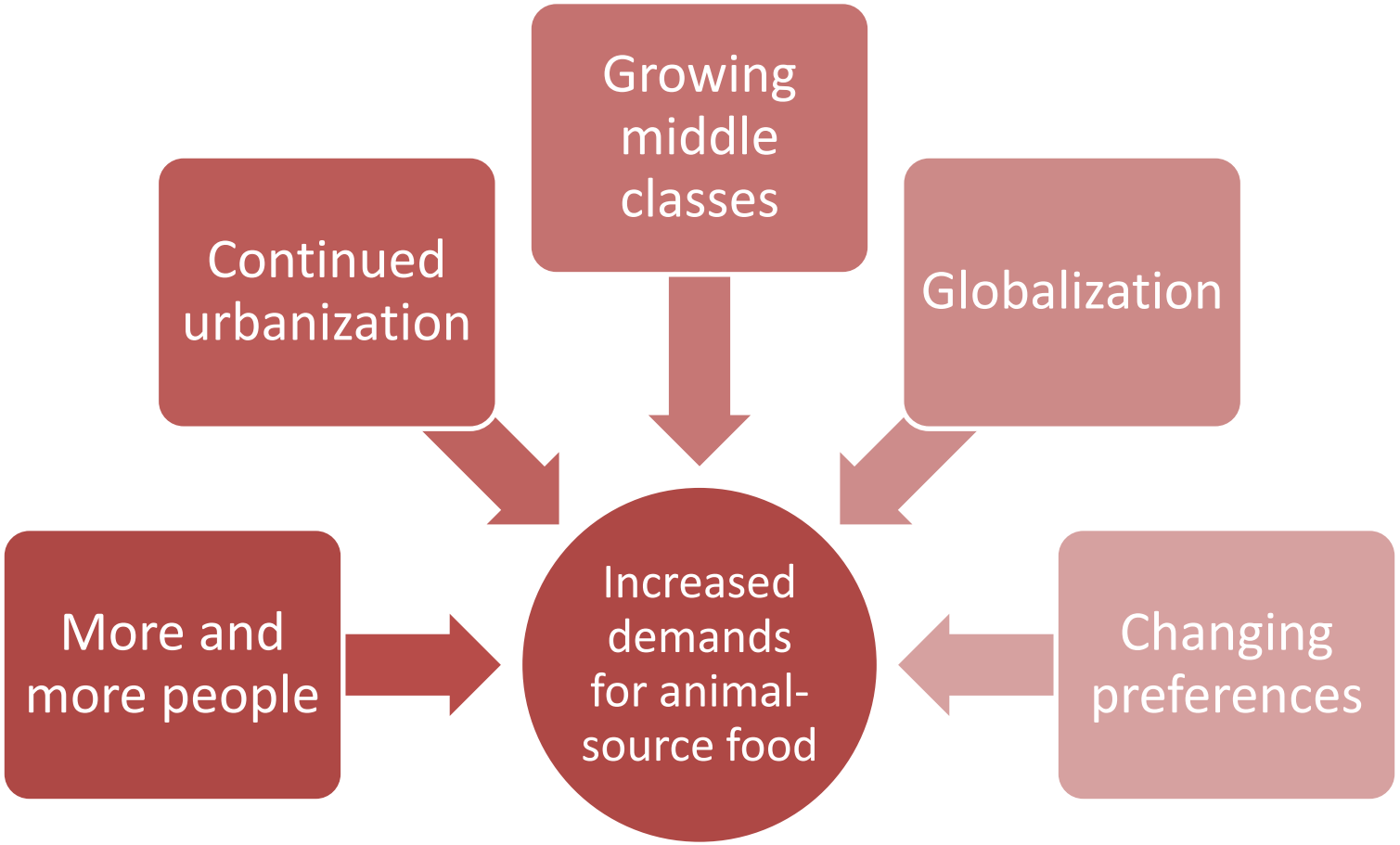
Why increasing demands?



The livestock revolution

- 1970-Mid 1990s
- Demand-driven, unlike the green revolution

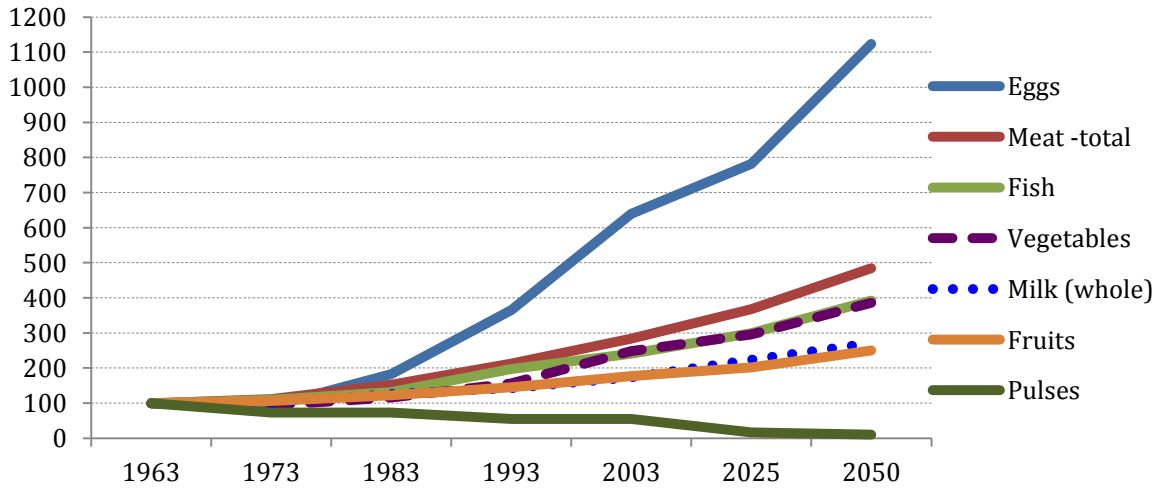
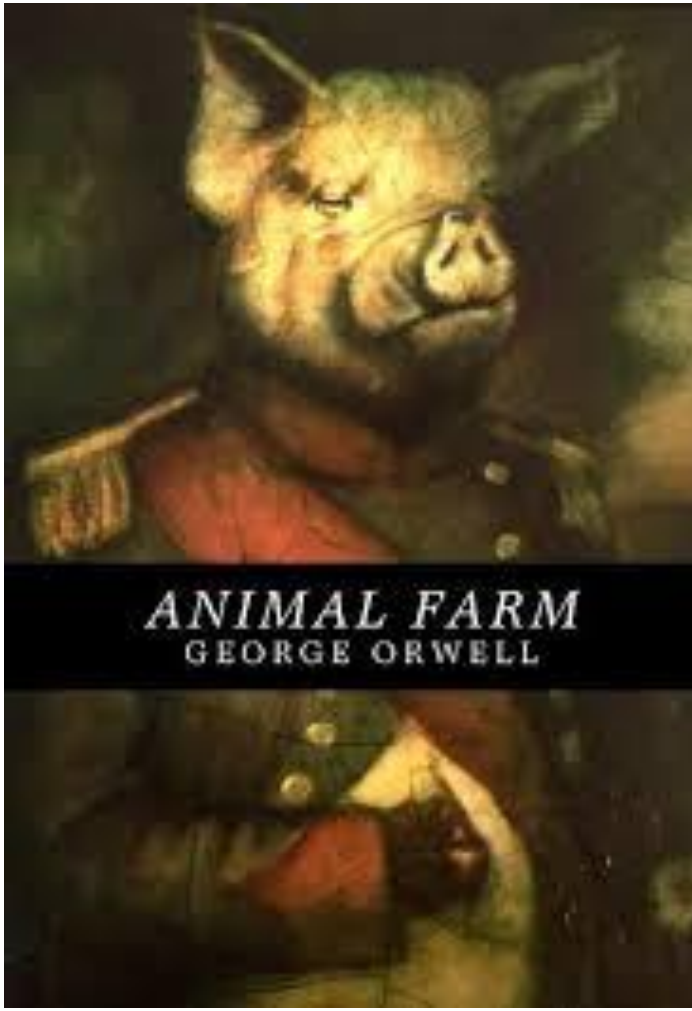


Figure 2: Increase in per capita consumption of perishables and pulses in developing countries with 1963 as index year (FAO, 2009).



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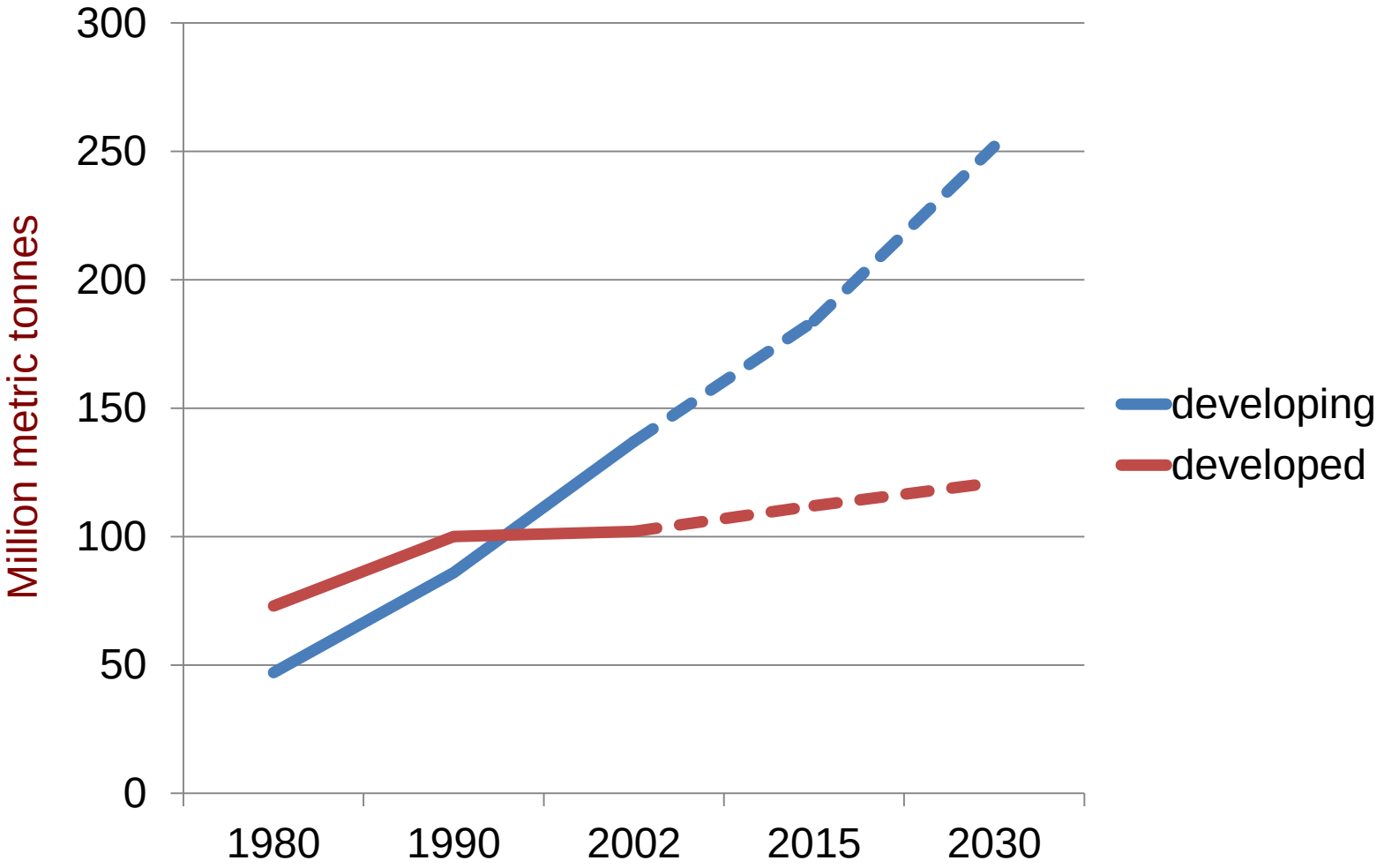
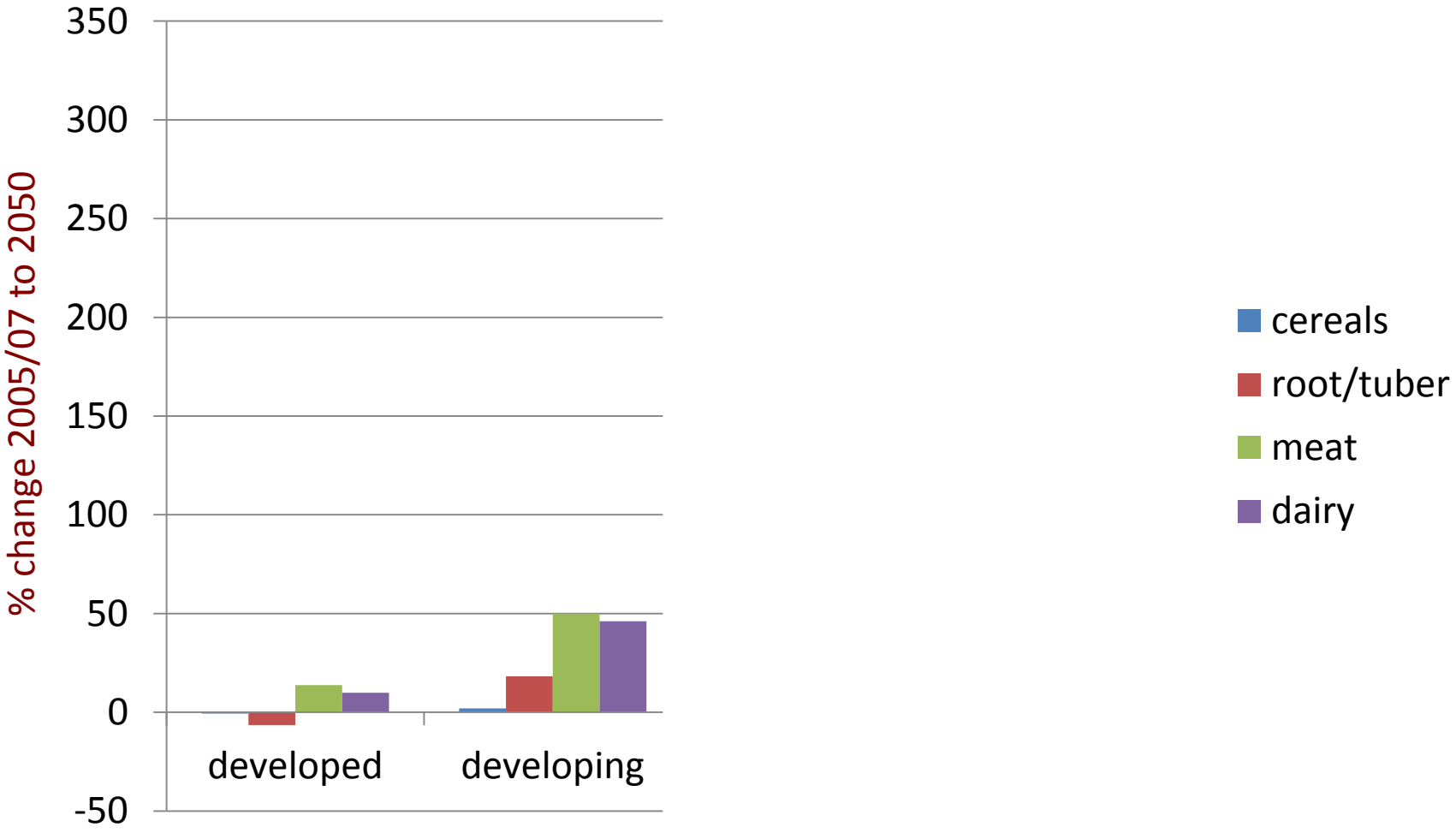
Gains in meat consumption in developing countries are outpacing those of developed



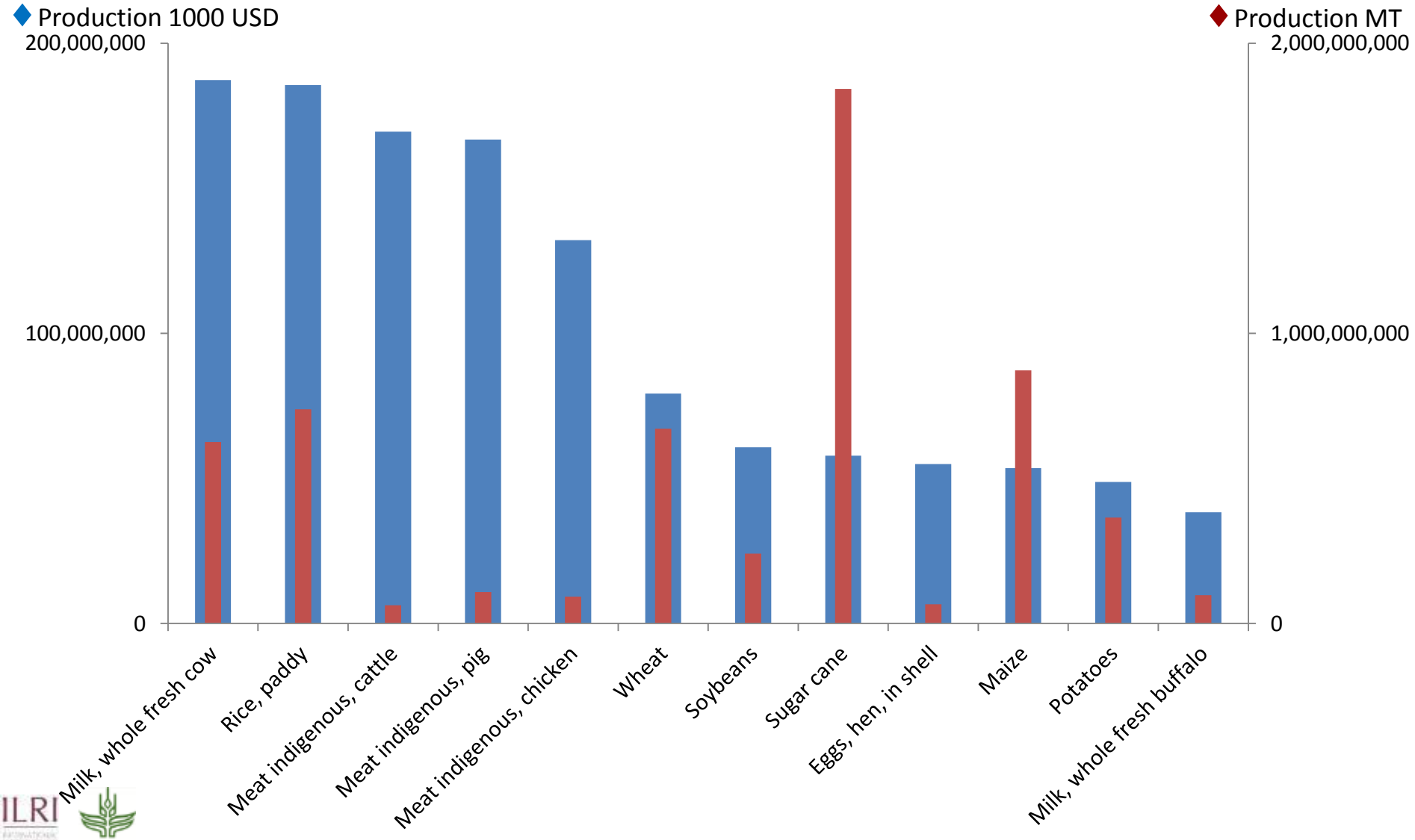
FAO 2006

Change in global and regional demand for food: Livestock and other commodities



Modified from Alexandratos and Bruinsma 2012

FAO statistics 2012



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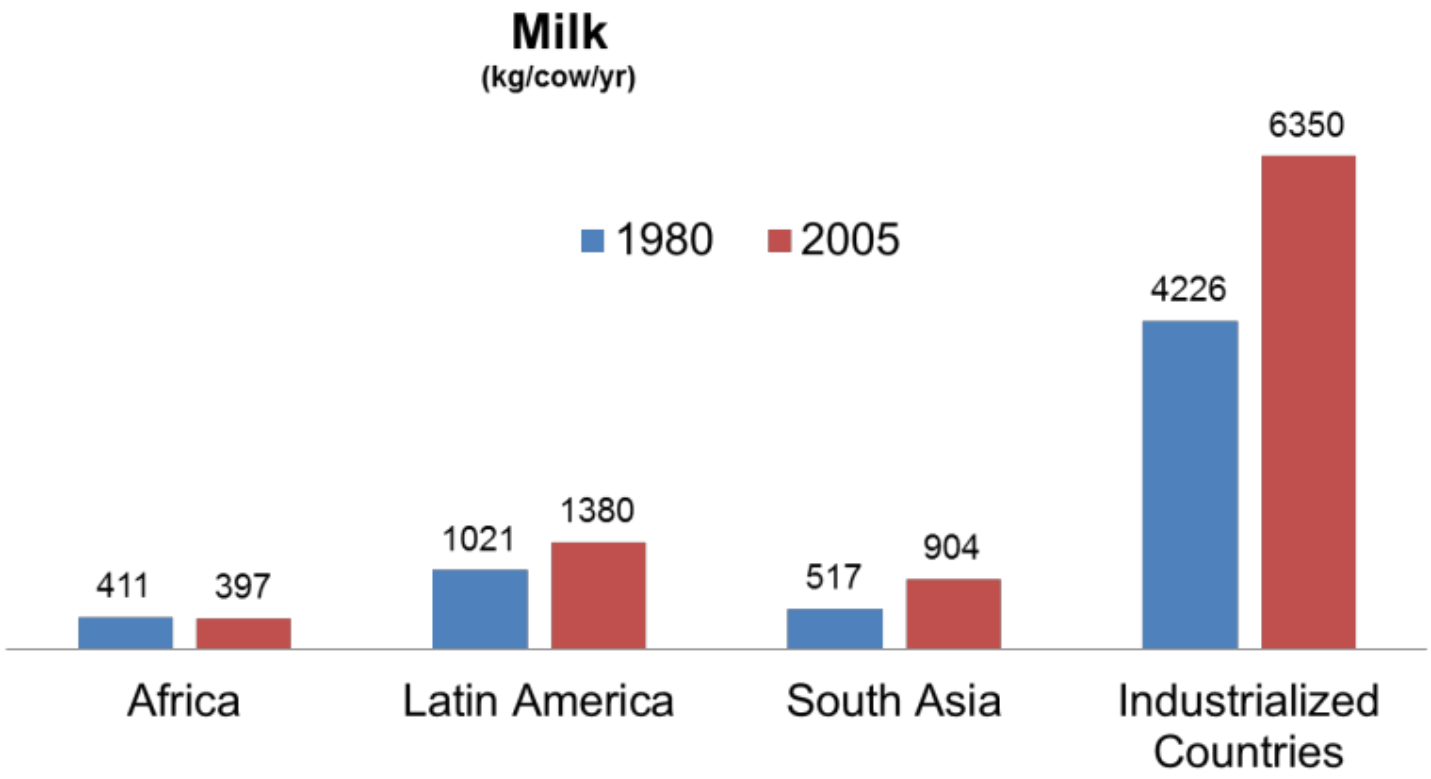
Big productivity gaps
-largely due to poor animal health, inadequate feed and low genetic potential

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



Steinfeld et al. 2006

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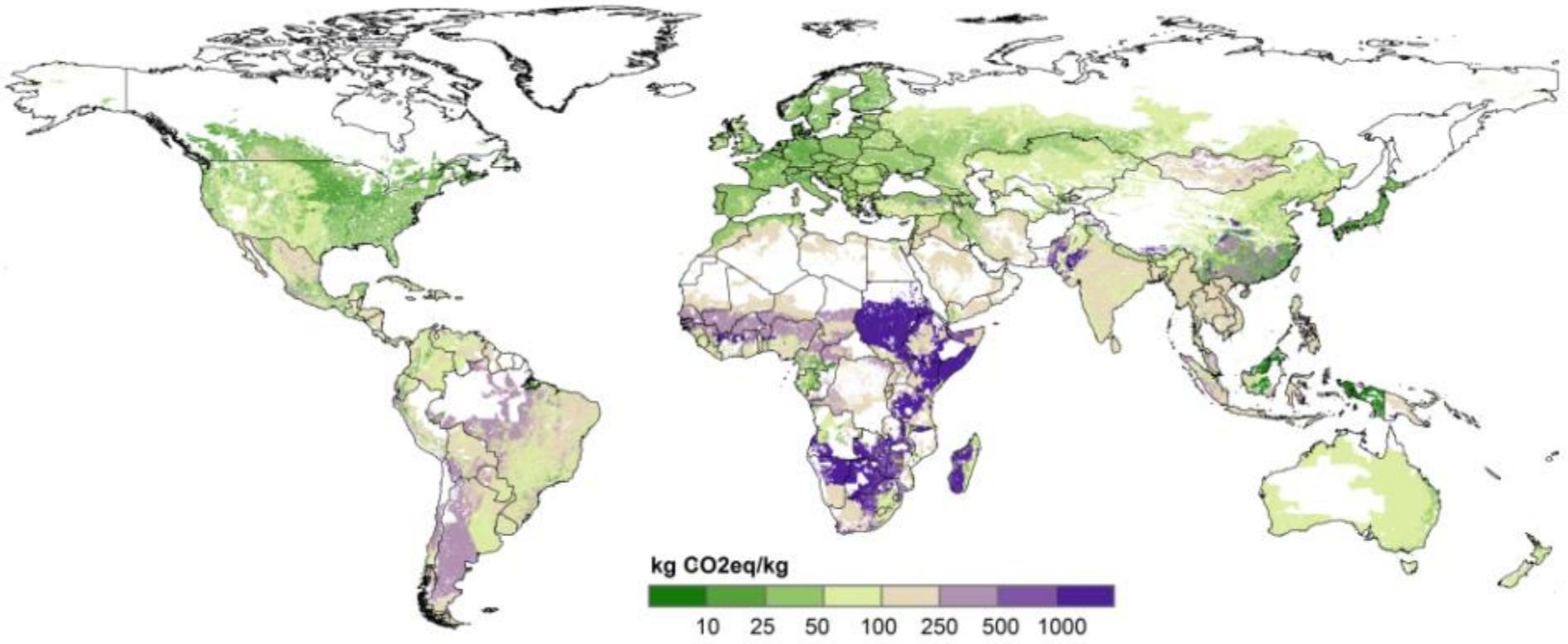
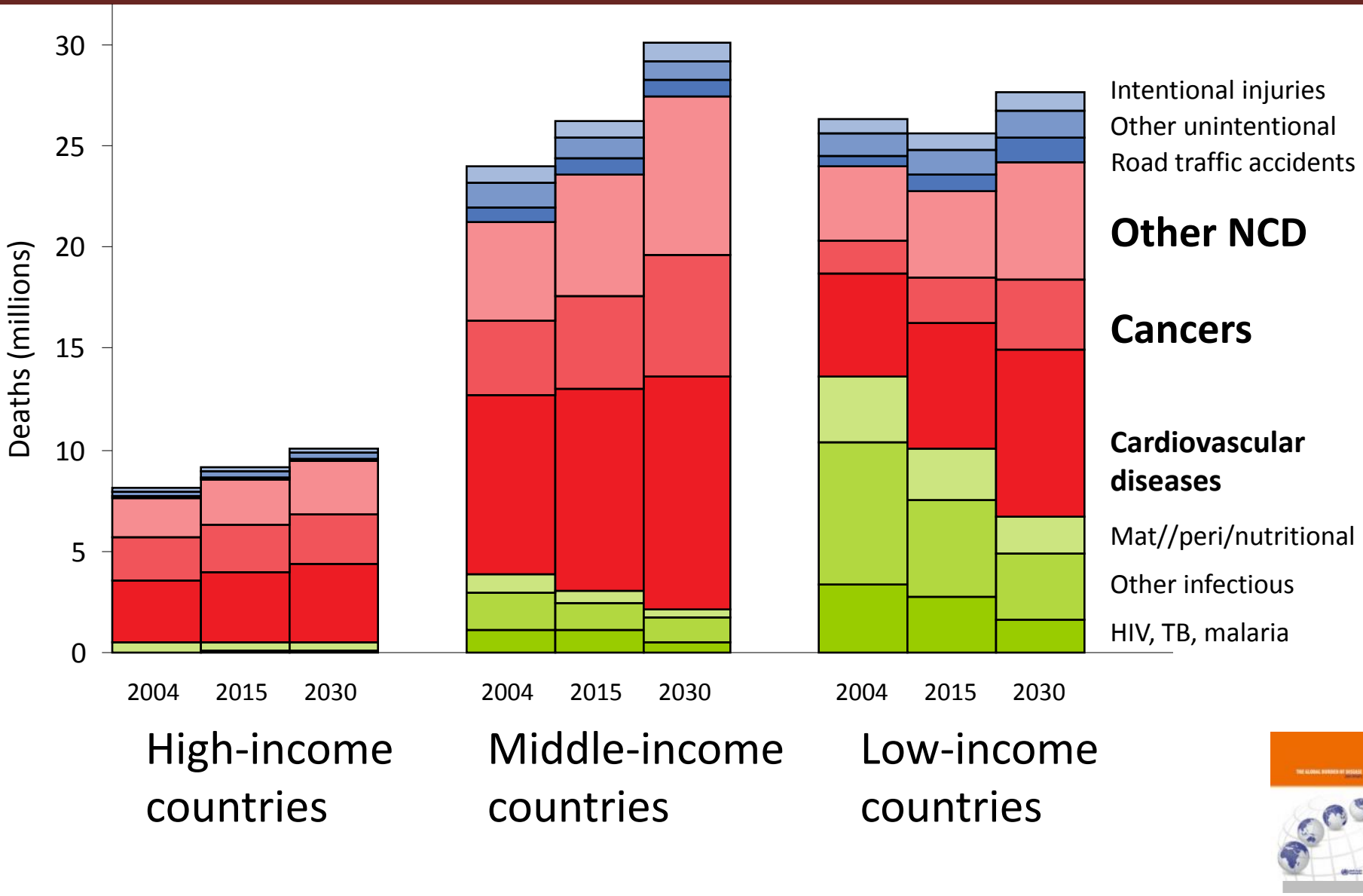
Example: Green house gases



GHG per kg of animal protein produced

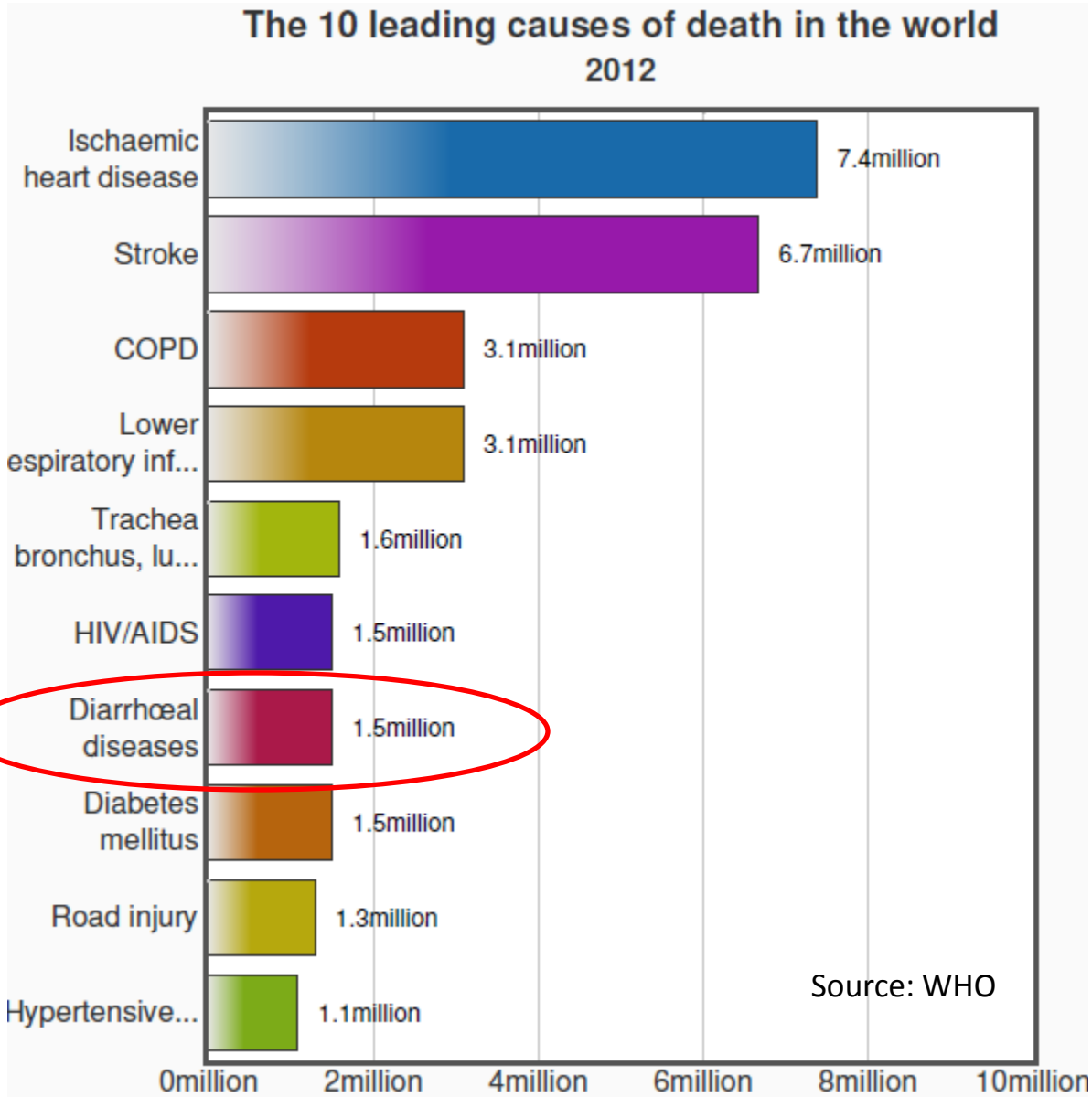
Herrero et al 2013

Mortality: global projection, 2004-2030



Infectious diseases

- Neglected
- Mainly affecting poor communities
- Chronic morbidity



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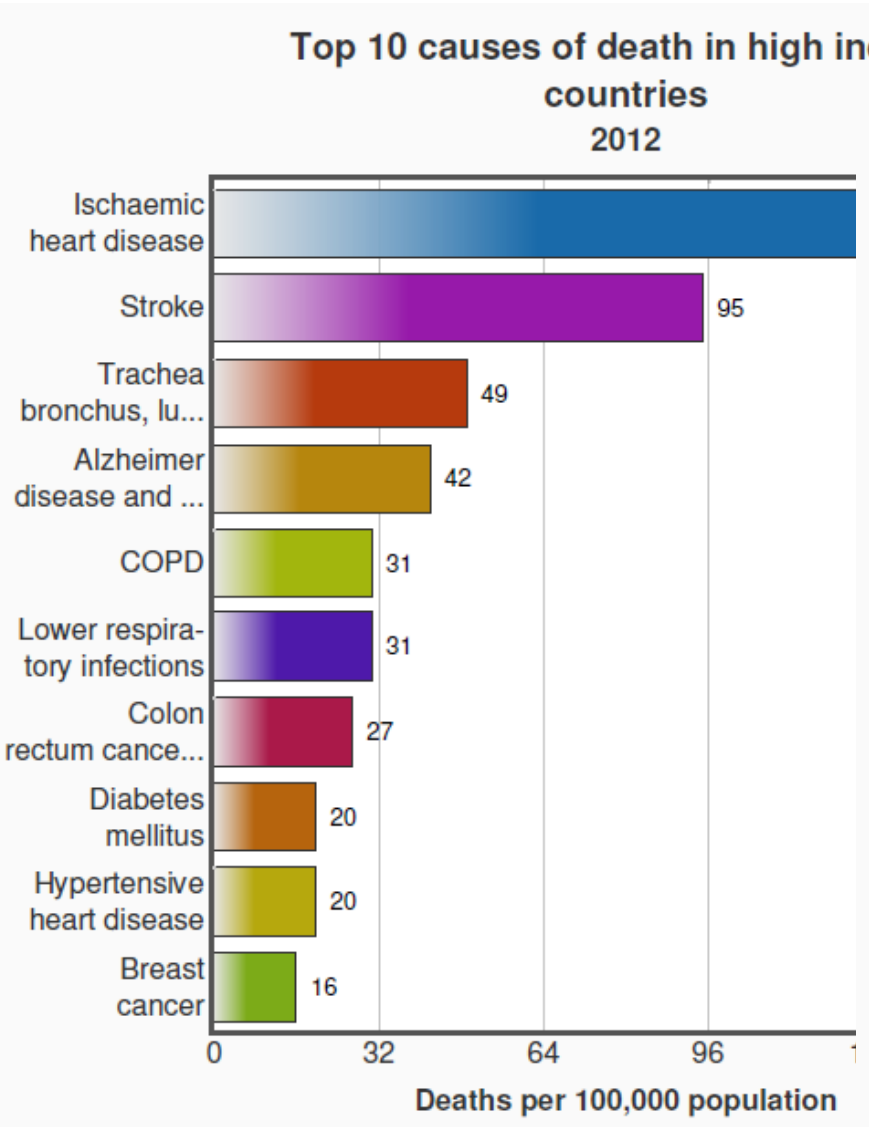
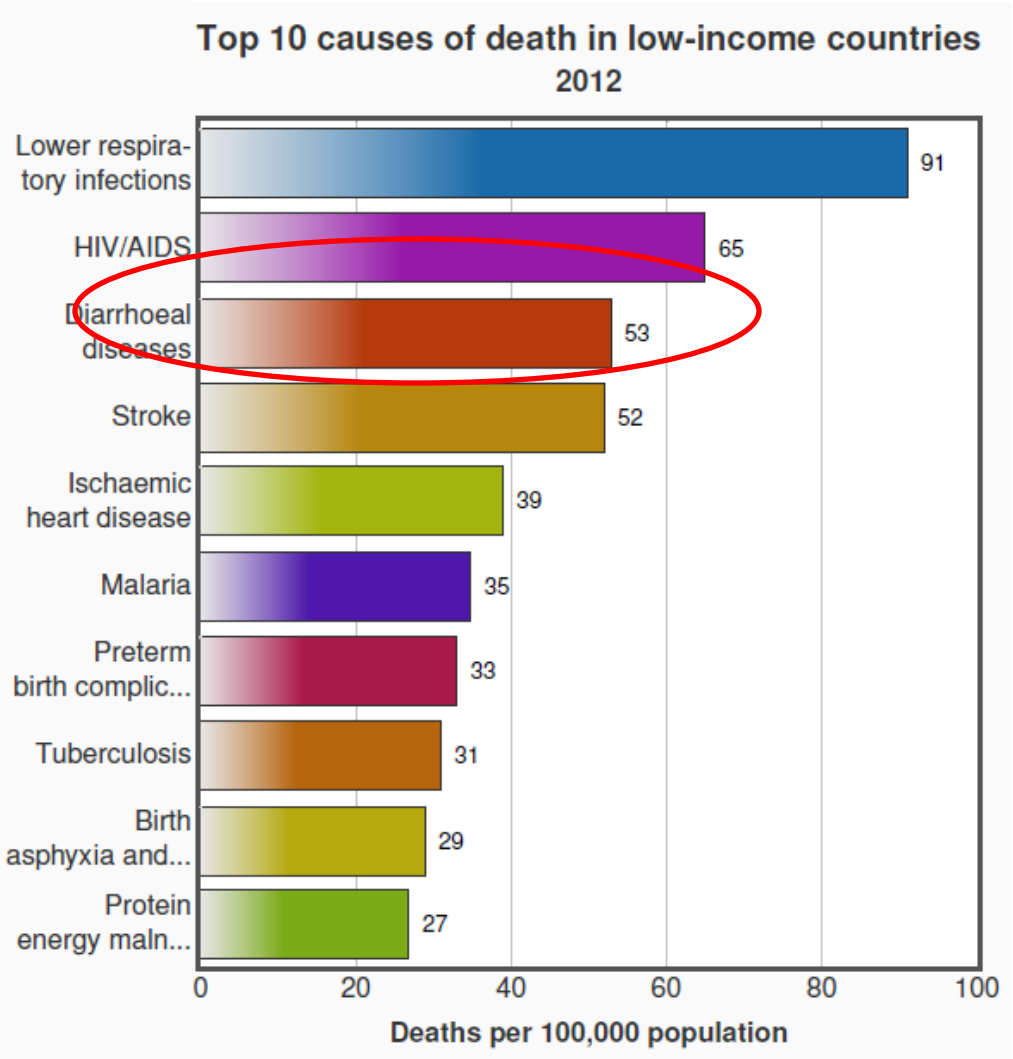
Endemic disease (neglected zoonoses)





Source: WHO

Costs of zoonotic disease

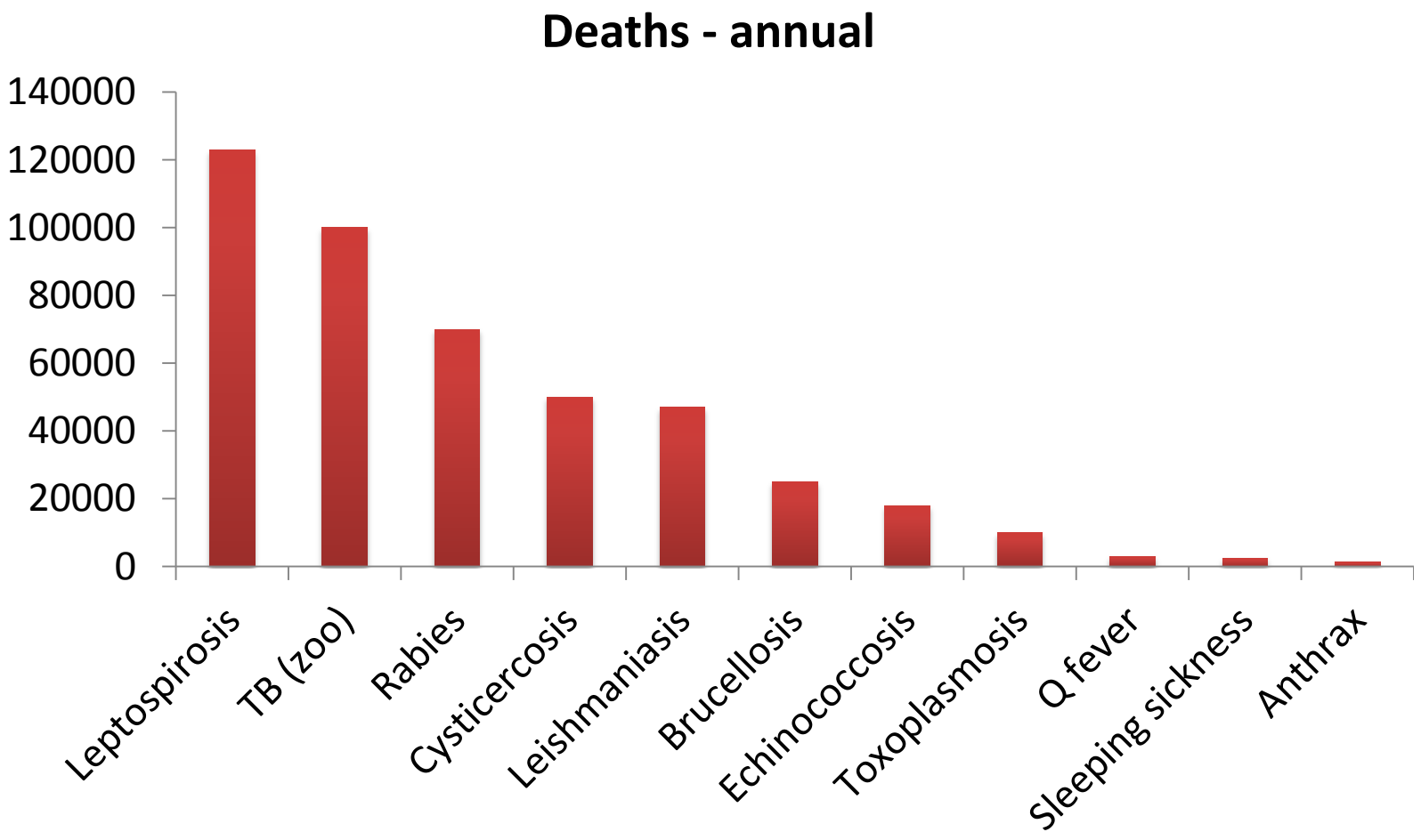
- **Zoonoses sicken 2.4 billion people, kill 2.2 million people and affect more than 1 in 7 livestock each year**
- **Cost $9 billion in lost productivity; $25 billion in animal mortality; and$50 billion in human health**

Map by ILRI, from original published in an ILRI report to DFID: *Mapping of Poverty and Likely Zoonoses Hotspots*, 2012.

Top Zoonoses (multiple burdens)

- Assessed 56 zoonoses from 6 listings: responsible 2.7 billion cases, 2.5 million deaths
- Top 13 responsible for 2.2 billion illnesses and most deaths
  - Wildlife interface
  - 9 have a major impact on livestock- affect 1 out of 7
  - All 13 amenable to on-farm intervention

Zoonoses



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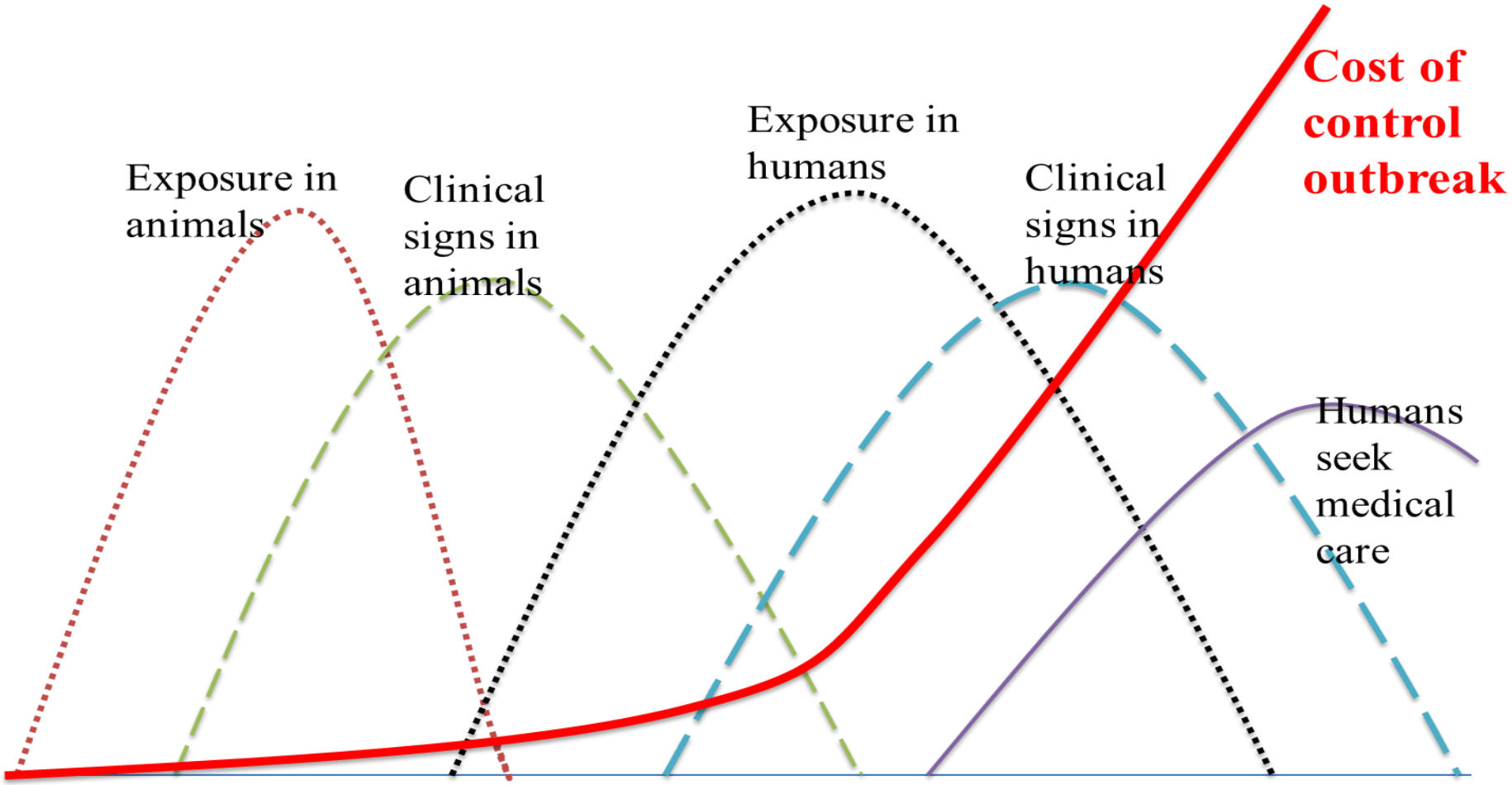
Timely detection and response



Adapted from IQM (2009)

Benefits of controlling zoonoses in animals and along the value chain

- Credible economic cost benefit studies (n=13)
  - Average benefit cost ratio 6:1
  - Median 4:1
  - Range 1.1-19.8

Developing countries	**3.7**
Developed countries	**7.4**

- Implies $85 billion losses could be averted by $21 billion expenditure

The business case for One Health

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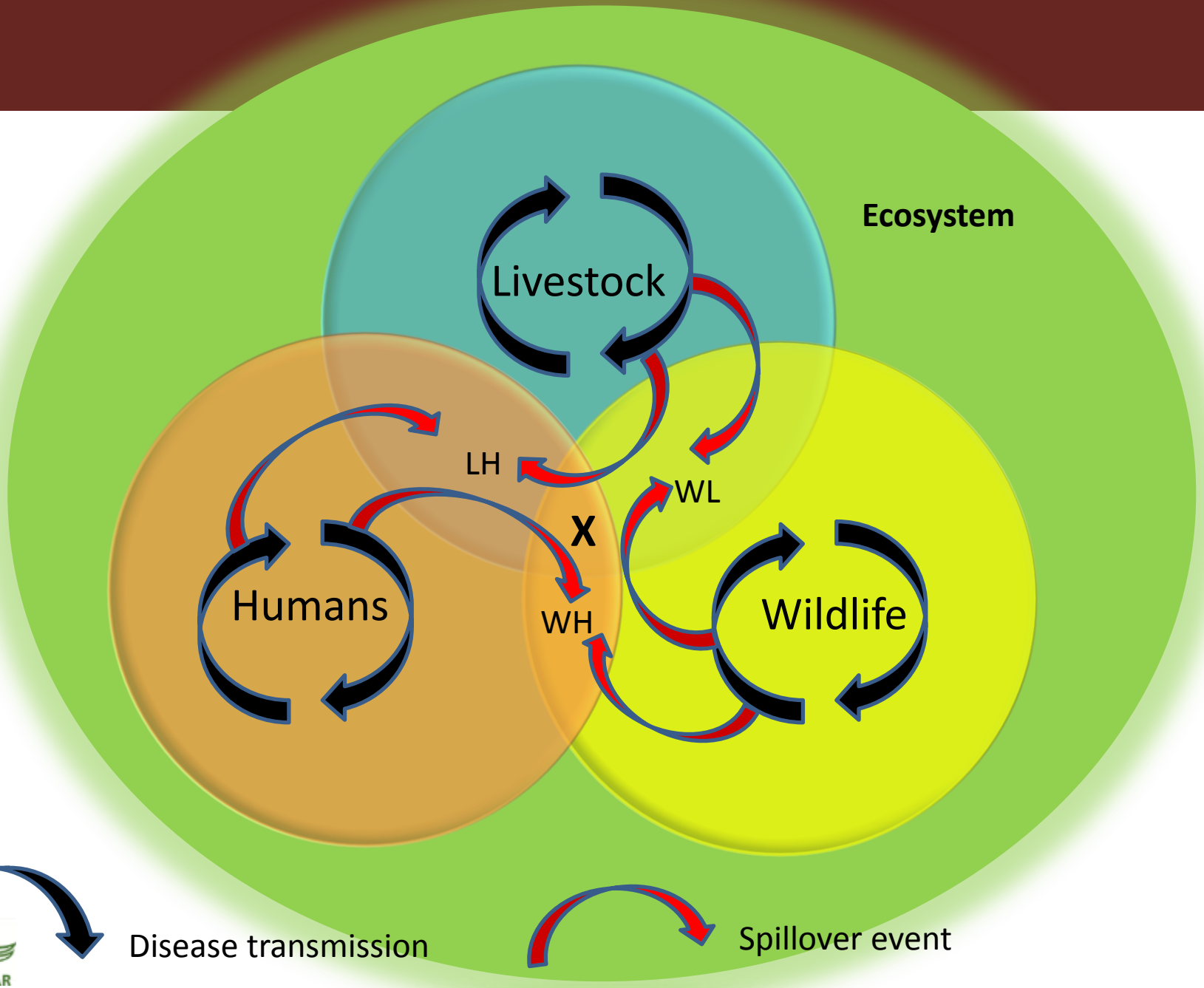
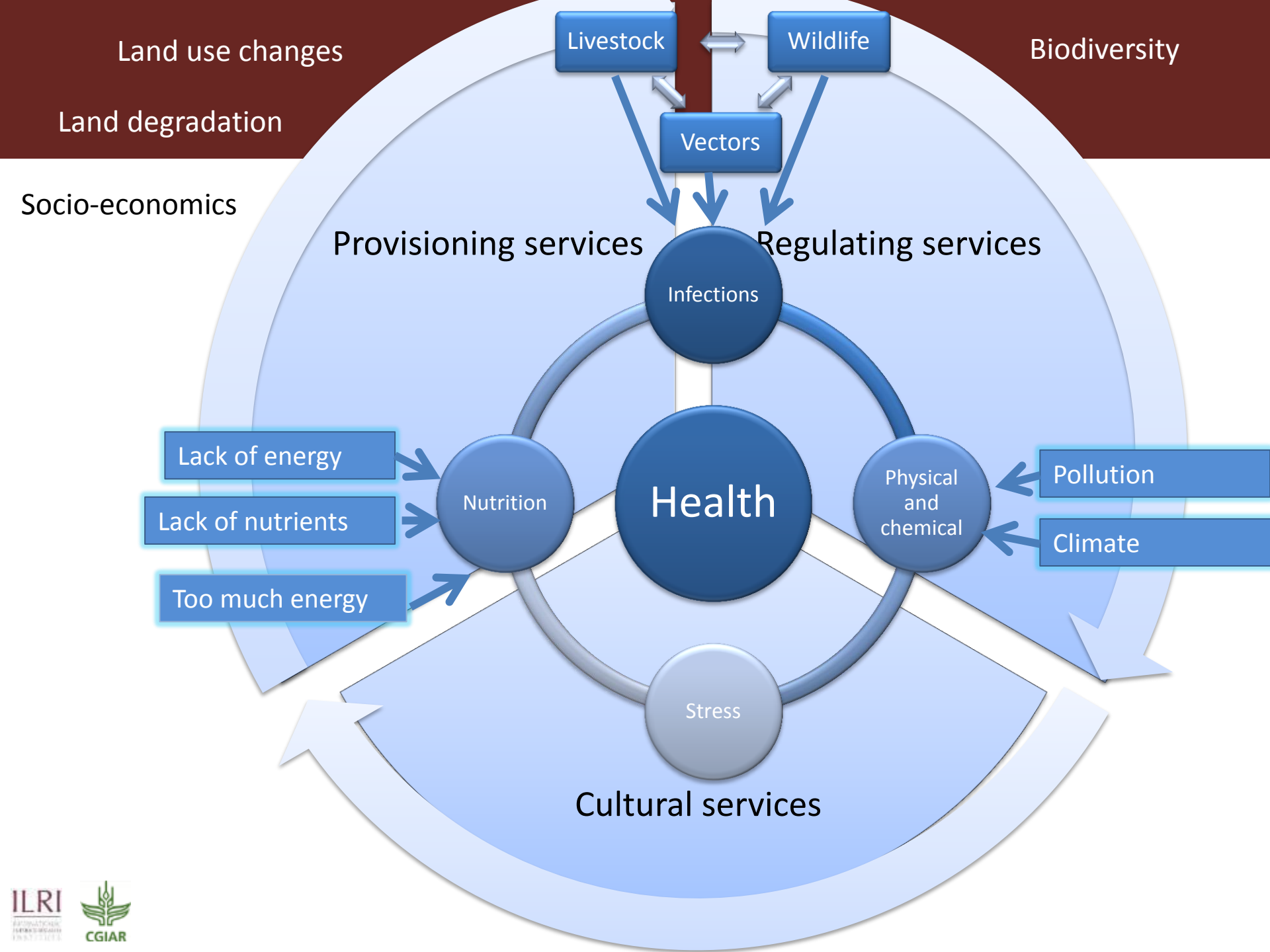
This article outlines a pathway to develop the business case for One Health. It describes the origin and development of One Health and then identifies five potential areas where One Health can add value and reduce costs. These are: (1) sharing health resources between the medical and veterinary sectors; (2) controlling zoonoses in animal reservoirs; (3) early detection and response to emerging diseases; (4) prevention of pandemics; and (5) generating insights and adding value to health research and development. Examples are given for each category along with preliminary estimates of the potential savings from adopting the One Health approach. The literature reviewed suggests that one dollar invested in One Health can generate five dollars worth of benefits and a global investment of US$25 billion over 10 years could generate benefits worth at least US$125 billion. Conservation implications: the time has come to make the bigger case for massive investment in One Health in order to transform the management of neglected and emerging zoonoses and to save the lives of millions of people and hundreds of millions of animals whose production supports and nourishes billions of impoverished people per annum.

Introduction

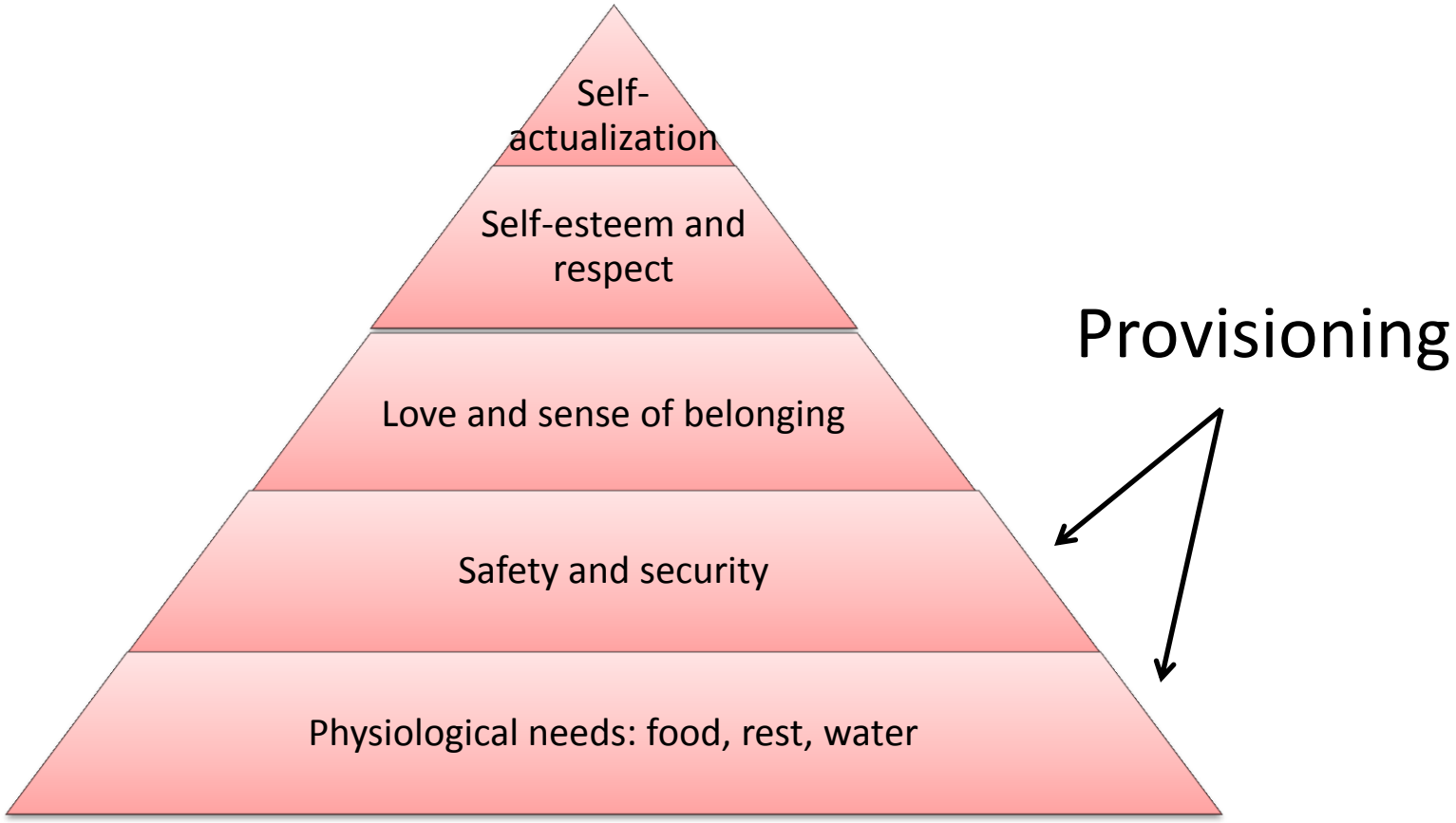
This article is based on an invited keynote presentation given at the Southern African Centre for


Ecosystem
Livestock
LH
WL
X
Humans
WH
Wildlife
Disease transmission
Spillover event


Land use changes
Land degradation
Biodiversity
Socio-economics
Livestock
Wildlife
Vectors
Provisioning services
Regulating services
Infections
Lack of energy
Lack of nutrients
Too much energy
Nutrition
Health
Physical and chemical
Pollution
Climate
Stress
Cultural services

Ecosystem services – and disease emergence

Ecosystem service	Importance	Effect of decrease
Provisioning	Economics, livelihoods	Increased poverty
Regulating	Health, environment	Increased disease
Cultural	Well-being, recreation	Increased stress?
Supporting	Basis for the other services	Increase in all above



Hierarchy of needs according to Maslow.

Example: Mycotoxins in the food

An example of trade-offs between food security and food safety

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Never heard about aflatoxins?

- Acute outbreaks can claim 100s of lives (Kenya outbreak 2004-2005 150 known fatal cases)
- 4.5 billion people chronically exposed (estimate by US CDC)
  - Cancer
  - Immunosupression
  - Stunting

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Economic flow

Agricultural services

Veterinary services

Feed producer

Feed seller

Farmer

Milk retailer

Consumer

Aflatoxin flow

Corn/feed purchased

AB1

Treatments

AB1-> AM1

AB1

AM1

Corn/feed produced at farm

AB1

AM1

Milk produced at farm

Human exposure

Farmer

Consumer

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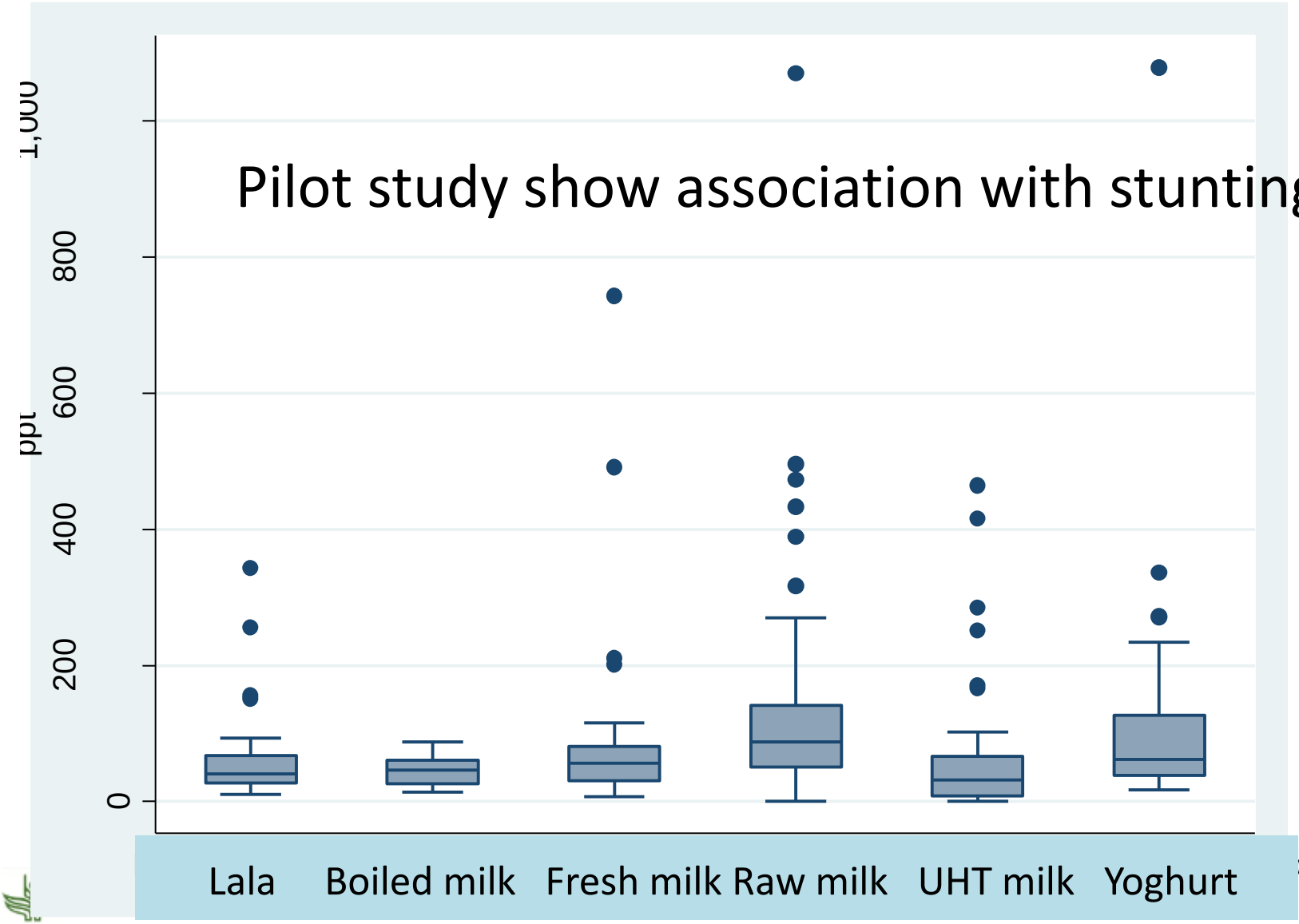
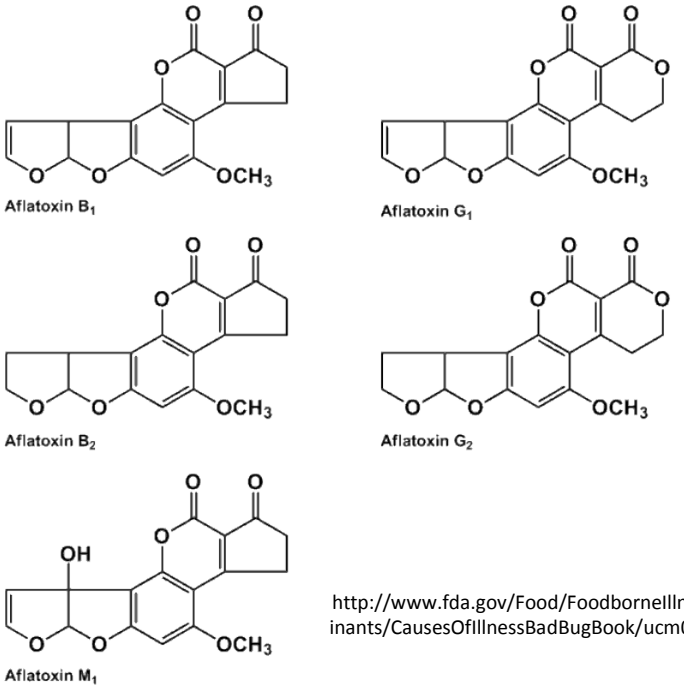
Dairy products and levels of aflatoxin



What are aflatoxins?

- Aflatoxin “discovered” as the cause of Turkey X disease, 1960s
- Toxin produced by *Aspergillus* spp, mainly *Aspergillus flavus* and *Aspergillus parasiticus*
- *Aspergillus flavus* toxin



http://www.fda.gov/Food/FoodborneIllnessContaminants/CausesOfIllnessBadBugBook/ucm070664.htm

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What promotes the fungal growth?

- Pre-harvest: damage by insects, draughts
    - Insects cause damage and are mechanical vectors
- Post-harvest: Poor storage conditions

Improper drying of grains - Different grains being dried on roadside with rains looming in the horizon. Photo by IITA

Major effects on trade

When EU harmonized the limits:

- Decrease to 4 ppb: saves 2 lives per billion
- Europe receives 57% of African and Middle eastern exports
- Estimated to decrease African exports by 64% (670 million USD)
- Peanuts one of Africa's few export commodities (Gambia, Senegal, South Africa)

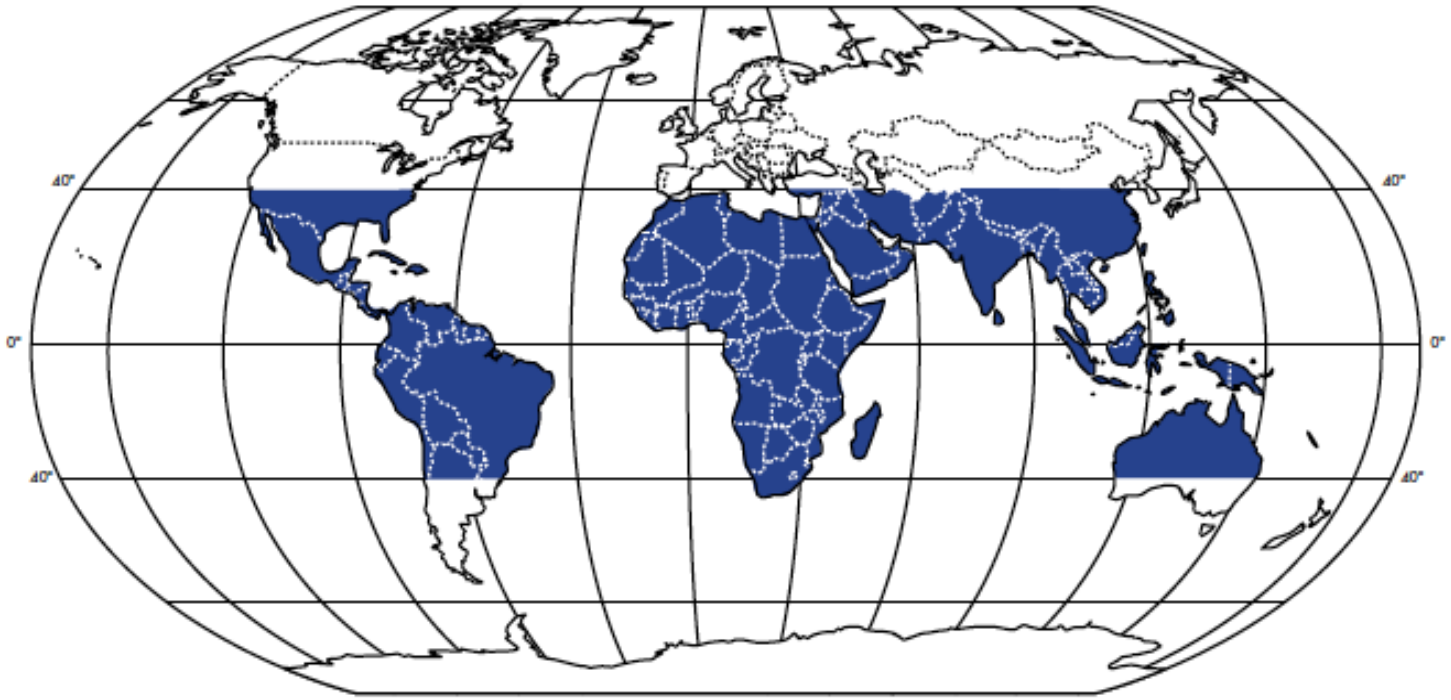
The consequences of export barriers

- The best products are exported
- The bad products are left to the national markets

Photo by IITA.

Aflatoxins are a global issue

Figure 1. Areas and Populations at Risk of Chronic Exposure to Uncontrolled Aflatoxin Contamination



Source: Williams et al., 2008

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DAILY NATION
Wednesday
November 9, 2011

Kebs tests showed Unimix was bad

Photo/FILE Families queue to receive relief food from the Kenya Red Cross Society at Lokichar in Turkana South District in the recent past.

Kids at centre of toxic food saga are 270,000

By CATHERINE KARONGO | November 3, 2011

School Children /FILE

NAIROBI, Kenya, Nov 3 – The number of school going children feared to have consumed the aflatoxin contaminated Unimix during the Kenyans4Kenya initiative is more than 270,000 and not 60,000 as earlier thought.

Public Health Minister Beth Mugo said on Thursday that 726 schools had been supplied with the contaminated food at the time of the recall.

"My ministry in collaboration with the Kenya Red Cross Society and manufacturers are still recalling the consignment which was distributed irrespective of whether it is suspected to be contaminated or not," the Public Health Minister said.

While issuing a ministerial statement in Parliament, Mugo blamed the Kenya Red Cross Society for failing to immediately inform the ministry about the contamination.

She said the ministry was notified of the contamination on October 6 by one of the manufacturers, Proctor & Allan.

Aflatoxins are a political issue

DAILY NATION

Kenya alert over 2.3m bags of bad maize

SHARE BOOKMARK PRINT RATING

Farmers spread their maize to dry in Kibwezi. Researchers say spreading maize on the ground increases its contact with the soil, where the fungus that produces aflatoxins resides. Photo/FILE

By LUCAS BARASA
Posted Monday, May 31 2010 at 18:44

How is ILRI working with this problem?

- Exposure of aflatoxin
  - Levels of aflatoxin
  - Consumption of contaminated products
- Who are the consumers?
  - Children
  - Pregnant and nursing mothers
  - The first 1000 days.
- Where is the problems?
  - Risk mapping

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How is ILRI working with this problem?

- Can we prevent aflatoxins?
  - Dryers, new technologies etc
- What can we do with contaminated products
  - Biodegradation
  - Binders
  - Policy and regulations
- What will happen in the future?
  - Predictive forecasting
  - Climate change

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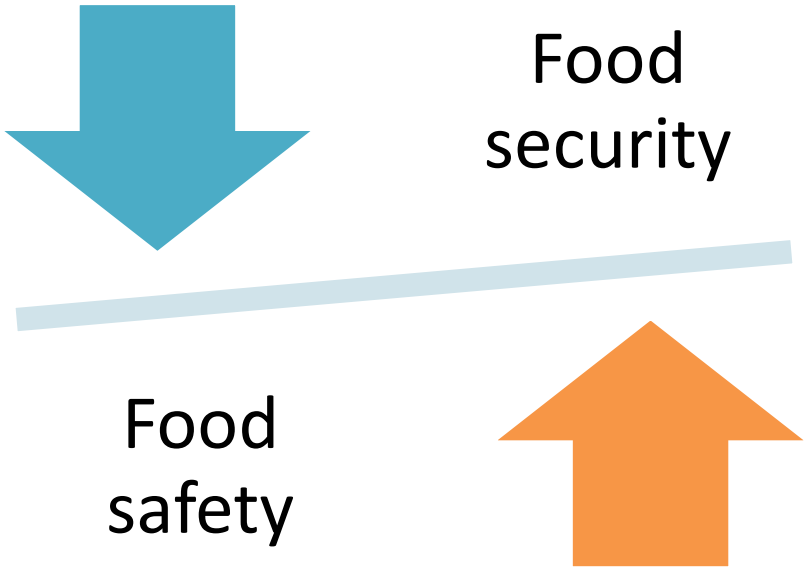
What can we do with the results – Do no harm!



Example- Milk production in India

Is there always a trade-off between food safety and food security?

IDRC CRDI

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KNOWLEDGE TO ACTION phfi PUBLIC HEALTH FOUNDATION OF INDIA

OFID The OPEC Fund for International Development Uniting against Poverty

Milk consumption in India

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

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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
- Animal-source food over-represented as a cause

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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*

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The importance of dairy production- Assam

- One of the poorest states
- Over 30 million people, 27% rural
- Agriculture accounts for ¼ of the state domestic product
- 8.5 million cattle, >90% indigenous
- 97% marketed in the informal traditional market
- Most initiatives focus on the organized sector

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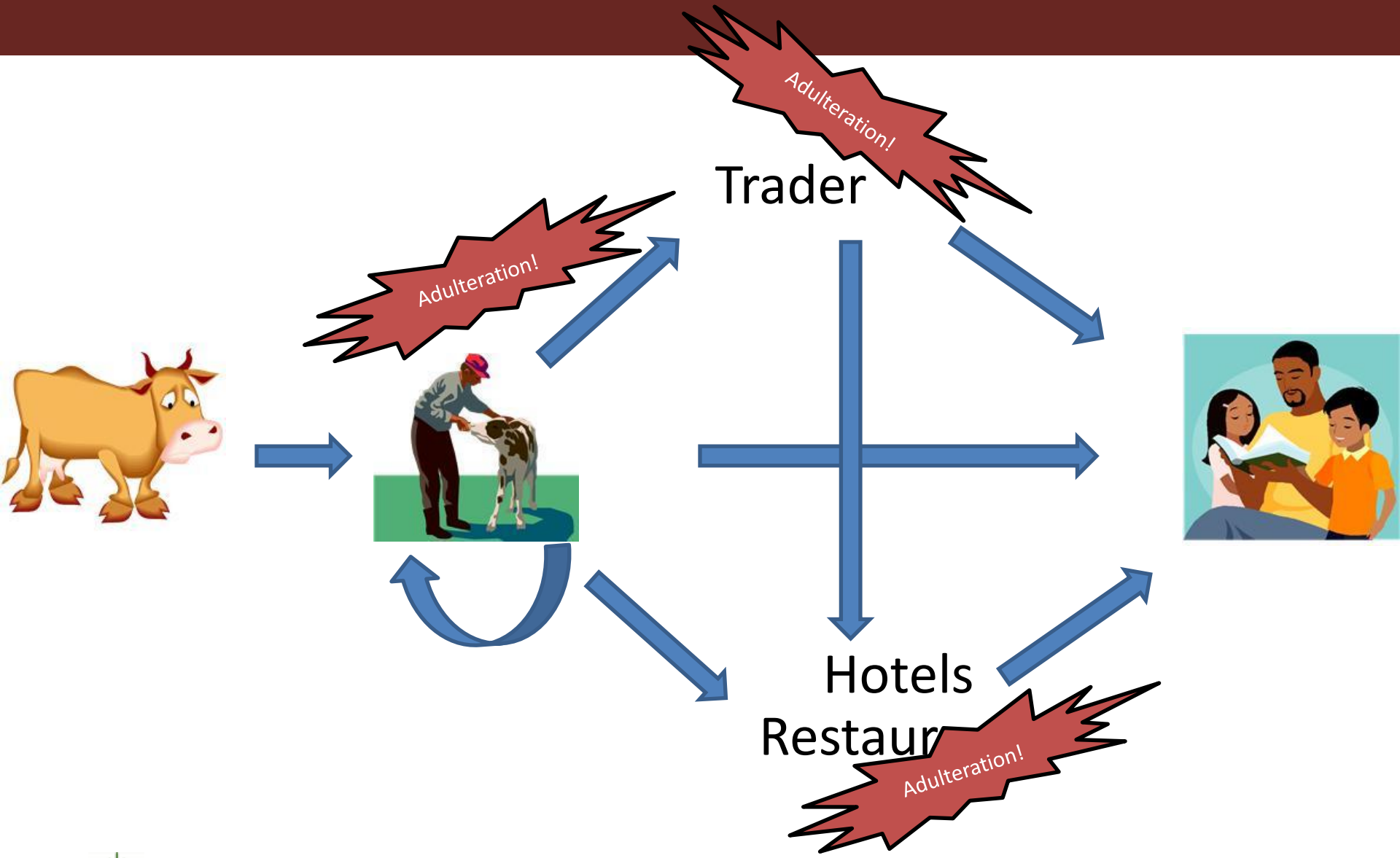
Pathways


Adulteration!
Trader
Adulteration!
Hotels
Restaur
Adulteration!

Adulteration- a problem?

1. Producers in 2009: 0-66% water added
2. Traders in 2009: 2-55% water added
3. Producers in 2012: between 0-28 % water added
4. Traders in 2012: 0-31 % water added

Adulteration occurs at every step!

Consumers can not tell the difference!

No clear association with bacterial count

Can diseases be transmitted from

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

Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012

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Can diseases be transmitted by ill a

	Believe diseases can be transmitted from milk
Producers	
2009	13.0% (52/401)
2012	35.4% (57/161)***
Trained (2012)	64.2% (34/53)***
Untrained (2012)	21.3% (23/108)
Traders	
2009	9.1% (16/175)
2012	41.5% (93/224)***
Trained (2012)	64.8% (79/122)***
Untrained (2012)	13.7% (14/102)

Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012

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Which diseases can be

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

Comparison between 2009 and 2012 survey
Comparison between trained and untrained 2012
Comparison between 2009 and untrained 2012

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What was the food security effect?

- Farmers reported healthier animals, less mastitis, better production

	Average milk production in liters per cow and day 2 years ago/before ILRI training	Average milk production in liters per cow and day now
Trained farmers	**7.0 (range 2.5-10)**	**7.8 (range 3-15)**
Untrained farmers	**7.3 (range 2.5-14)**	**6.8 (range 2.5-14)**

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Why a veterinary public health question?

What is necessary for health?

Example: Dynamic drivers of disease in Africa

One action- different outcomes

espa ecosystem services for poverty alleviation

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Livestock and the risk of diseases


ILRI/James Wakhungu


ILRI/Shiphatu Thupitor


ILRI/Dave Elsworth

ZOONOSES and livestock disease

58% of human pathogens are zoonotic
(Woolhouse et al, 2005)

- **Endemic disease**
  (diseases of poverty)
  Neglected tropical diseases
- ***"Endemic epidemics"***
- **Emerging disease**
  75% zoonotic

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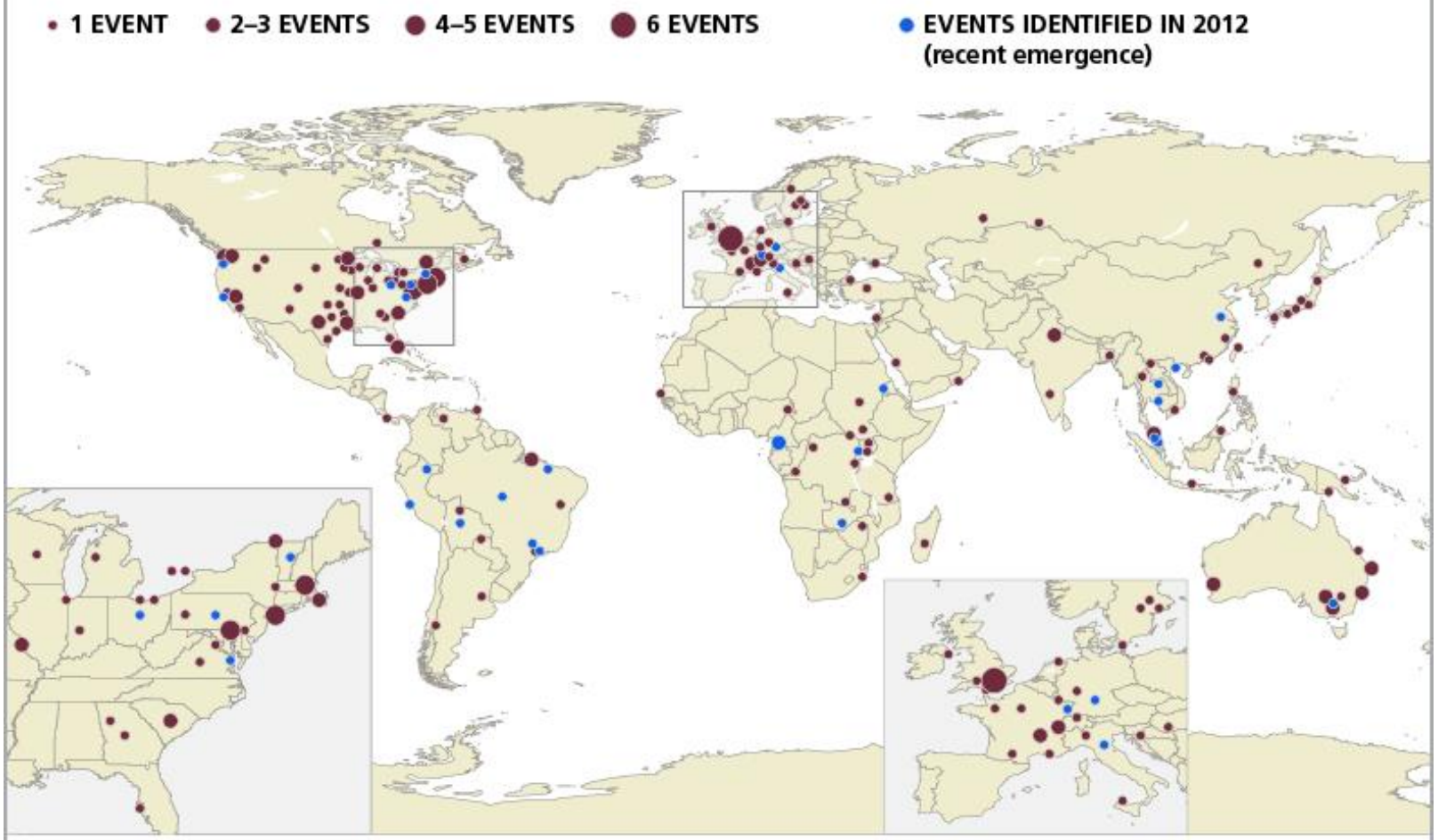
Emerging Zoonotic Disease Events, 1940–2012

Potential Hotspots in US, Western Europe, Brazil, Southeast Asia

Most emerging human diseases come from animals. This map locates zoonotic events over the past 72 years, with recent events (identified by an ILRI-led study in 2012) in blue. Like earlier analyses, the study shows western Europe and western USA are hotspots; recent events, however, show an increasingly higher representation of developing countries.



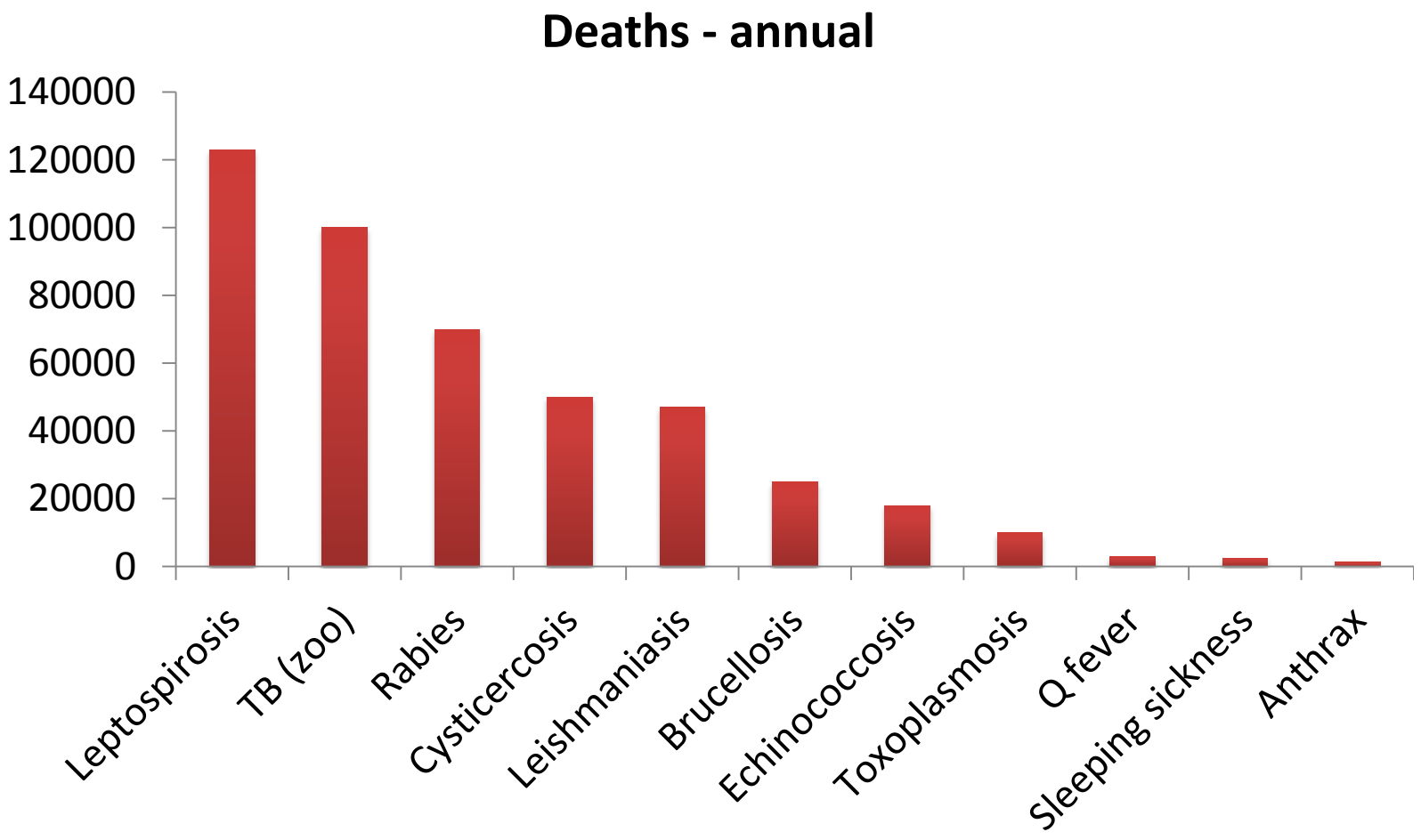
Map by IOZ, published in an ILRI report to DFID: *Mapping of Poverty and Likely Zoonoses Hotspots*, 2012.

Top Zoonoses (multiple burdens)

- Assessed 56 zoonoses from 6 listings: responsible 2.7 billion cases, 2.5 million deaths
- Top 13 responsible for 2.2 billion illnesses and most deaths
  - Wildlife interface
  - 9 have a major impact on livestock- affect 1 out of 7
  - All 13 amenable to on-farm intervention

  World bank (2010) estimates for last century :
  - direct costs of zoonotic outbreaks >20 billion USD
  - indirect costs 200 billion USD

Zoonoses



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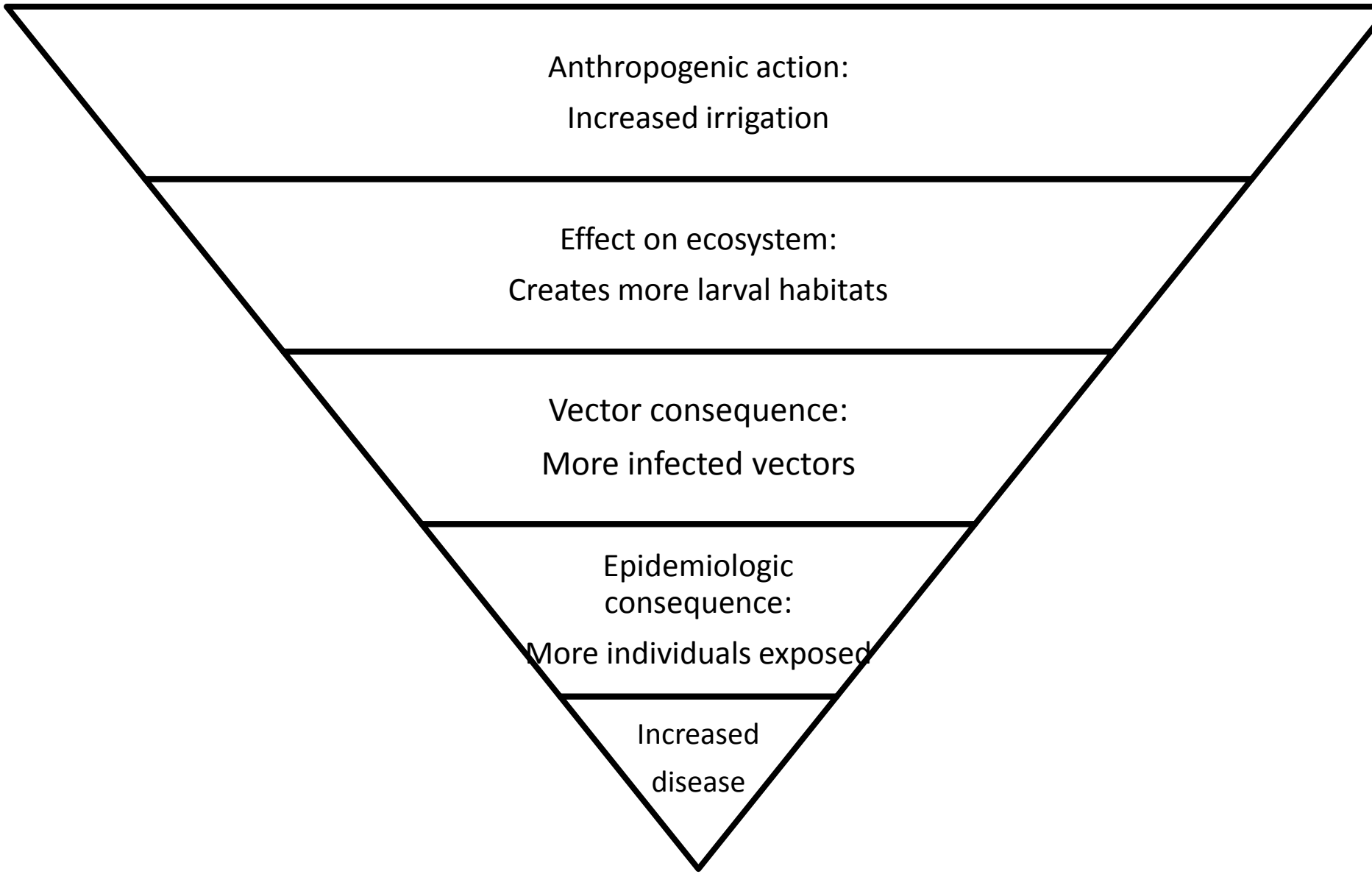
Case study- irrigation and disease



Case study: Kenya

- Rift valley fever/ mosquitoes
- Land use changes
  - Protected area vs irrigated area
  - Pastoralist areas

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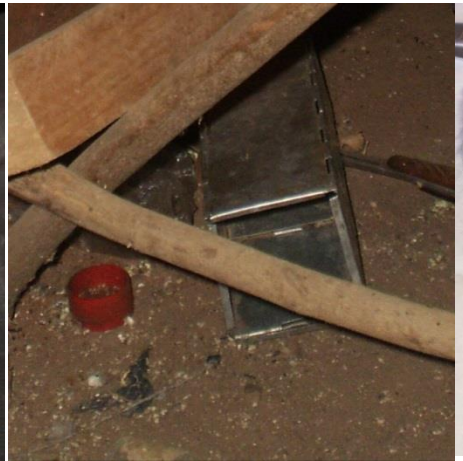
Case study: Kenya

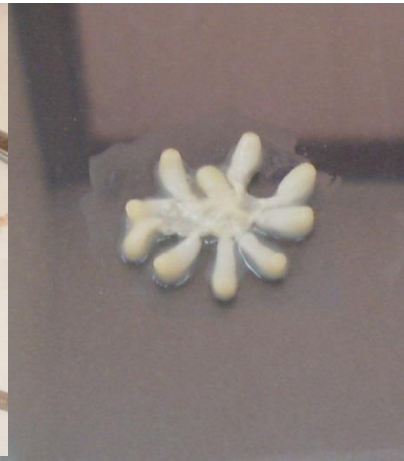
- Making changes in a highly diverse landscape
- Increased number of scavengers
- Increased numbers of mosquitoes



Case study: Kenya

- Participatory rural appraisals indicated a concern about rodents



Case study: Kenya

- What to study:
  - Can we trust hospital data?
  - Screen all febrile patients
  - Too many differentials: Malaria, RVF, Dengue, YF, Brucella, Leptospira, Chikungunya, CCHF

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Case study: Kenya

- Who to study:
  - Humans and livestock
  - Mosquitoes
  - Rodents
  - Bats
  - Ticks

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Cross-cutting issues

- Participatory rural appraisals
- The economic burden of disease
- The association between poverty and zoonoses- the vicious circle
- Climate change and predictive modelling

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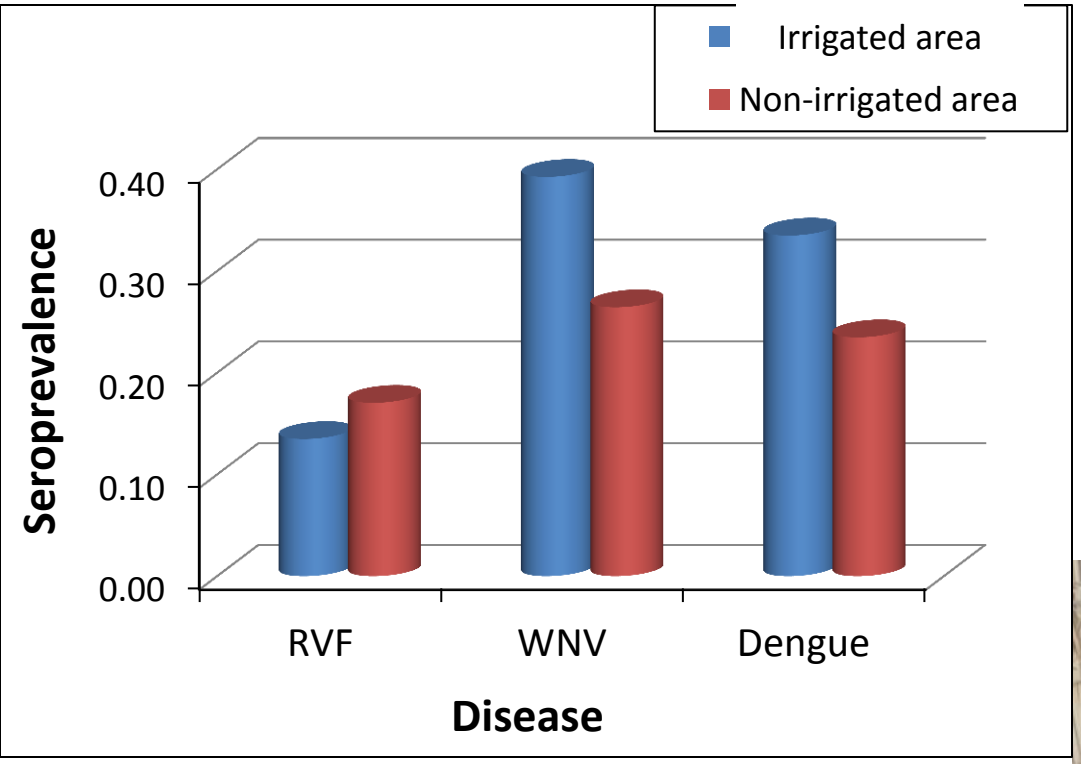
Irrigation- preliminary results



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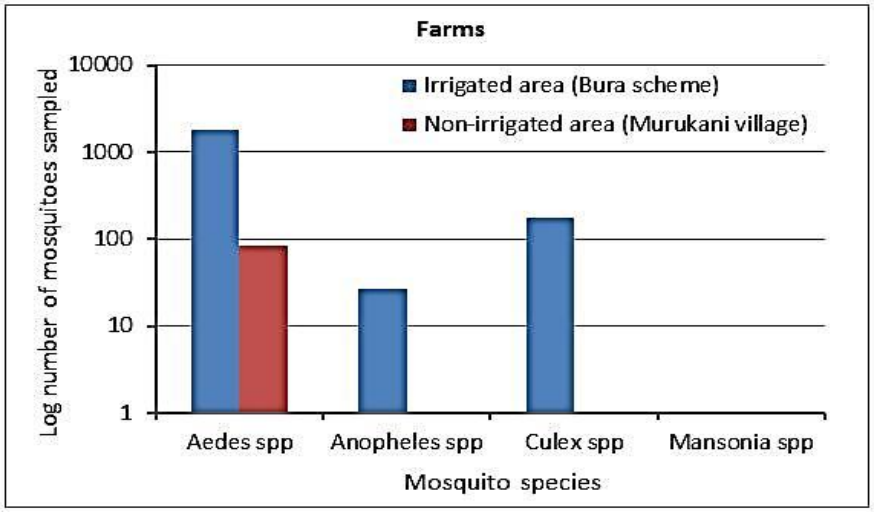
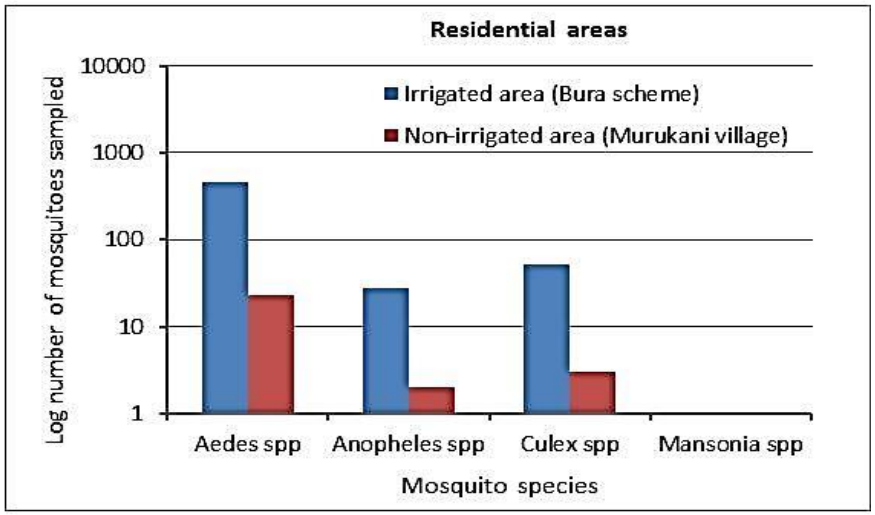
Results

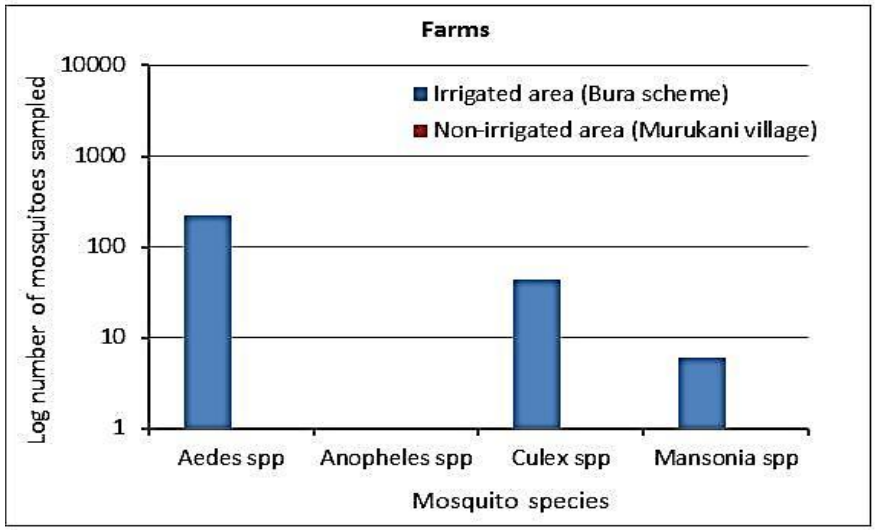
Mosquitoes trapped – relative abundance and species distribution

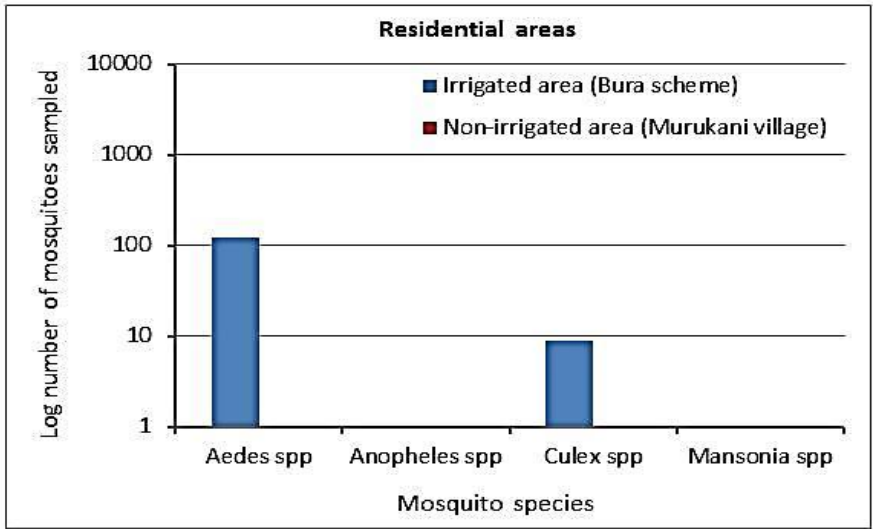
(a) Results from surveys done when irrigation was active





(b) Results from surveys done at the inactive phase of irrigation





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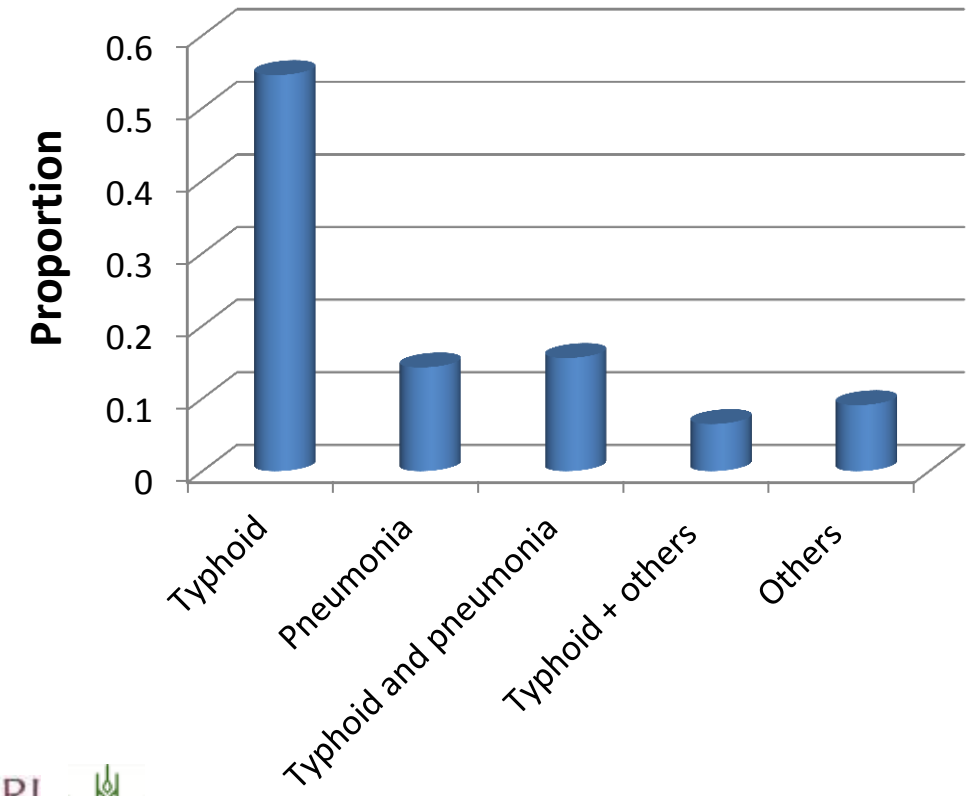
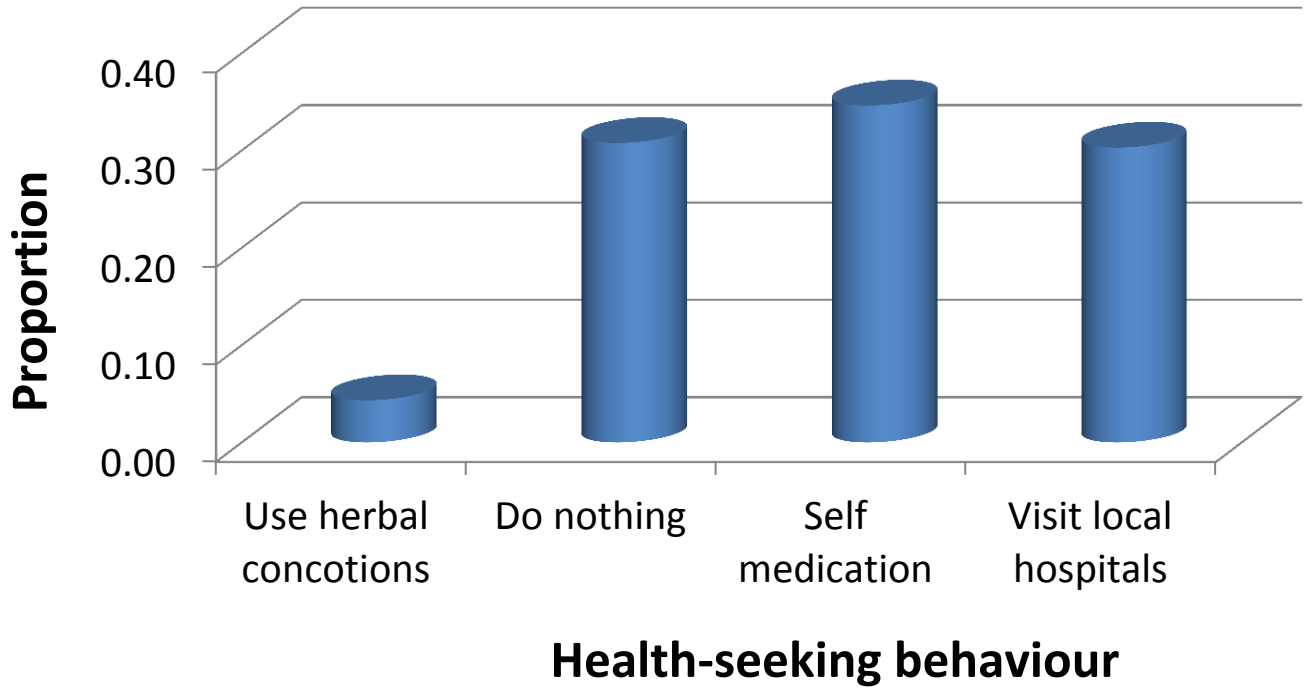
Intervention points

Communities' perceptions on diseases that manifest similar signs as malaria – limited knowledge on arboviruses





Ways in which the local communities respond to febrile illnesses such as malaria

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Unwillingness to pay for prevention

How much did you spend last year on the following health protection (Kenyan shilling)?

	Mosquito nets	Vaccines & routine clinic visits for kids	Boiling or other water treatment	Insurance (annual fee)	Other health prevention
Mean	762	254	6.8	0.9	586
Range	0-3150	0-5000	4 households paid between 150-600	220 households paid nothing, one household paid 200	0-6000

How much did you spend last year on the following health prevention for animals?

	Deworming	Vaccinations (to prevent not to treat)	Tick and fly treatments	Insurance (annual fee)
Mean	928	437	599	0
Range	0-11000	0-5000	0-5000	Not existing

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More material than we can manage to analyze…

- Multiple diseases
- Still mosquitoes and ticks to identify and screen for virus
- Rodents and bats?
- The association between poverty and zoonoses- the vicious circle
- Climate change and predictive modelling

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Kenya attack: 147 dead in Garissa University assault

3 April 2015 | Africa

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Conclusions 1

- We need a one health approach and increasing understanding of drivers
- The livestock revolution has benefitted poor farmers both by increased incomes and improved nutrition
- More people, more insecurity and more disease

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Conclusions 2

- Not the livestock revolution predicted by Orwell
- But still not a situation where all people are equally equal regarding a secured access to safe food

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