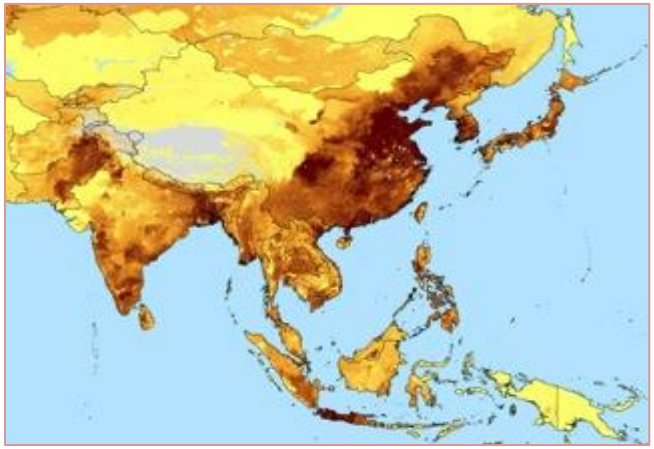
Livestock and food security

An ILRI perspective

Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015



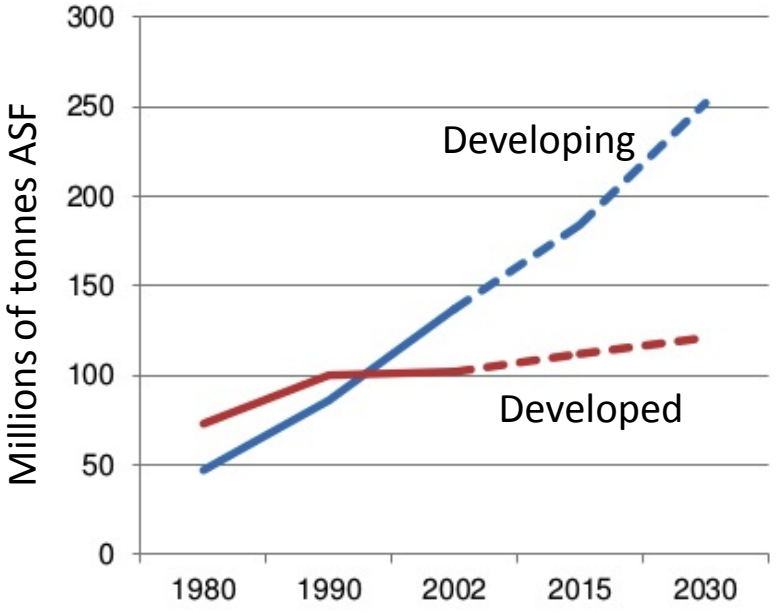
ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

CFS Committee on World Food Security

HLPE High Level Panel of Experts

Why are livestock important?



- Increasing recognition of role in achieving an adequate and balanced diet, and especially strategic for women and young children
- Extended rapid growth in demand for animal-source foods
- Reaching limits of expansion – pressure on feed resources
- Pressure/incentives to intensify
- Upward pressure on prices

OVER-ARCHING ISSUES

- How to achieve sustainable diets globally?
  - ✓ Safe and appropriate consumption
  - ✓ Acceptable environmental trade-offs
- Livestock as a tool for development
  - ✓ Ensuring adequate, safe animal-source food to nourish the poor in 2050
  - ✓ As an asset for generating income and smoothing the transition out of agriculture

Pathways to improved Food Security

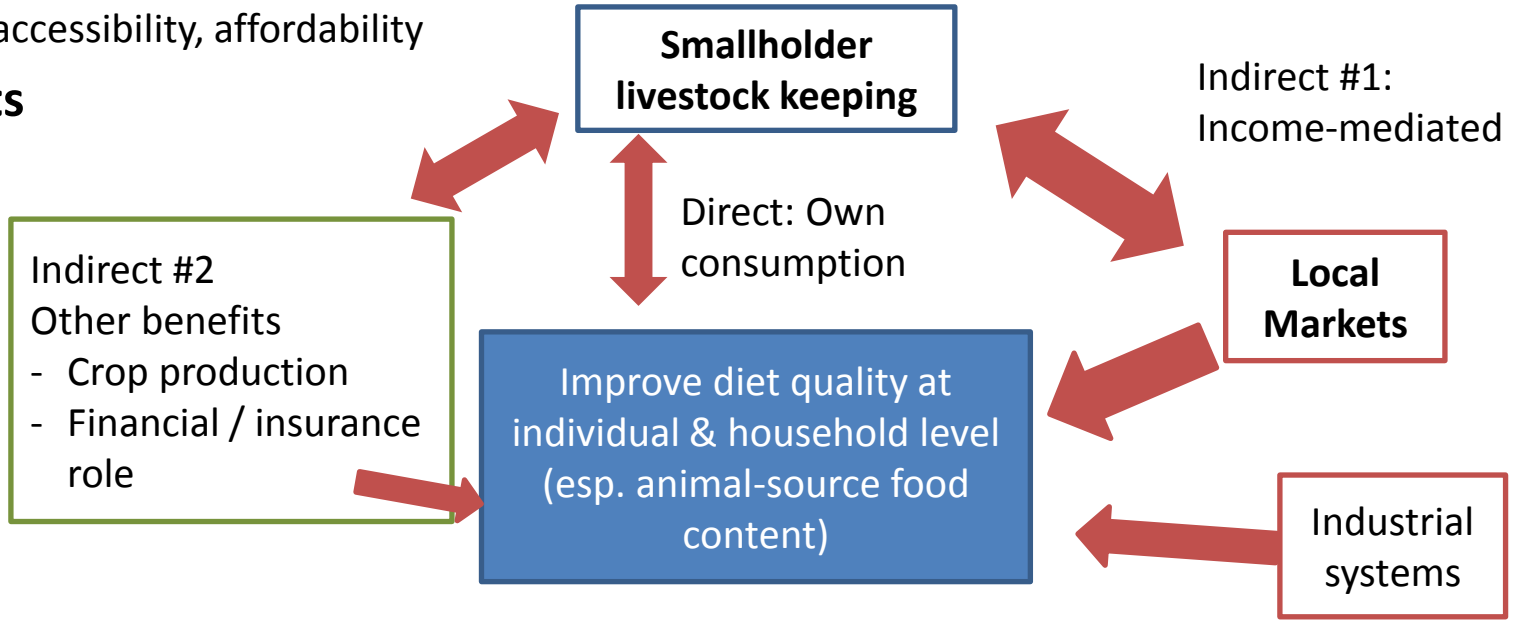
A. Livestock-keeping households (nearly 1 billion people!)

- Direct: consumption of household's own livestock products
- Indirect #1: Income from livestock buys food
- Indirect #2: Better crop production for food/income; financial instruments
- Dynamic – facilitating transition to professional agriculture / out of agriculture

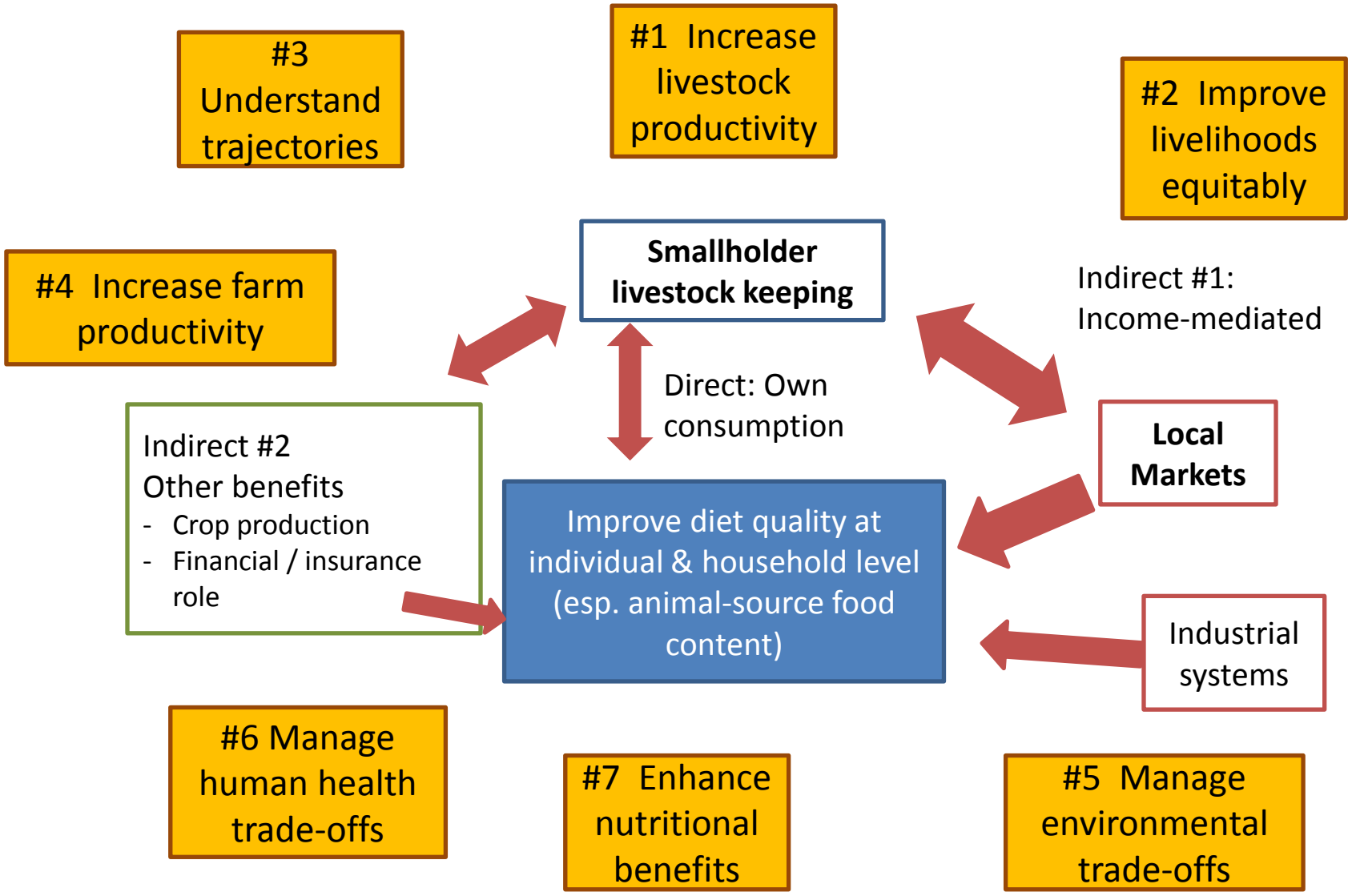
B. Consumer households

- Rely mostly on local small-scale production & marketing systems
- Protecting/enhancing (sustainably)
  availability, accessibility, affordability

Varying contexts & trajectories

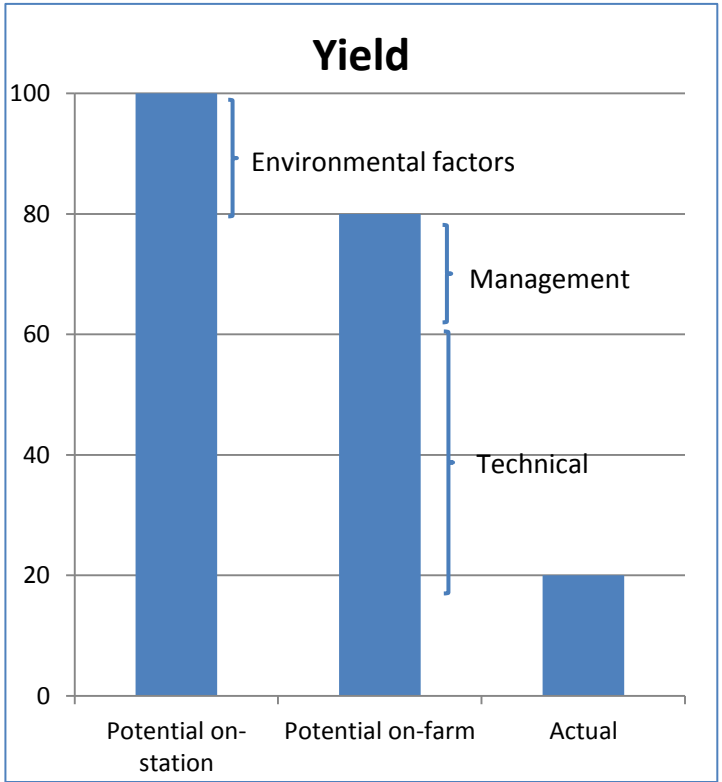


Working toward improved Food Security: Our Agenda



Increasing smallholder livestock productivity

- Why is it critical for food security?
  - To increase supply from smallholder systems -- the main source of animal-source foods for low-income households
    - Protect and enhance availability, affordability
    - Address increasing resource pressures and trade-offs
    - Transition from expansion to intensification
  - To avoid missing window of opportunity to reduce rural poverty and smooth transition out of agriculture

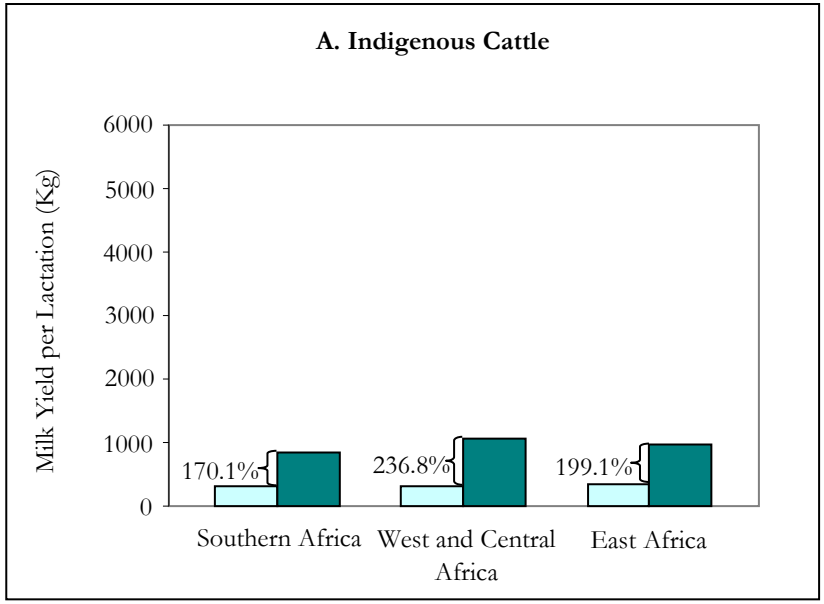


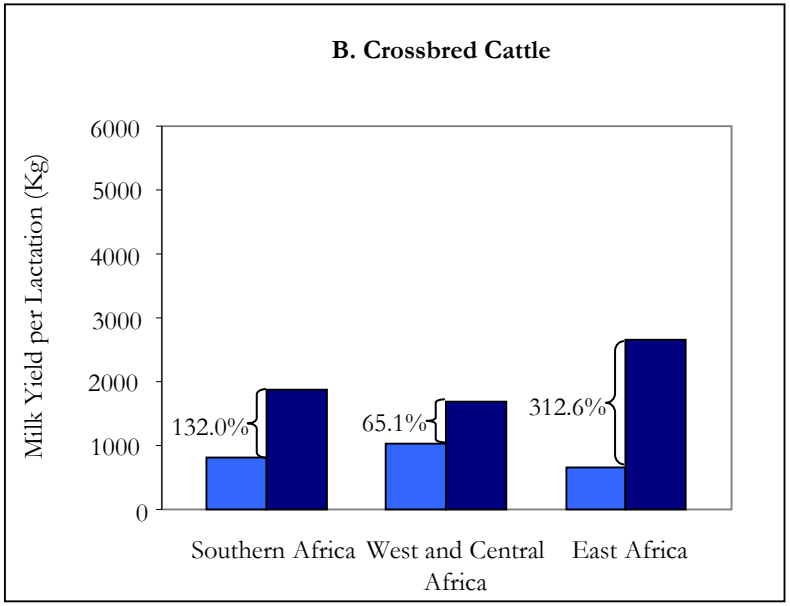
- Key challenge: Understanding the 'yield gap'
  - Need for a conceptual and methodological framework for prioritizing

Complex interplay of factors

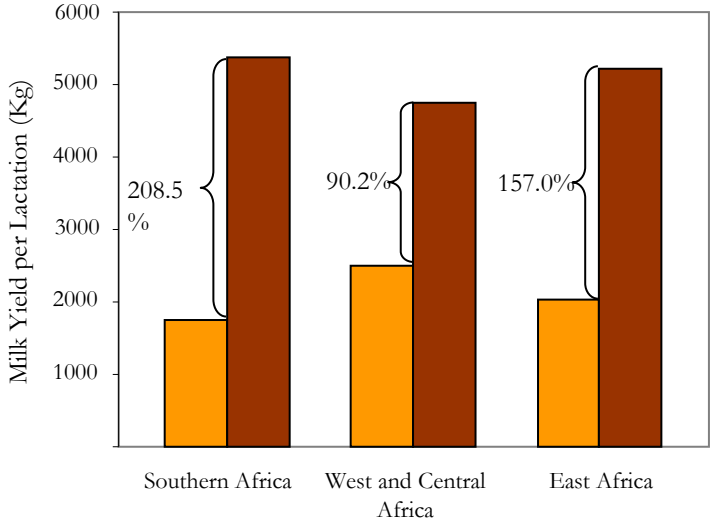
P is the phenotype	The animal we see, its production etc.
G is the genotype	The genetic make up of the animal
E is the environment	All factors (ambient conditions, health, nutrition, husbandry) except the genes of the animal
GE is the interaction	Between the genes and the environment

Genetics as the game changer
Estimates of potential versus realized dairy productivity

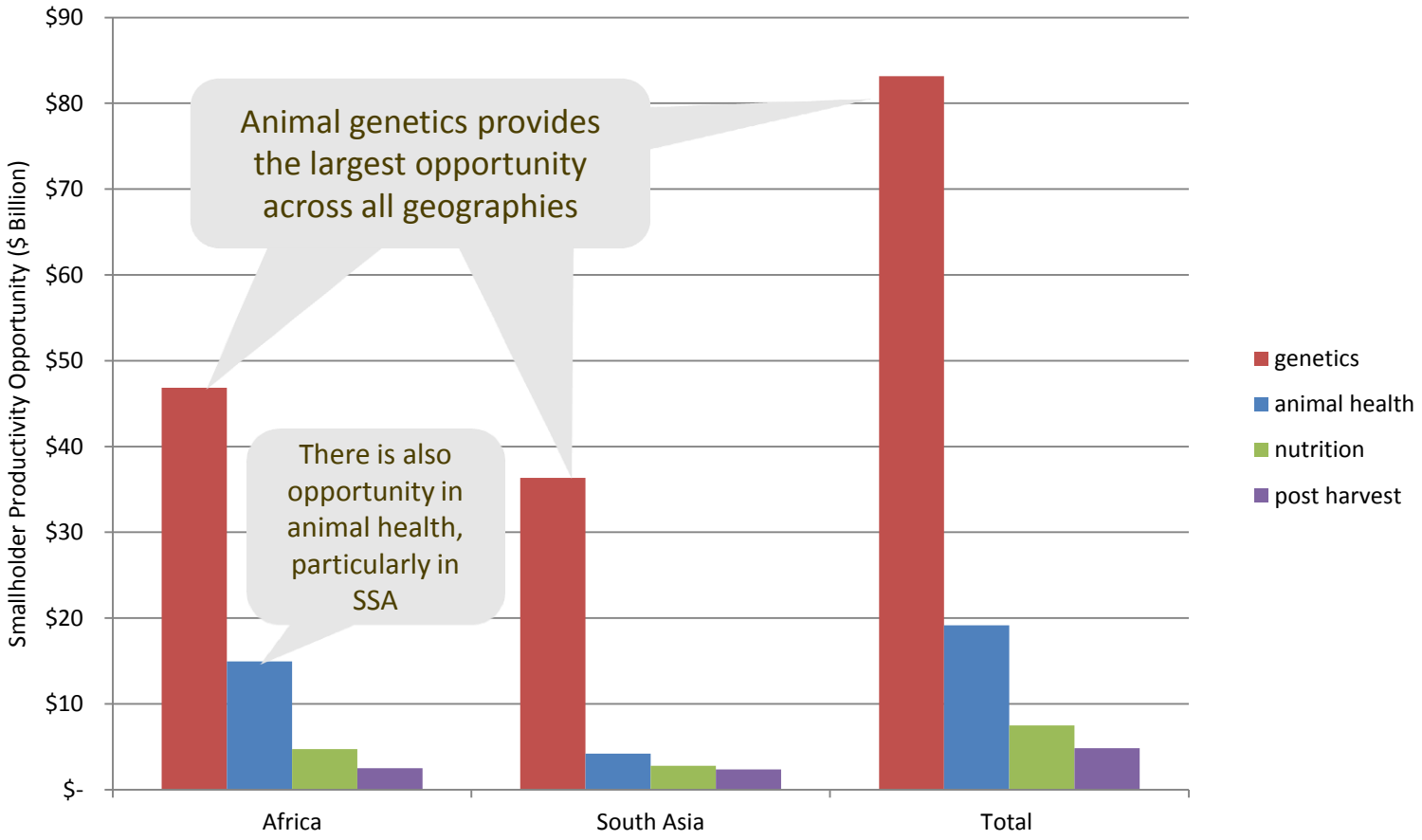




C. Exotic Cattle



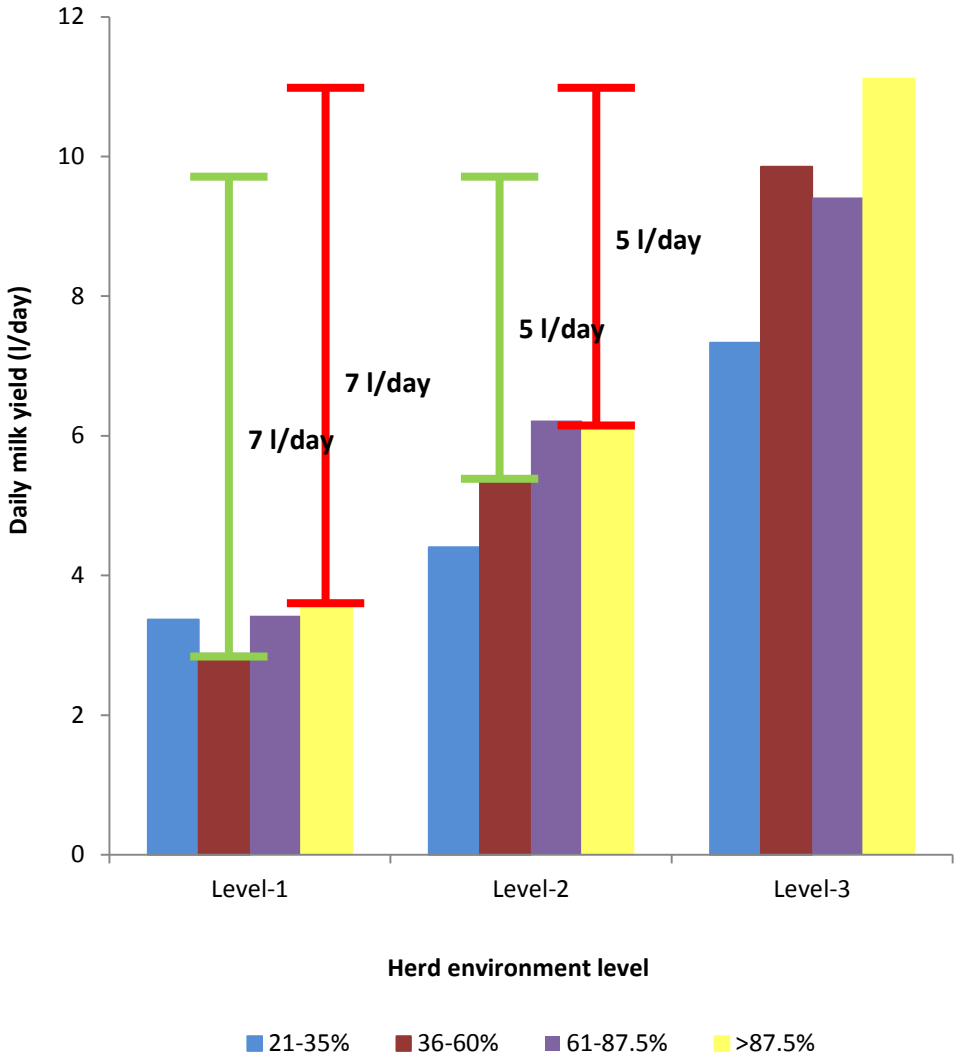
One take on opportunities to increase smallholder productivity



Sources: estimates based on BMGF analytical models referencing multiple data sources including: Oct 4-5 Livestock Landscape Analysis Expert Panel Workshop; Oct 27 Livestock Foundation Genetics Workshop; Expert Interviews; FAOSTAT; OIE Technical Disease Cards; the Center for Food Security and Public Health Animal Disease Information; OIE-WAHID database; Merck Veterinary Manual; 2011 Market Probe market research for Kenya, Ghana, Nigeria, Ethiopia

ILRI CGIAR

But it isn't just genetics



Milk production by % dairyness

- *High grade cattle only showed substantially better milk yields than other grades in the highest production environment*

Entry points: technical drivers

- Genetics
  - Incentives and innovative recording systems for genetic selection programs
  - Optimizing indigenous-exotic crossbreeding: matching breed to environment
  - Genetic modification for disease resistance vs reliance on vaccines

- Animal Health
  - Novel vaccine development for neglected diseases
  - Managing disease where surveillance and veterinary services are weak
  - Adapting new technologies to increase access and use of diagnostics

- Animal Nutrition
  - Better use of existing feed biomass through reservation/conservation options
  - Improving voluntary intake and reducing feed wastages
  - Matching better key feed nutrients with animal production level – balanced rations

Entry points: socio-economic

- Institutional arrangements to support uptake of technologies and access to market
  - Business groups to create economies-of-scale
  - Business development services to stimulate supporting services
  - Innovation platforms to facilitate coordination and develop adaptive capacity
  - Appropriate, enabling policies and regulation to ‘formalize’ informal markets

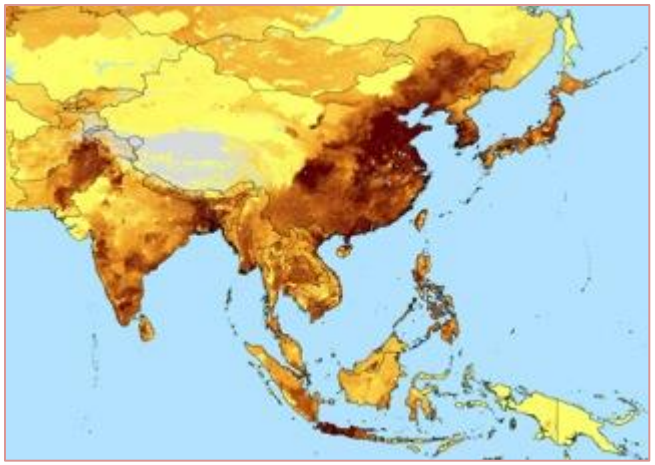
Key Messages

- Good opportunities for science to improve productivity of animal-source food production if appropriately oriented to developing country context
- Work to be done on figuring how to prioritize what will give biggest return in addressing yield gap
- Genetics can be game changer, but isn't a silver bullet

Intensification and the future of livestock and food security

Timothy Robinson

Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015



ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

CFS Committee on World Food Security

HLPE High Level Panel of Experts

Overview

- The global livestock sector - trends and drivers
- Mapping livestock distributions and production systems
- Forecasting intensification
- Examples: Avian Influenza and antimicrobial resistance
- Conclusions

The changing livestock sector

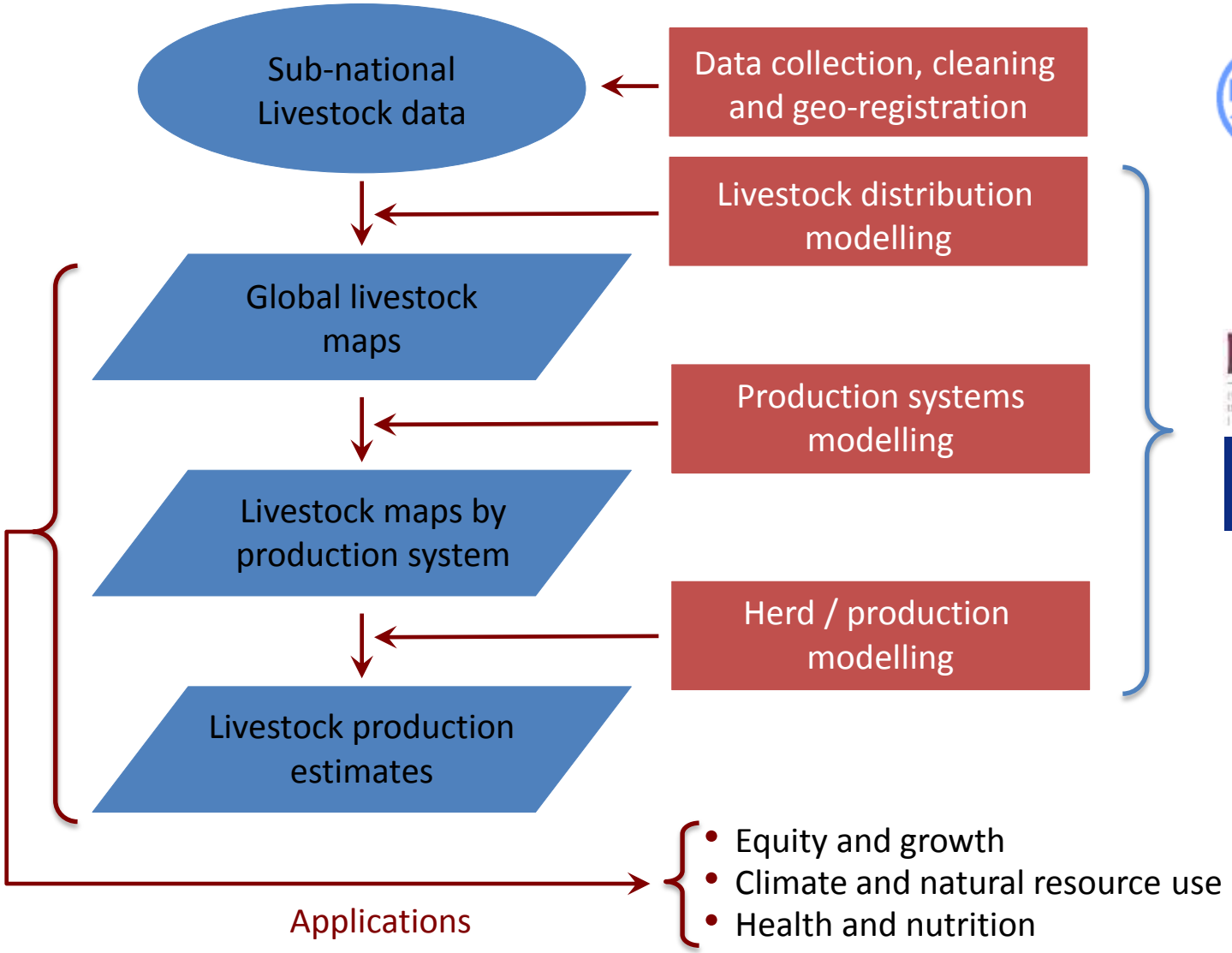
- Demographic and social drivers
  - Population: + 32% or 9.6 billion people by 2050
  - Income growth: + 2% per year by 2050
  - Urbanization: 70% will live in cities by 2050

  ➜ Growth in demand for animal source foods
  - + 70% by 2050
  - + 200 million tonnes of meat

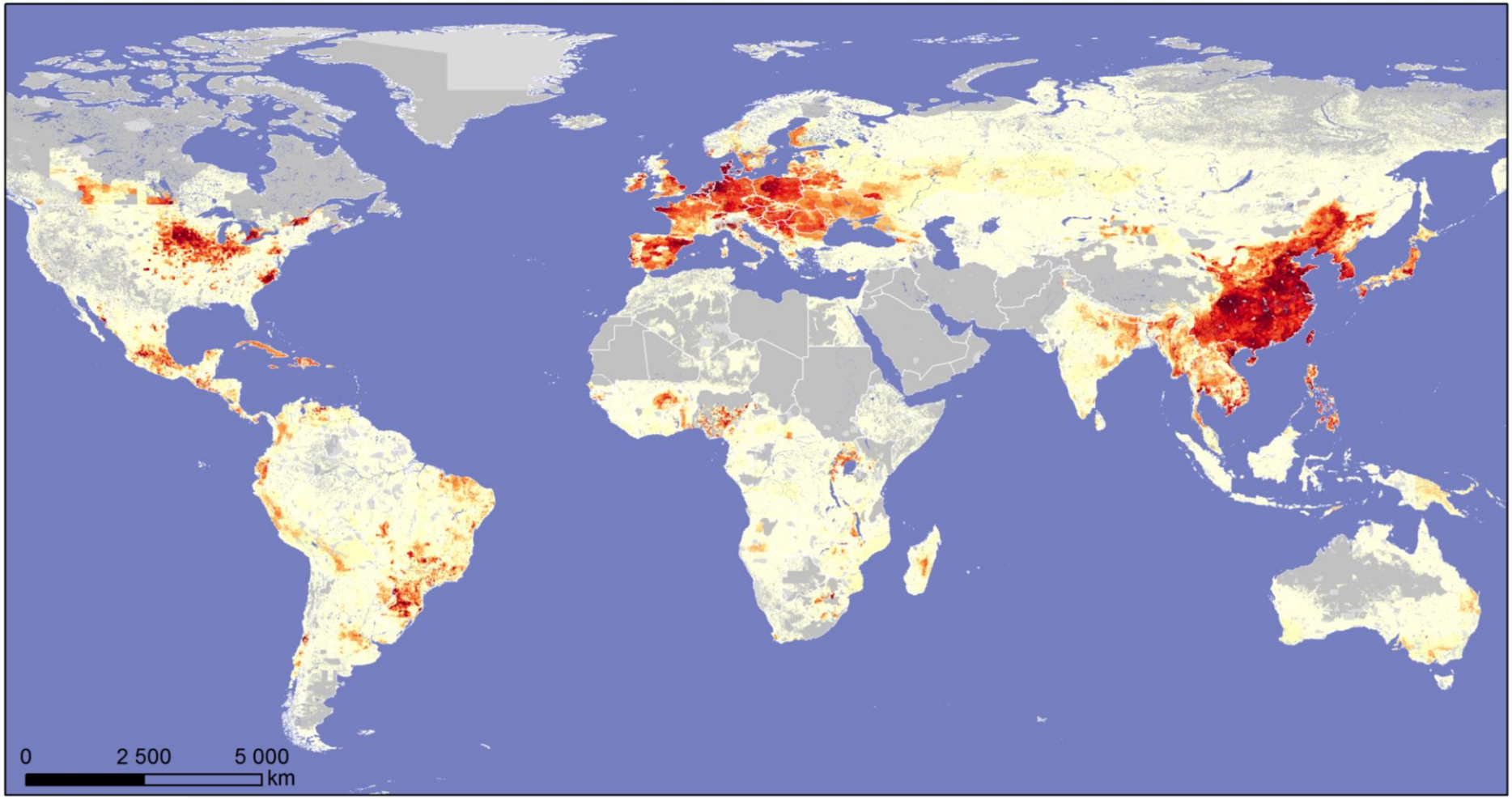
  ➜ Structural changes in the livestock sector
  - Shift from ruminant to monogastric
  - Intensification of production

  ➜ Impinges on global public goods
  - Poverty and growth
  - Health and nutrition
  - Climate and natural resources
- **Integrated approach to socially desirable livestock sector development**
- **Need reliable data and information to guide policy**

Livestock distribution and production



Global distribution of pigs

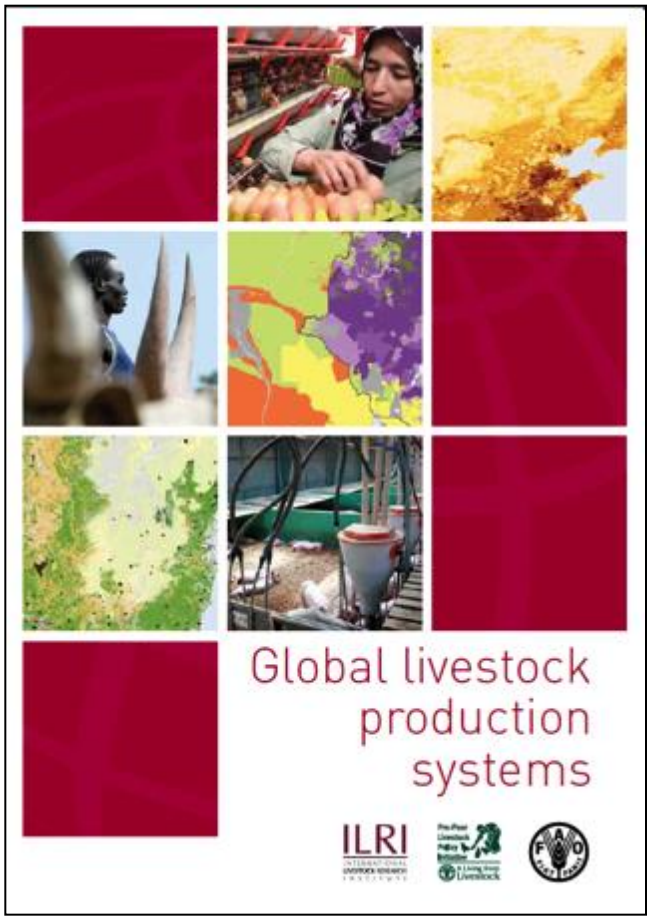


Pigs per square kilometre (2006)

Unsuitable	1 - 5	10 - 20	50 - 100	> 250
< 1	5 - 10	20 - 50	100 - 250	

Source: Robinson et al. (2014)

Livestock production systems



Robinson et al. (2011)

Ruminant systems:

- Based on land use and agro-ecological potential
- No actual livestock data

Monogastric systems:

- Based on scale and intensification
- Use livestock densities

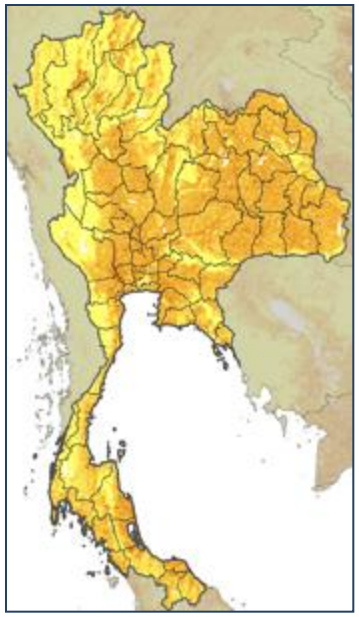
Monogastric production systems

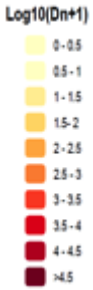
Livestock distribution

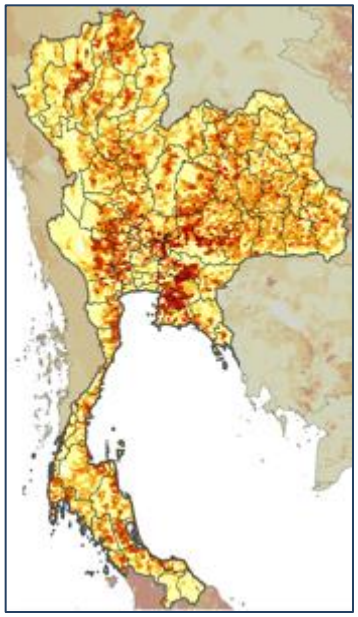
% backyard

Extensive production

Mapped based on rural population





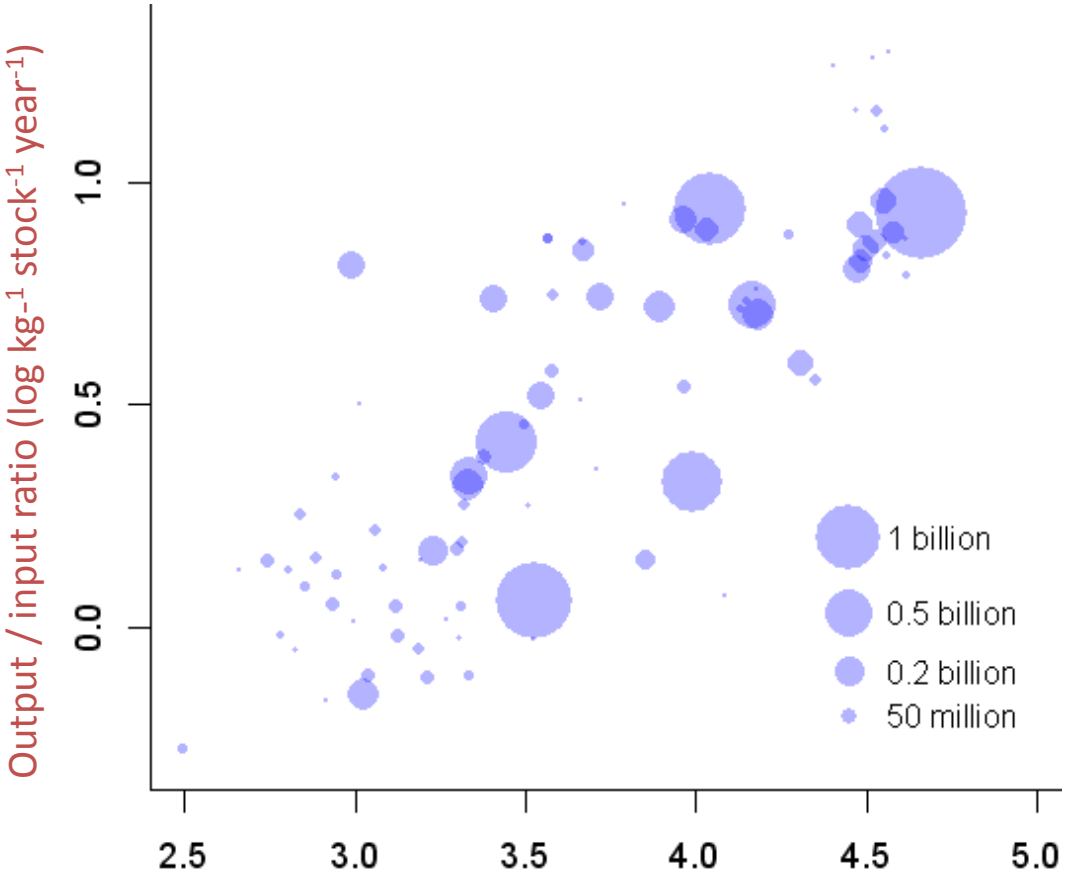


Difference (total – extensive)

% intensive

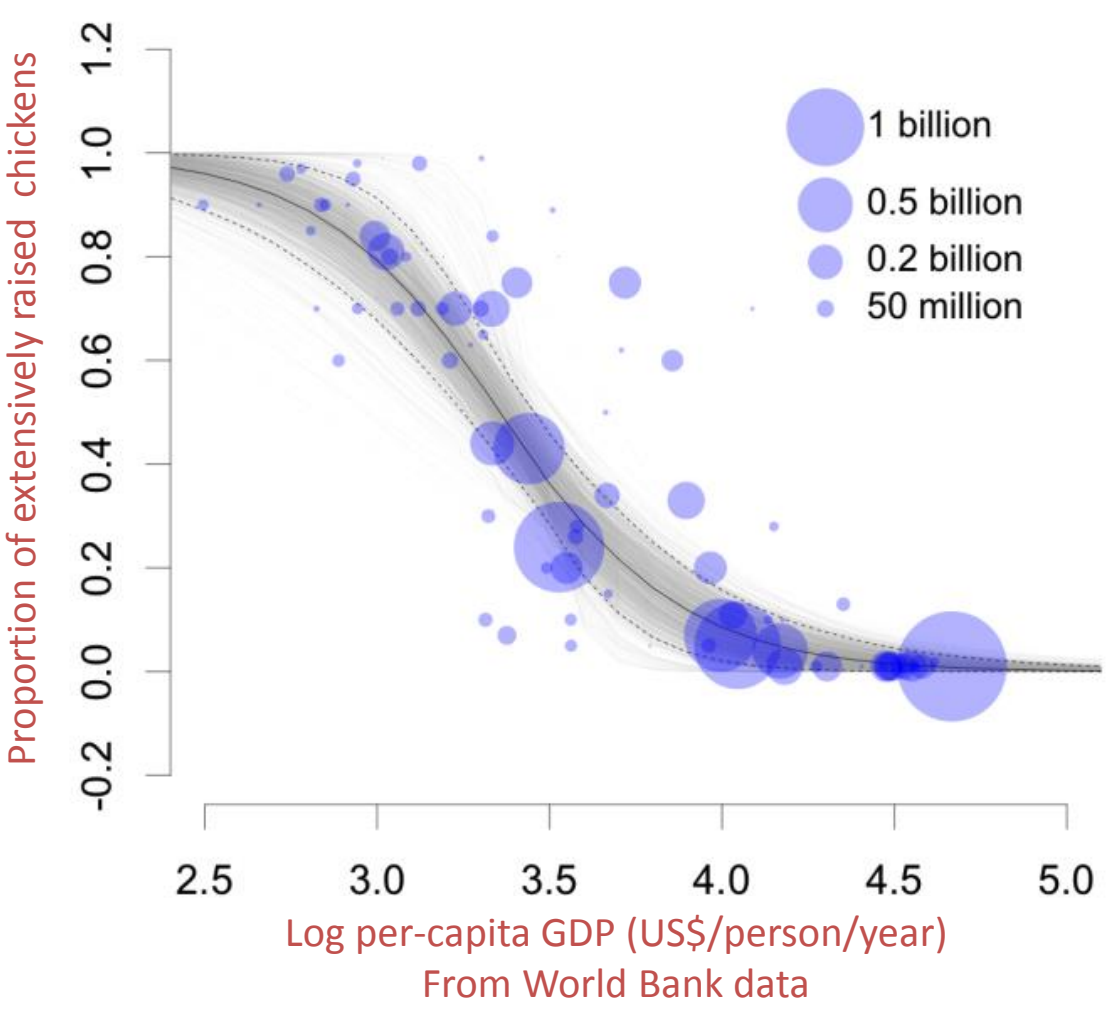
Intensive production

Chicken systems



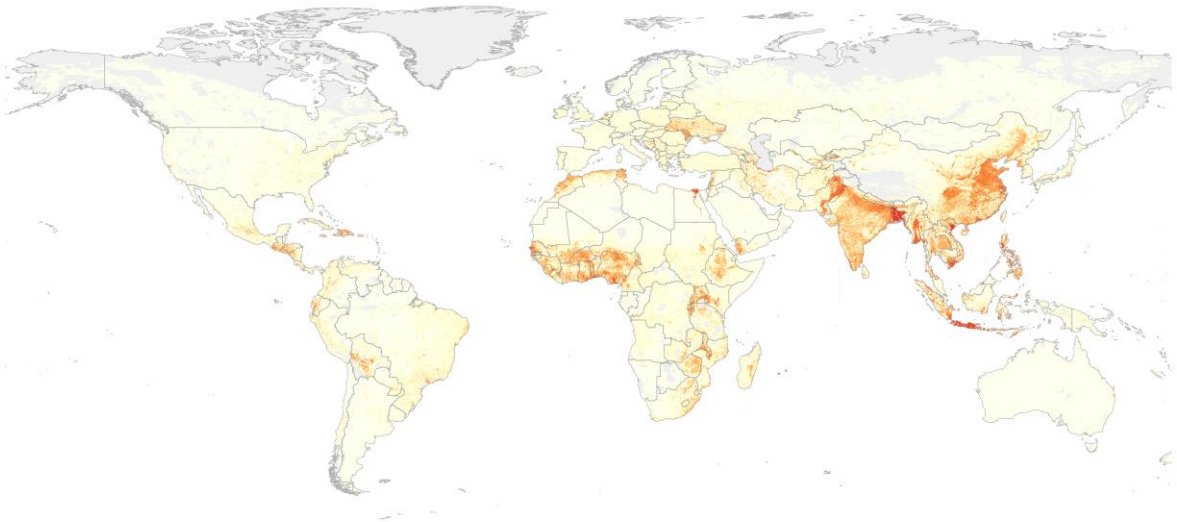
Source: Gilbert et al. (under review)

Chicken systems

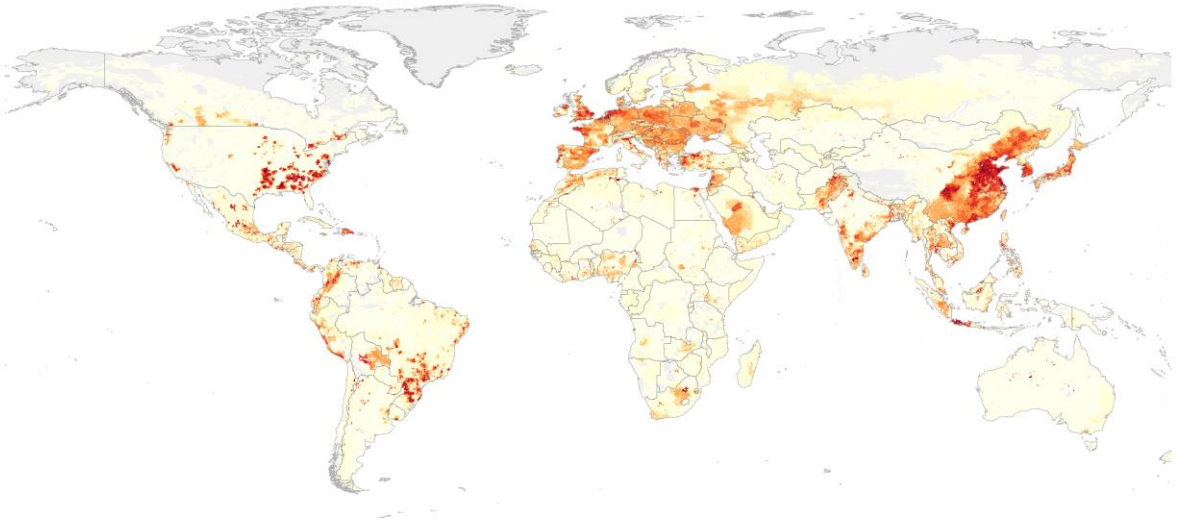


Source: Gilbert et al. (under review)

Chicken systems



Extensive chicken production

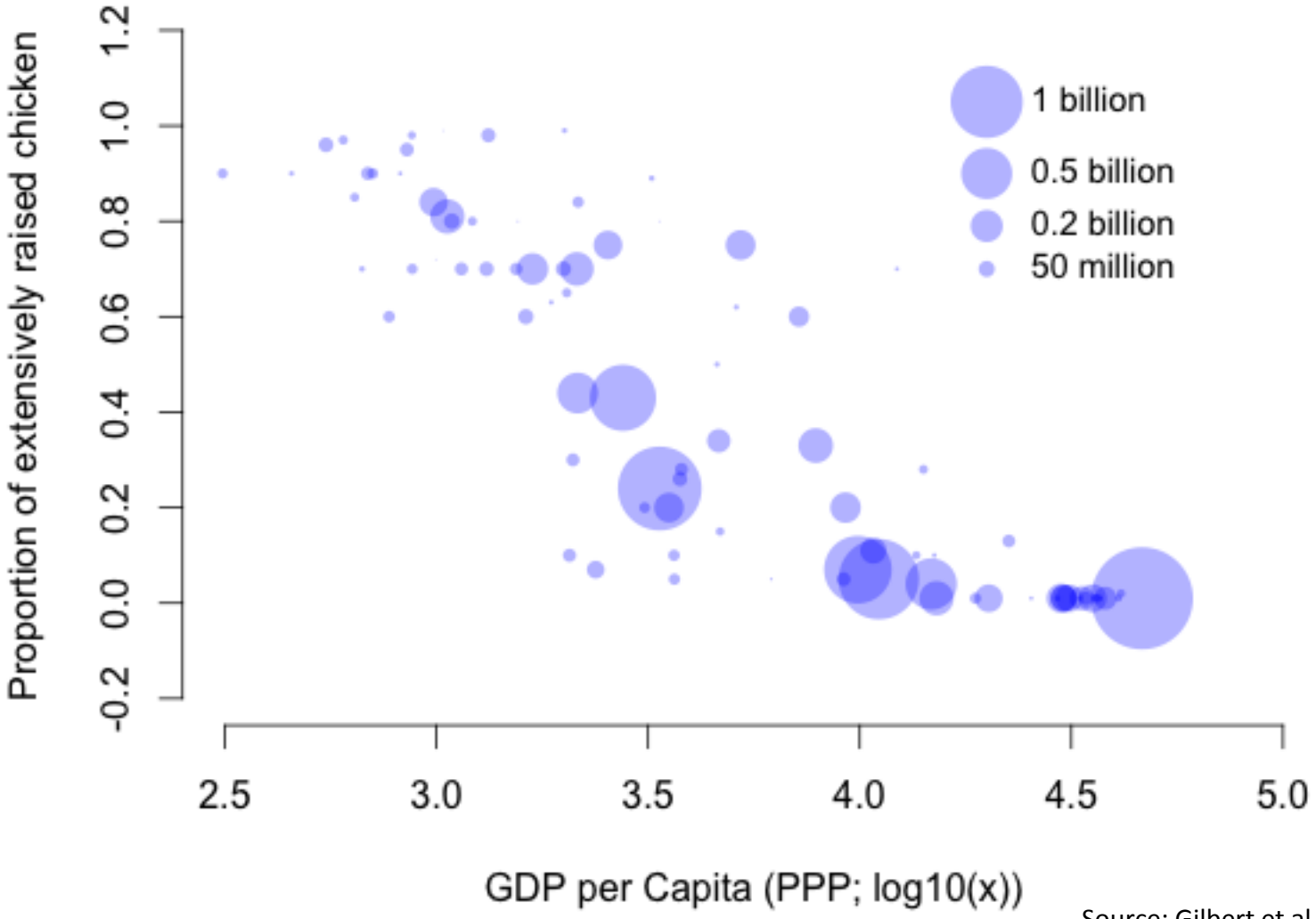


Intensive chicken production

Source: Gilbert et al. (under review)

Intensification trajectories

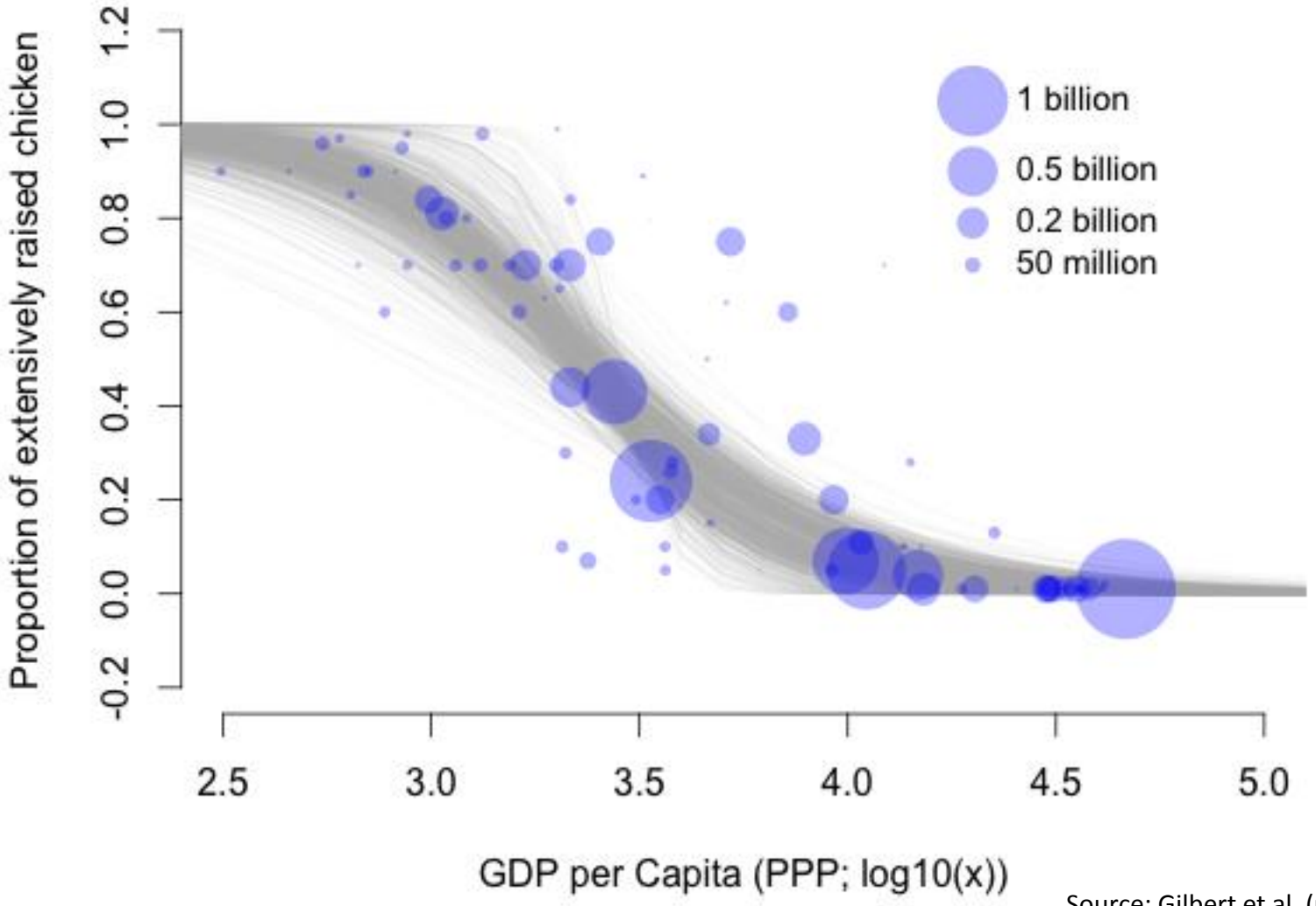
Data mining extensive and intensive chicken production



Source: Gilbert et al. (under review)

Intensification trajectories

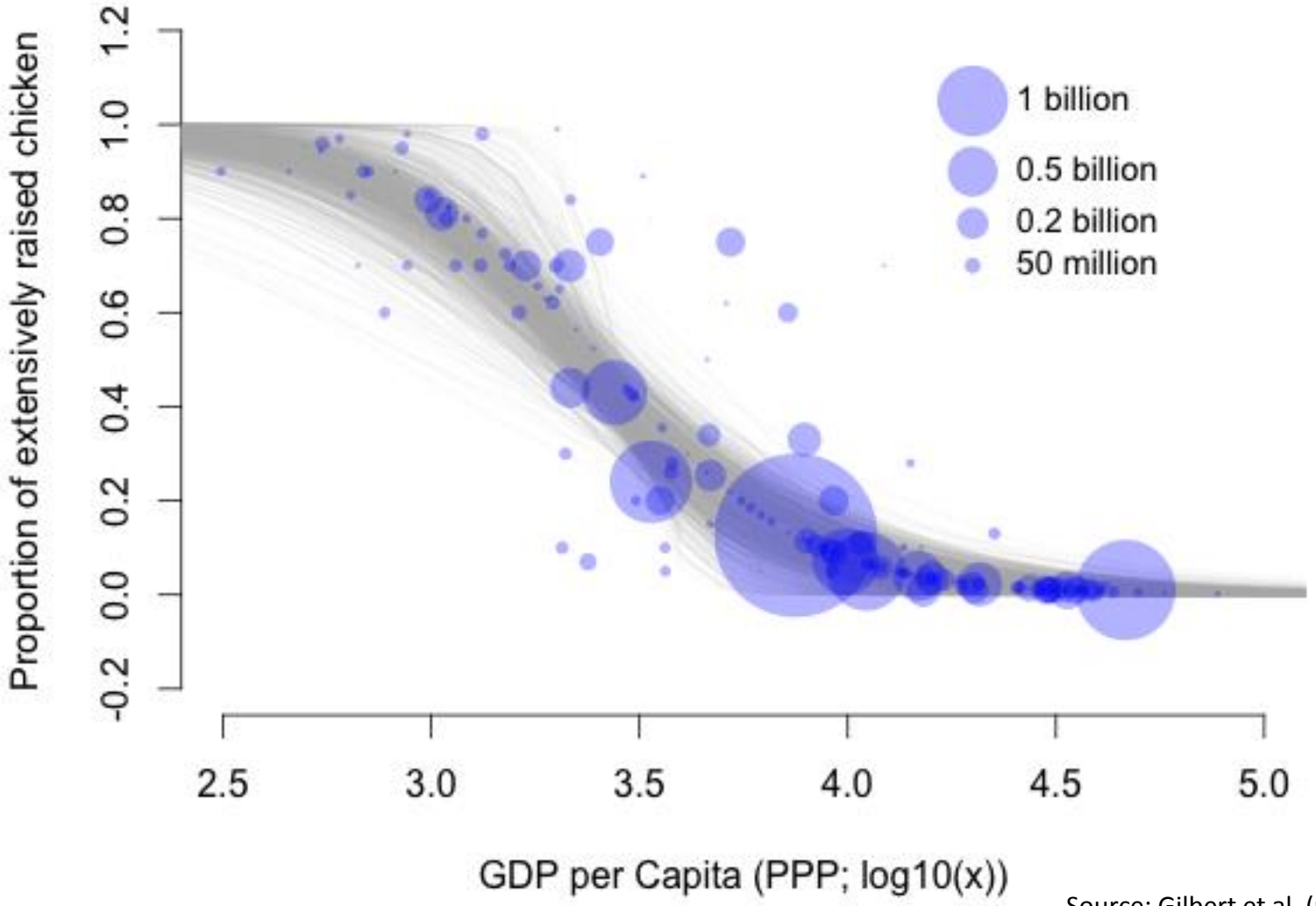
Creating bootstrapped models



Source: Gilbert et al. (under review)

Intensification trajectories

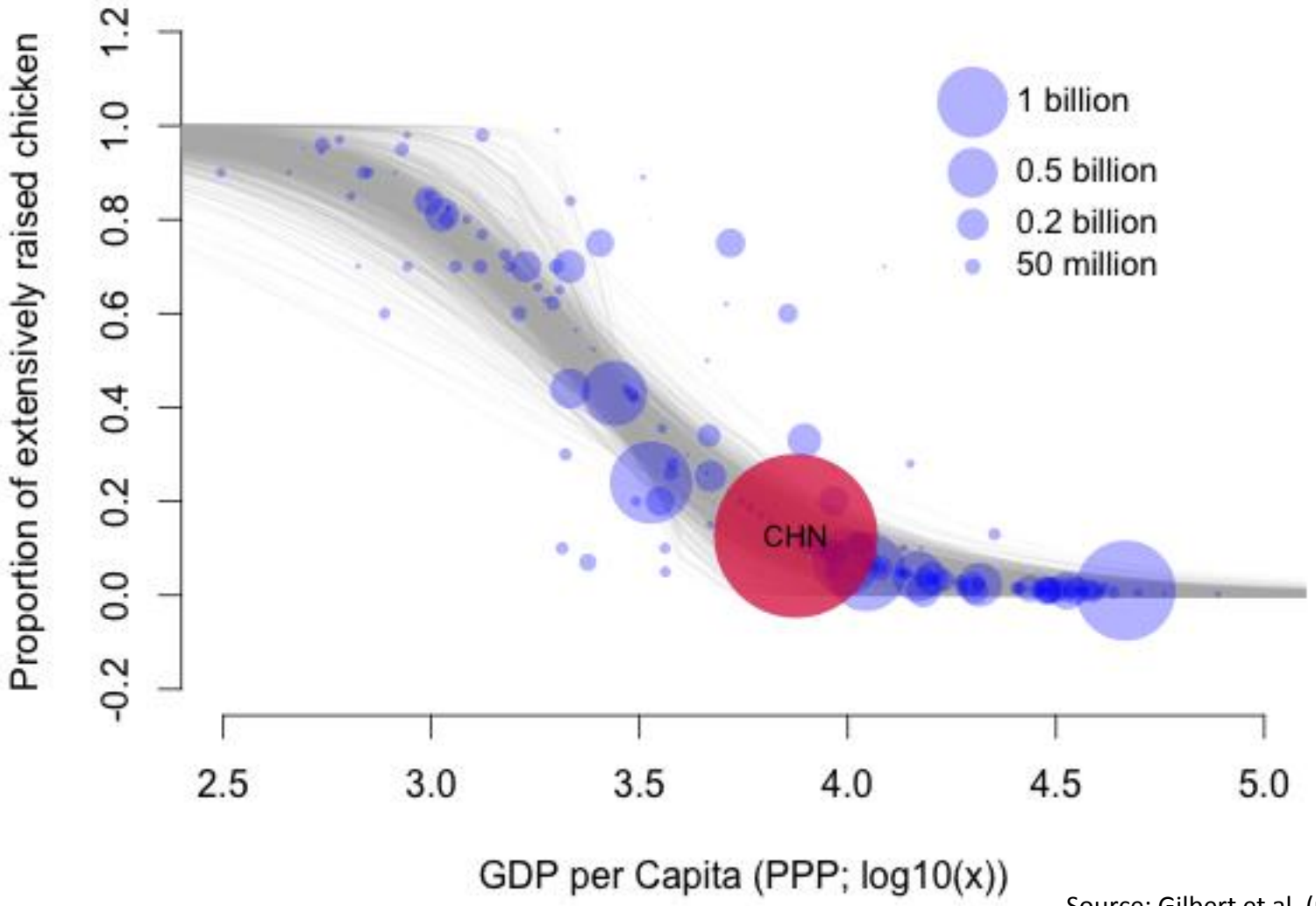
Applying models to all countries



Source: Gilbert et al. (under review)

Intensification trajectories

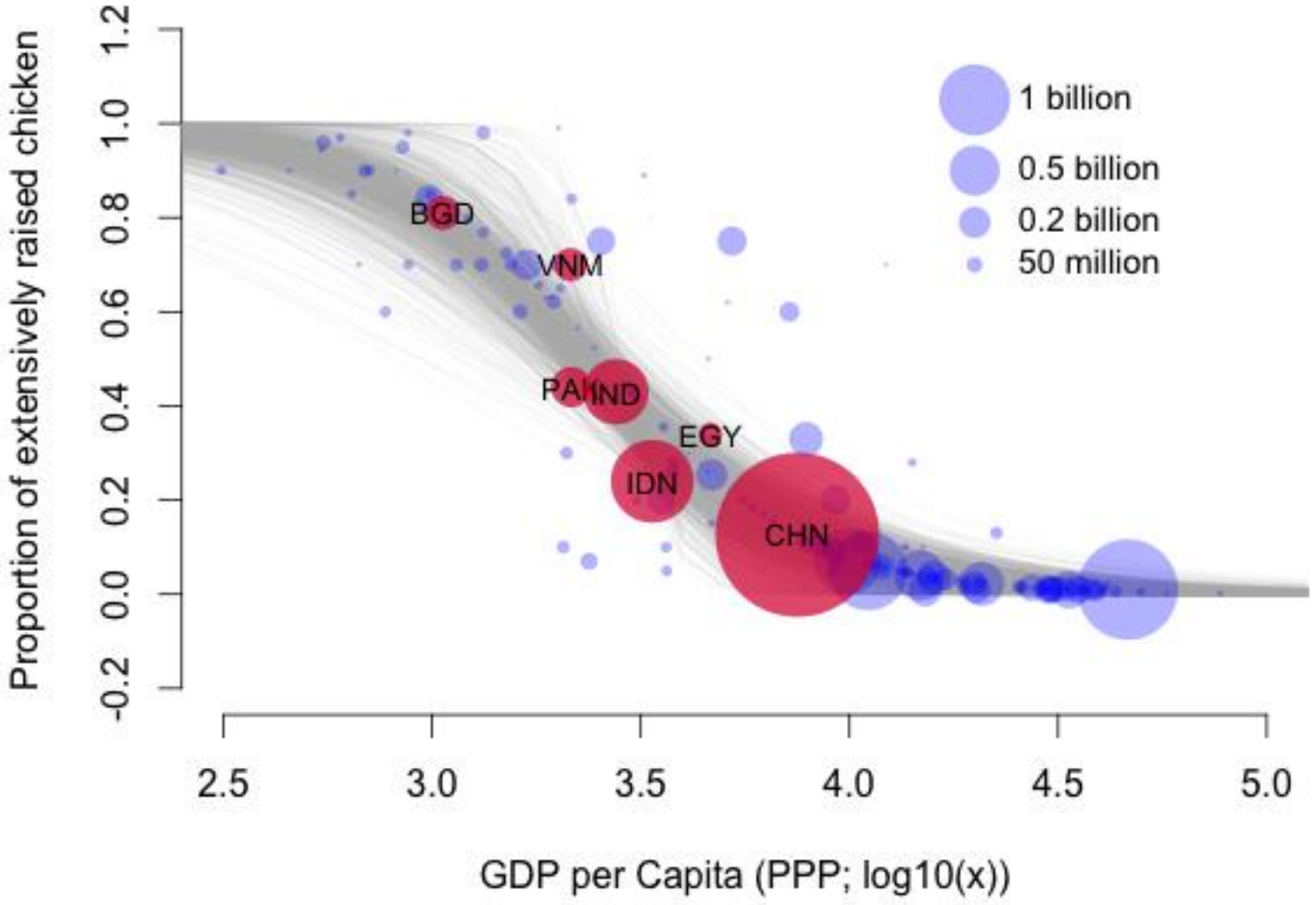
Here is China…



Source: Gilbert et al. (under review)

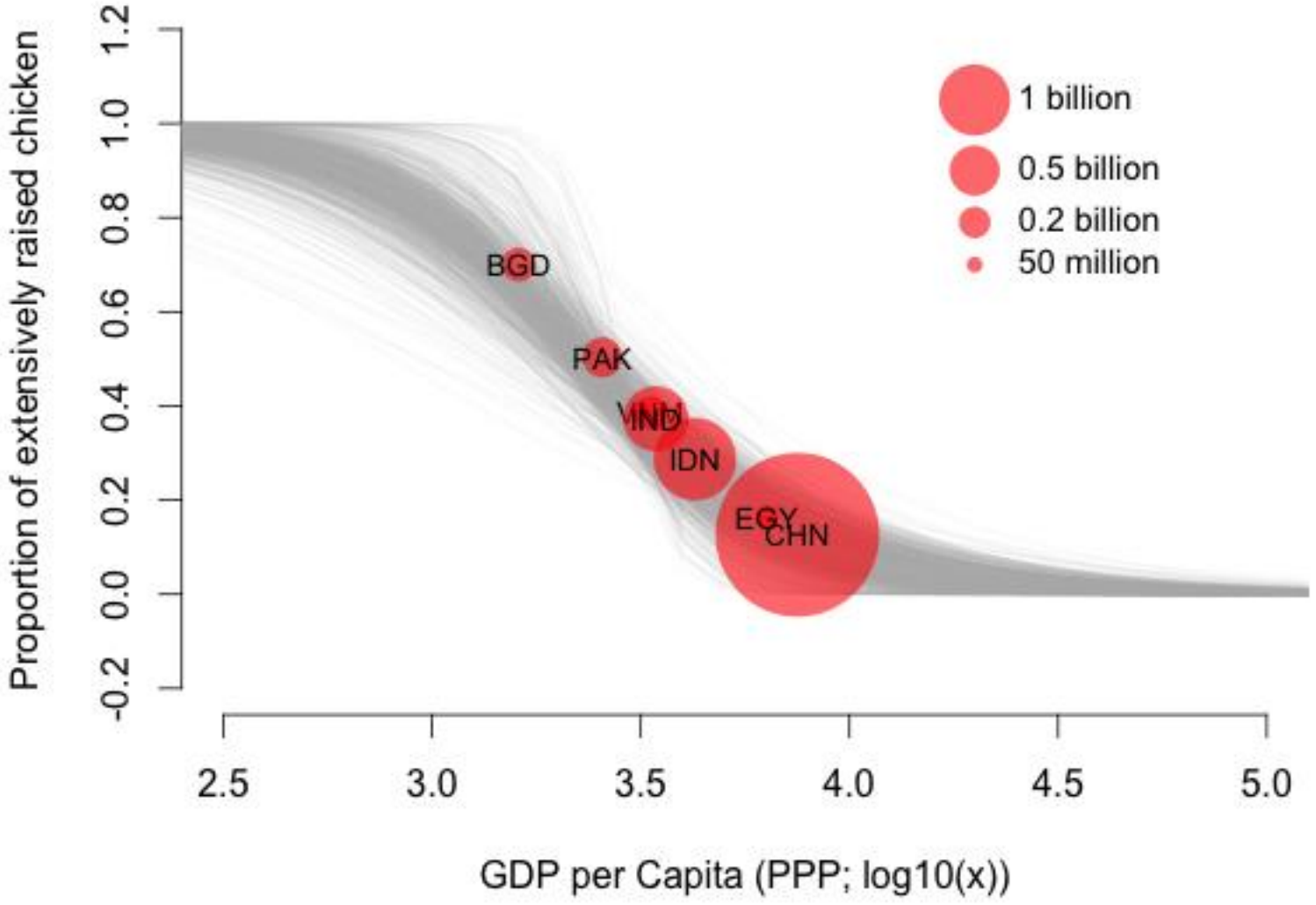
Intensification trajectories

… and several other important countries for AI in human



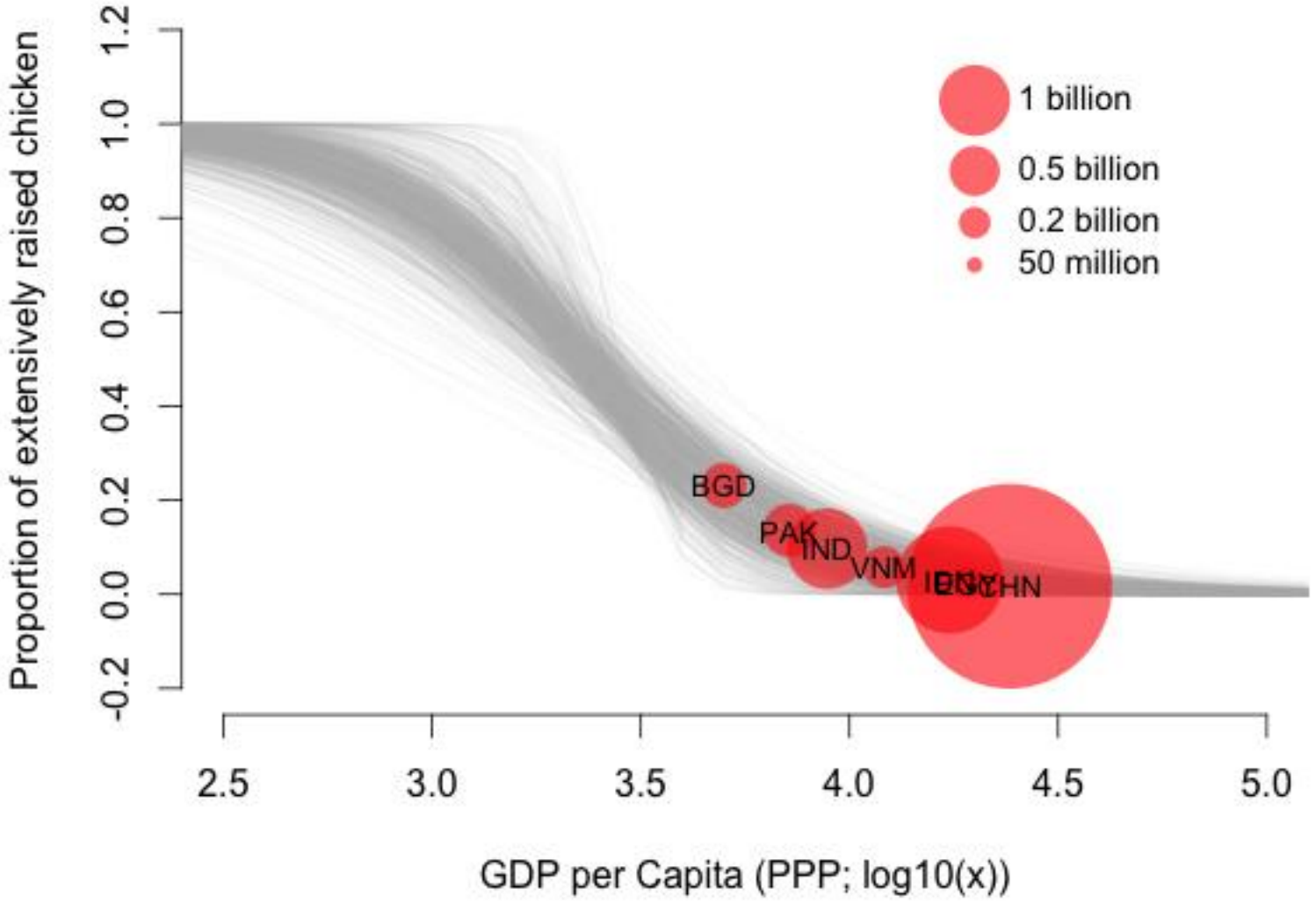
Intensification trajectories

Focus on these countries, standardized to 2010 data



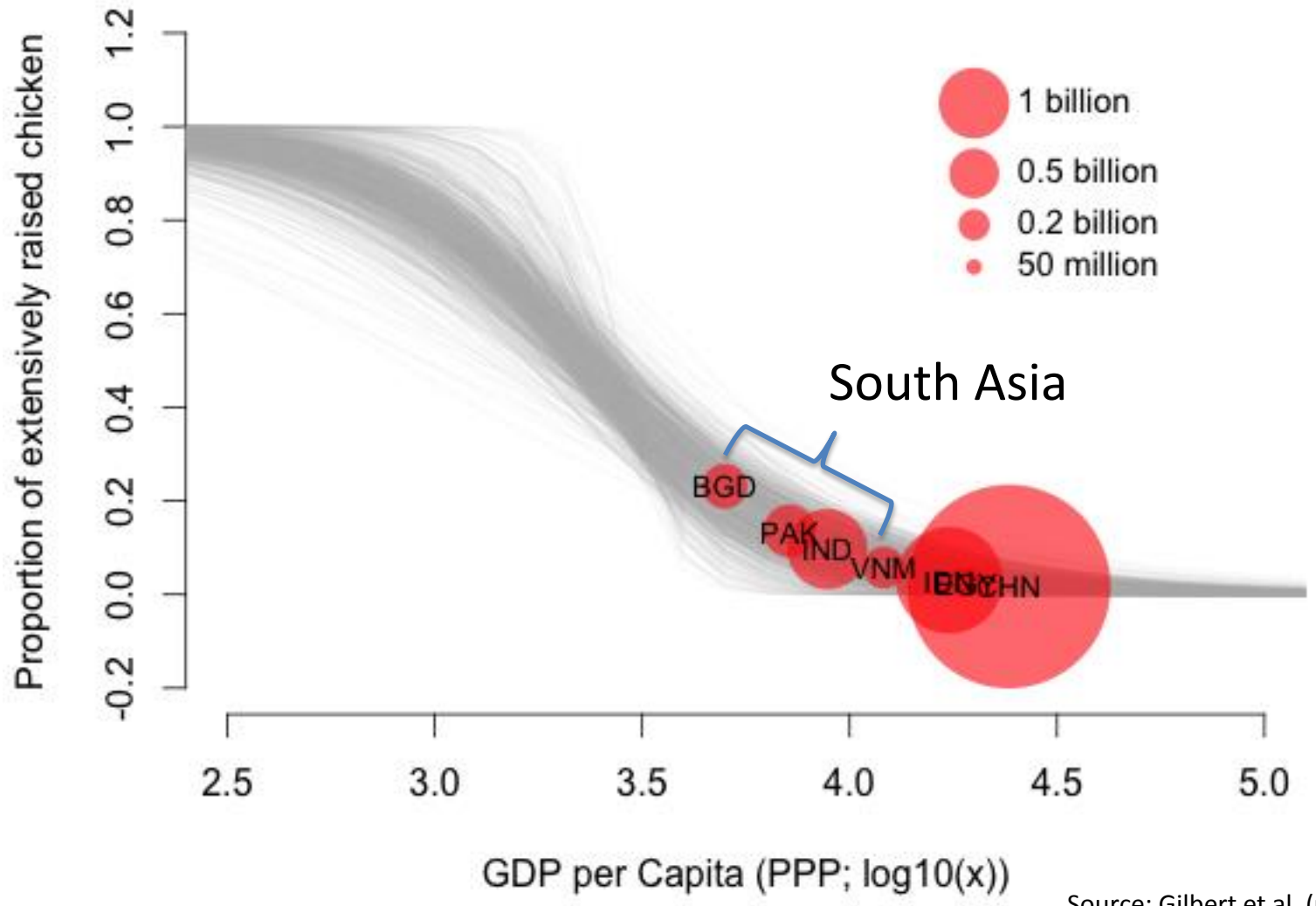
Intensification trajectories

Focus on these countries, standardized to 2030 FAO projections



Intensification trajectories

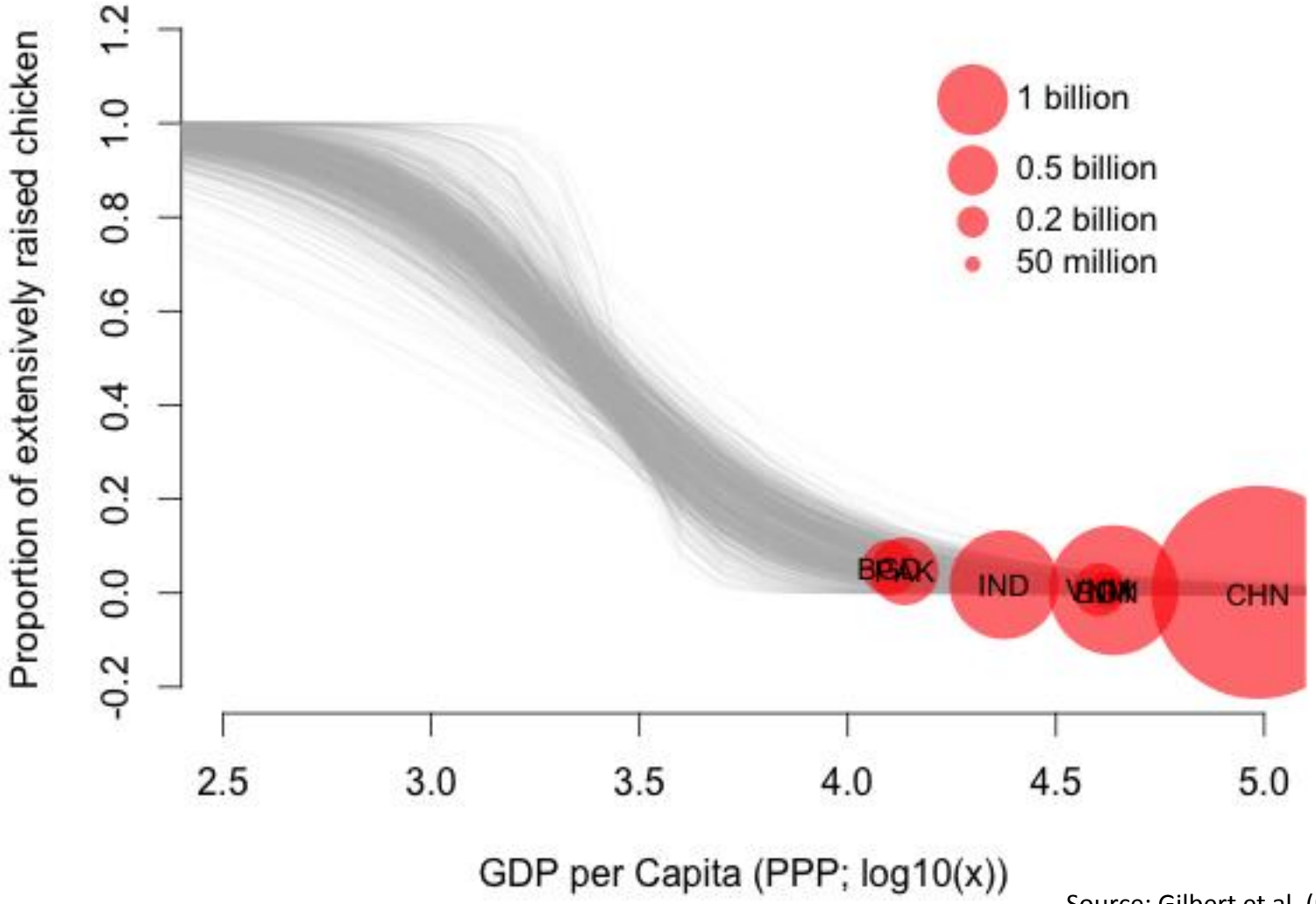
Focus on these countries, standardized to 2030 FAO projections



Source: Gilbert et al. (under review)

Intensification trajectories

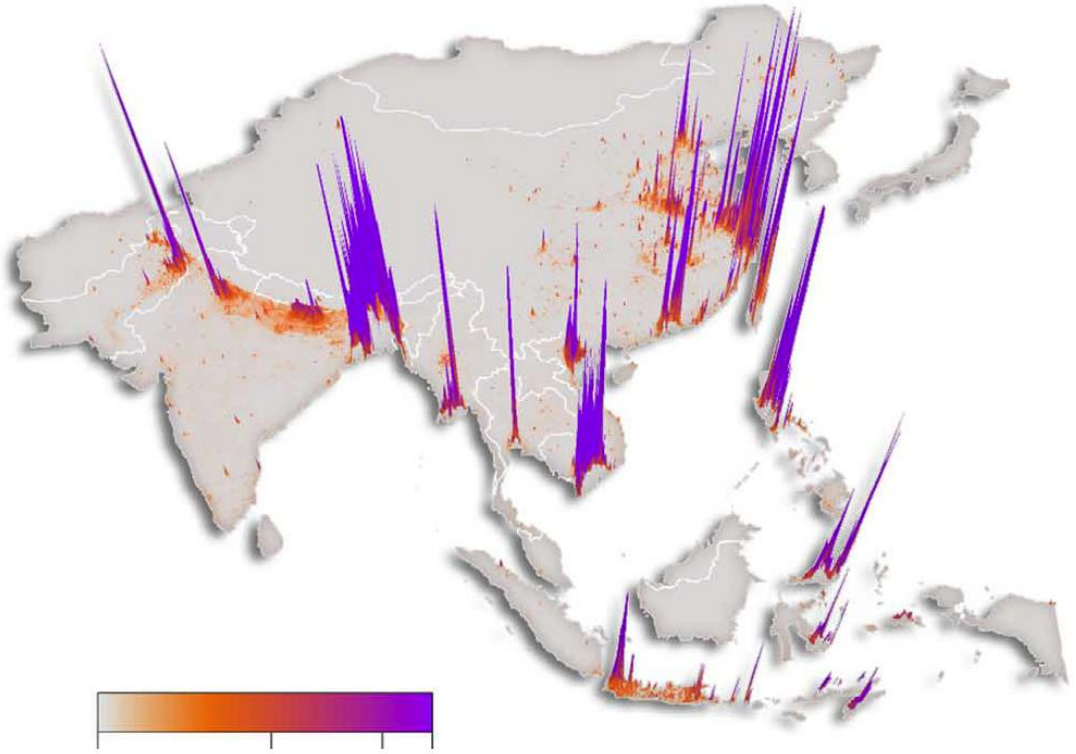
Focus on these countries, standardized to 2050 FAO projections



Source: Gilbert et al. (under review)

Emerging diseases – Avian Influenza

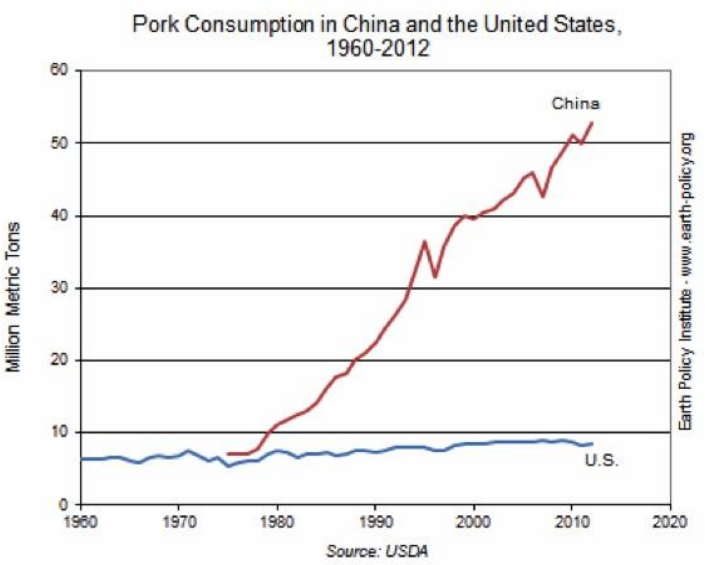
H7N9 risk prediction

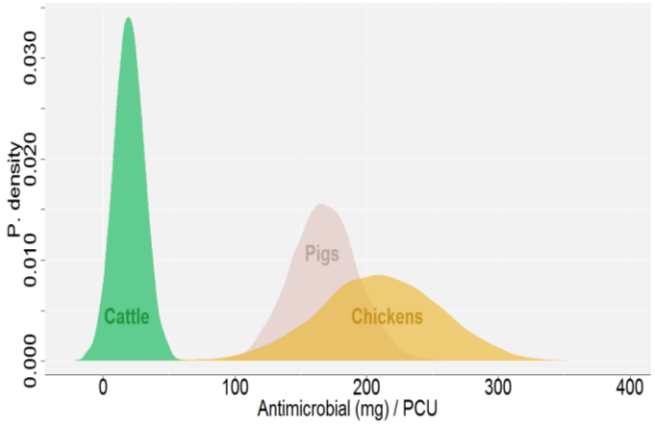


Source: Gilbert et al. (2014)

Antimicrobial resistance

- USA: at least 2 million people get drug-resistant infections each year, and at least 23,000 die from them
- USA: 80% of antimicrobial sales are in the agricultural sector
- Total consumption in the livestock sector in 2010 estimated at 63,151 tons
- Global antimicrobial consumption will rise by 67% by 2030
- It will nearly double in BRICS (Brazil, Russia, India, China, and South Africa) countries
- China's livestock industry by itself could soon be consuming almost one third of world's available antibiotics.

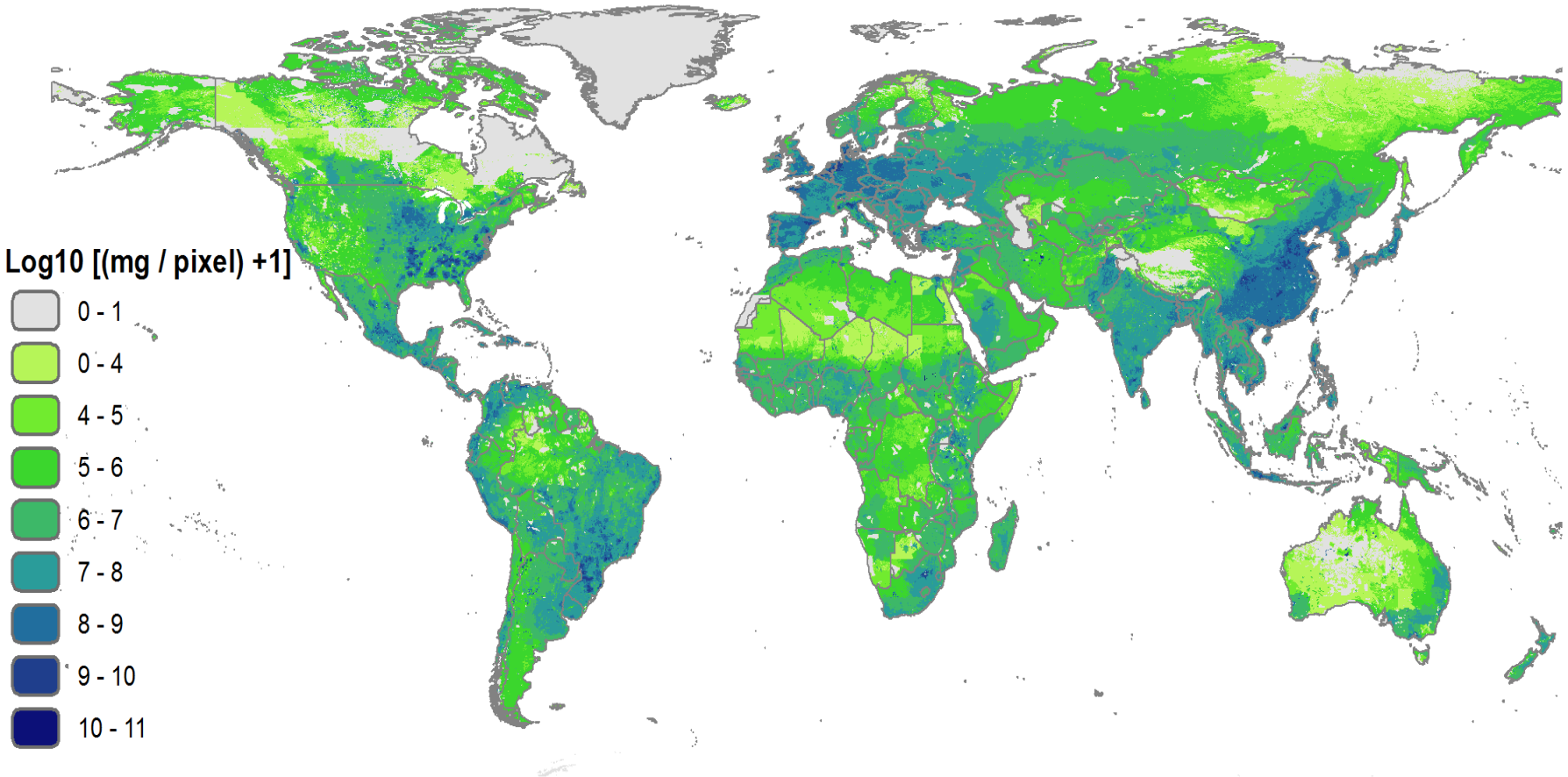




Antimicrobial resistance

Global antimicrobial use in food animals

(mg per 10km pixel)



Source: Van Boeckel et al. 2015

Antimicrobial resistance

- The European Union banned the use of antibiotics to boost animals' growth in 2006
- There is a ‘voluntary’ ban in the USA
- Chick-fil-A, McDonalds and Costco stopping antimicrobial use in the production chain

- ➜ Concerted action – multi-stakeholder platforms
- ➜ Strengthen the evidence base linking agricultural use to AMR in the medical sector
- ➜ Appropriate approaches in different settings – poor countries may not have the ‘resilience’ or ‘capacity’ of Europe in withstanding a blanket ban, for example
- ➜ This is a global issue and calls for a coordinated, global response

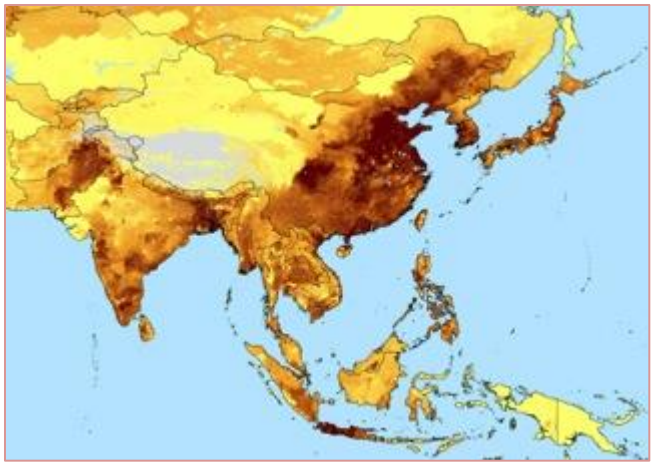
In conclusion

- Rapid demand growth for Animal Source Foods – particularly in developing and emerging economies
- The response of the livestock sector to this growth has major implications for global, interconnected, public goods
- This calls for integrated solutions to guide sector development along a sustainable pathway
- These are global issues and require global responses

Livestock, livelihoods, gender and food security

Isabelle Baltenweck & Alessandra Galie

Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015



ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

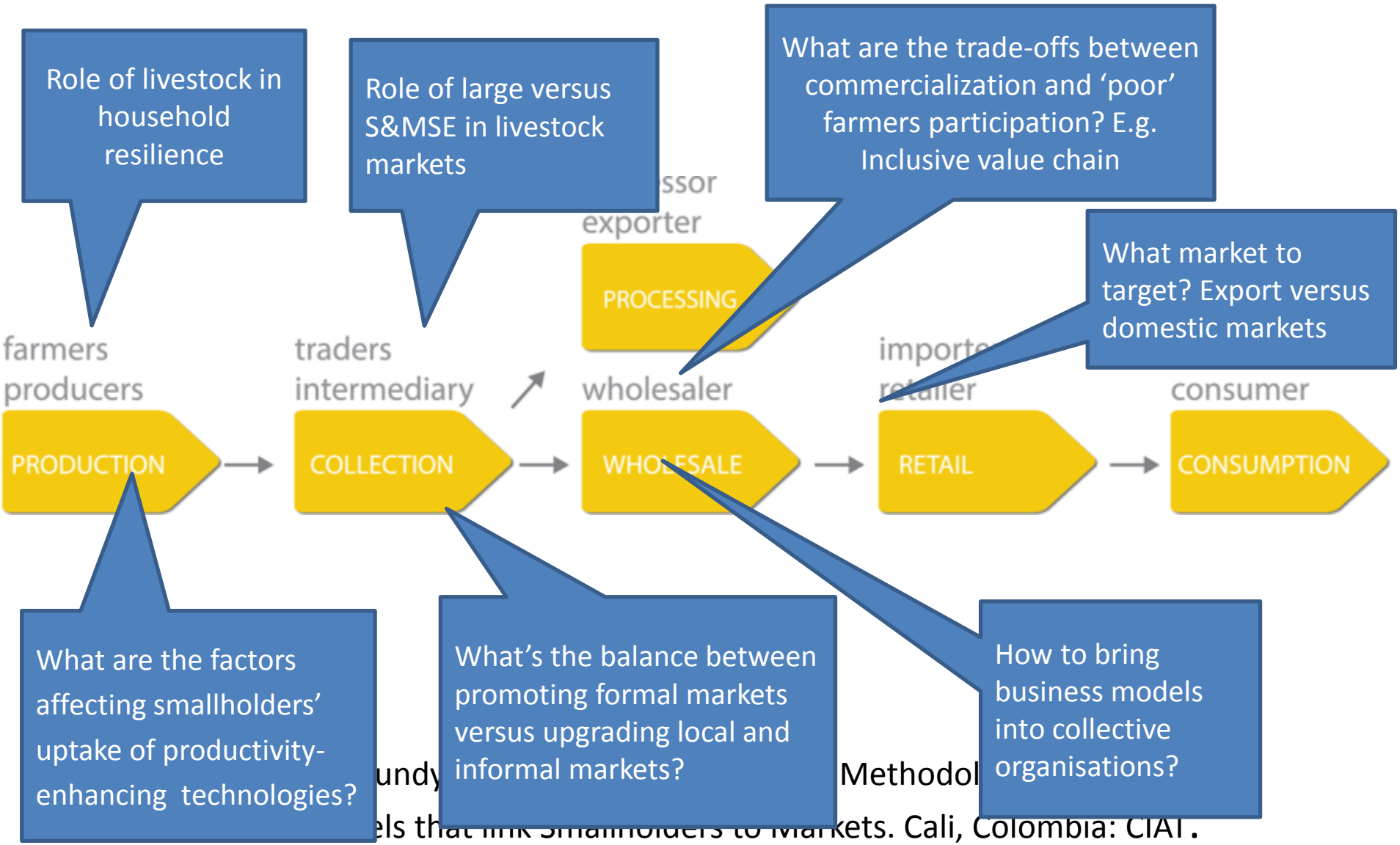
CFS Committee on World Food Security

HLPE High Level Panel of Experts

Livestock & livelihood options, key issues

- 70% of the world's rural poor rely on livestock for important parts of their livelihoods.
- Nearly 1 billion poor livestock keepers in the world, around two-thirds are rural women.
- Over 100 million landless people keep livestock.
- Livestock is a direct source of food (milk/ eggs/ meat) and provides income
- Livestock as an asset to protect against shocks
- In the poorest countries, livestock manure comprises over 70% of soil fertility amendments
- Rural income multipliers are higher for livestock than for other commodities
- Many employed in local informal livestock product markets, as well as input markets and services

Livestock & livelihood options, research questions

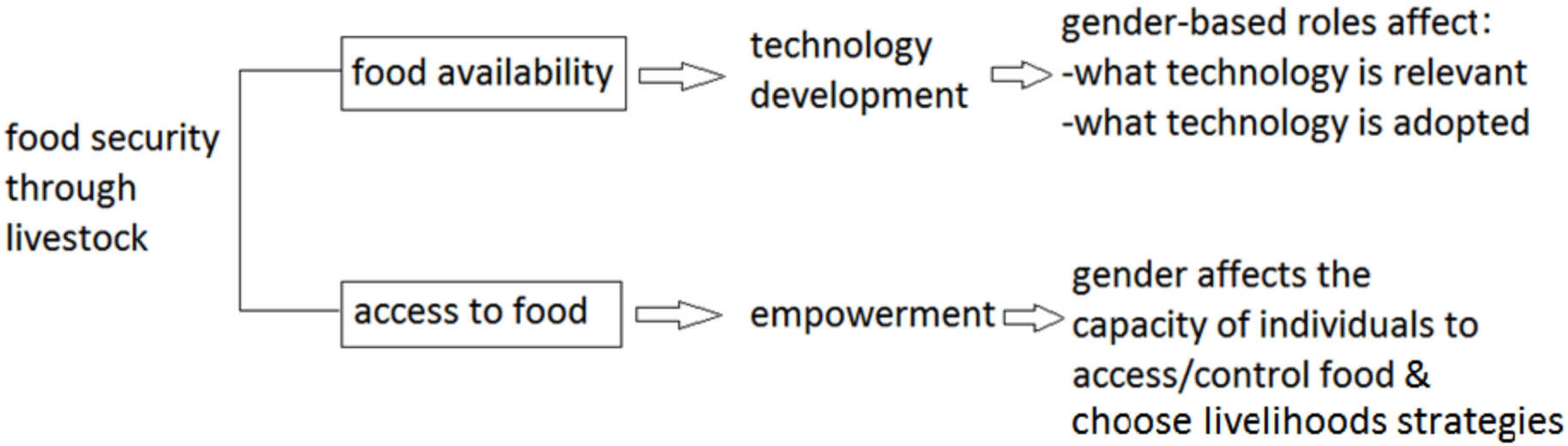


undy Methodol

els that link Smallholders to Markets. Cali, Colombia: CIAT.

Gender and livestock

- Gender in livestock is key for food security & livelihoods:



- Livestock is key for gender equity:

-women can often own animals (more than e.g. land)

-women can often control the milk and its revenues

-livestock is accessible food, livelihoods, collateral, living bank, status

References, contact Isabelle Baltenweck (i.baltenweck@cgiar.org)

- Baltenweck, I. 2014. Linking poor livestock keepers to markets. Rural21 48(4):22-24.
- Dehinenet, G., Mekonnen, H., Kidoido, M., Ashenafi, M and Guerne Bleich, E. (2014). Factors influencing adoption of dairy technology on small holder dairy farmers in selected zones of Amhara and Oromia National Regional States, Ethiopia. *Discourse Journal of Agriculture and Food Sciences*. Vol. 2(5): 126-135
- Dione, M.M., Ouma, E.A., Roesel, K., Kungu, J., Lule, P. and Pezo, D. 2014. Participatory assessment of animal health and husbandry practices in smallholder pig production systems in three high poverty districts in Uganda. Preventive Veterinary Medicine 117(3-4):565-576.
- Elizabeth Waithanji, Jemimah Njuki, Samuel Mburu, Juliet Kariuki & Fredrick Njeru 2015. A gendered analysis of goat ownership and marketing in Meru, Kenya. Development in Practice Vol. 25 (2) pg. 188 - 203
- Farnworth, Cathy and Kathleen Colverson 2015. 'Building a Gender-Transformative Extension and Advisory Facilitation System in Africa', Agri-gender, journal of gender, agriculture and food security, 1, 1, pp. 20-39.
- Galiè, Alessandra, Annet Mulema, Maria A Mora Benard, Sheila N Onzere and Kathleen E Colverson 2015. Exploring gender perceptions of resource ownership and their implications for food security among rural livestock owners in Tanzania, Ethiopia, and Nicaragua. Agriculutre and Food Security 2015 4:2
- Kristjanson, P., Waters-Bayer, A., Johnson, N., Tipilda, A., Njuki, J., Baltenweck, I., Grace, D. and MacMillan, S. 2014. Livestock and women's livelihoods: A review of the recent evidence. IN: Quisumbing, A.R., Meinzen-Dick, R., Raney. T.L., Croppenstedt, A., Behrman, J.A. and Peterman, A.(eds.), Gender in agriculture: Closing the knowledge gap. Dordrecht: Springer and Rome: FAO: 209-233.
- Lapar, M.L., Nguyen, T., Zou, C., Liu, J., Li, X. and Randolph, T. 2014. Assessing impact of feed technology adoption by smallholders in sweetpotato-pig systems in SiChuan, China. *Asian Journal of Agricultural Development* 2014 9 (awaiting mahider link)
- Meinzen-Dick, R., Johnson, N., Quisumbing, A.R., Njuki, J., Behrman, J.A., Rubin, D., Peterman, A. and Waithanji, E. 2014. The gender asset gap and its implications for agricultural and rural development. IN: Quisumbing, A.R. et al. (eds.). 2014. Gender in agriculture: Closing the knowledge gap. Dordrecht: Springer and Rome: FAO: 91-115

ILRI CGIAR

Crop livestock interactions and mixed farm evolution

Alan Duncan, Nils Teufel

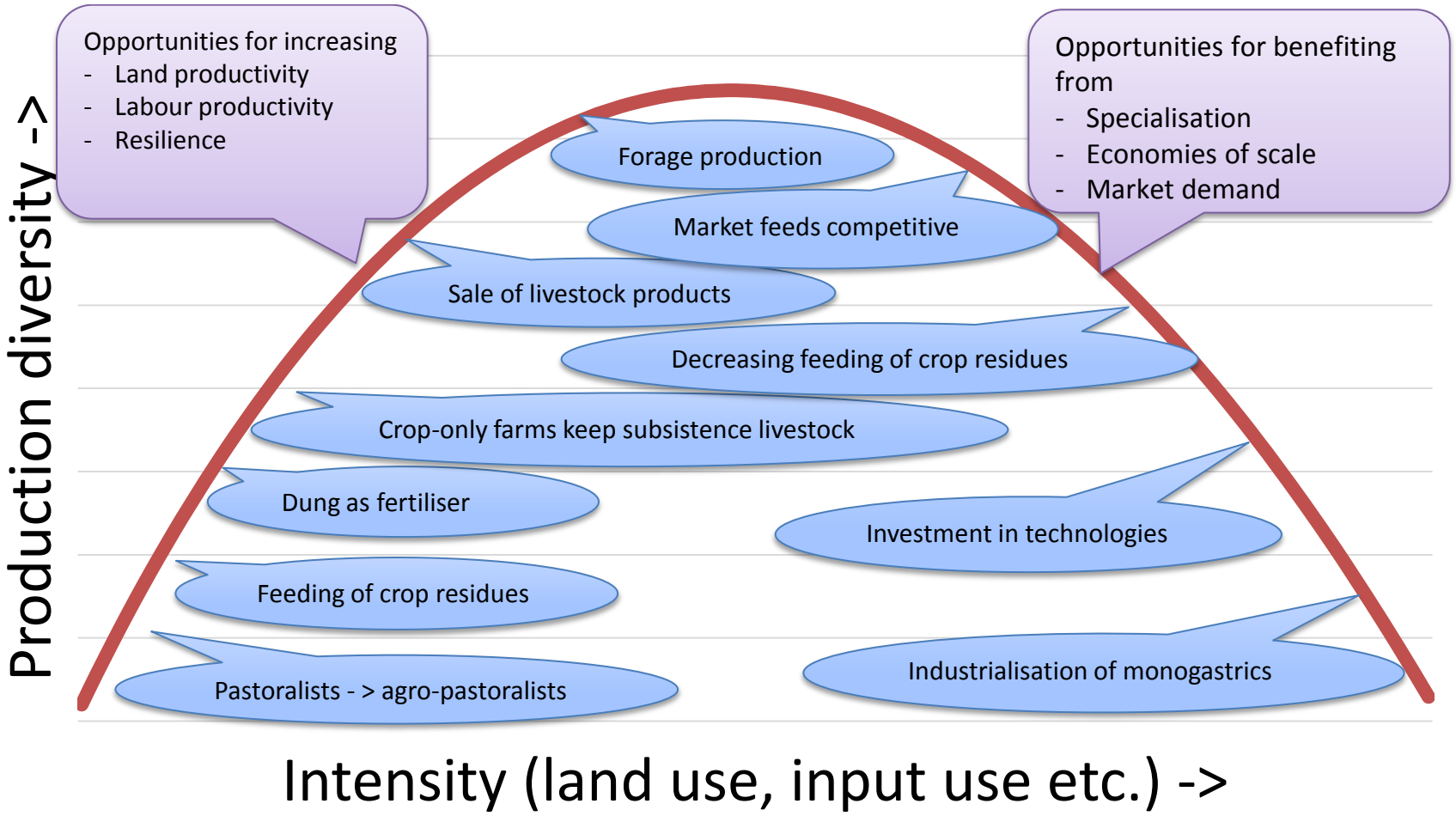
Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

CFS Committee on World Food Security
HLPE High Level Panel of Experts

Typical evolution of mixed farms



Implications for food security & nutrition

- Major assumption:
  Intensification increases food production & diet diversity
- More **efficient resource** use increases food production
- Increasing **production diversity & intensity** improves nutrition through more diverse subsistence consumption
- Greater market integration changes crop-livestock **interactions** and food sources

ILRI CGIAR

ILRI research – efficient resource use

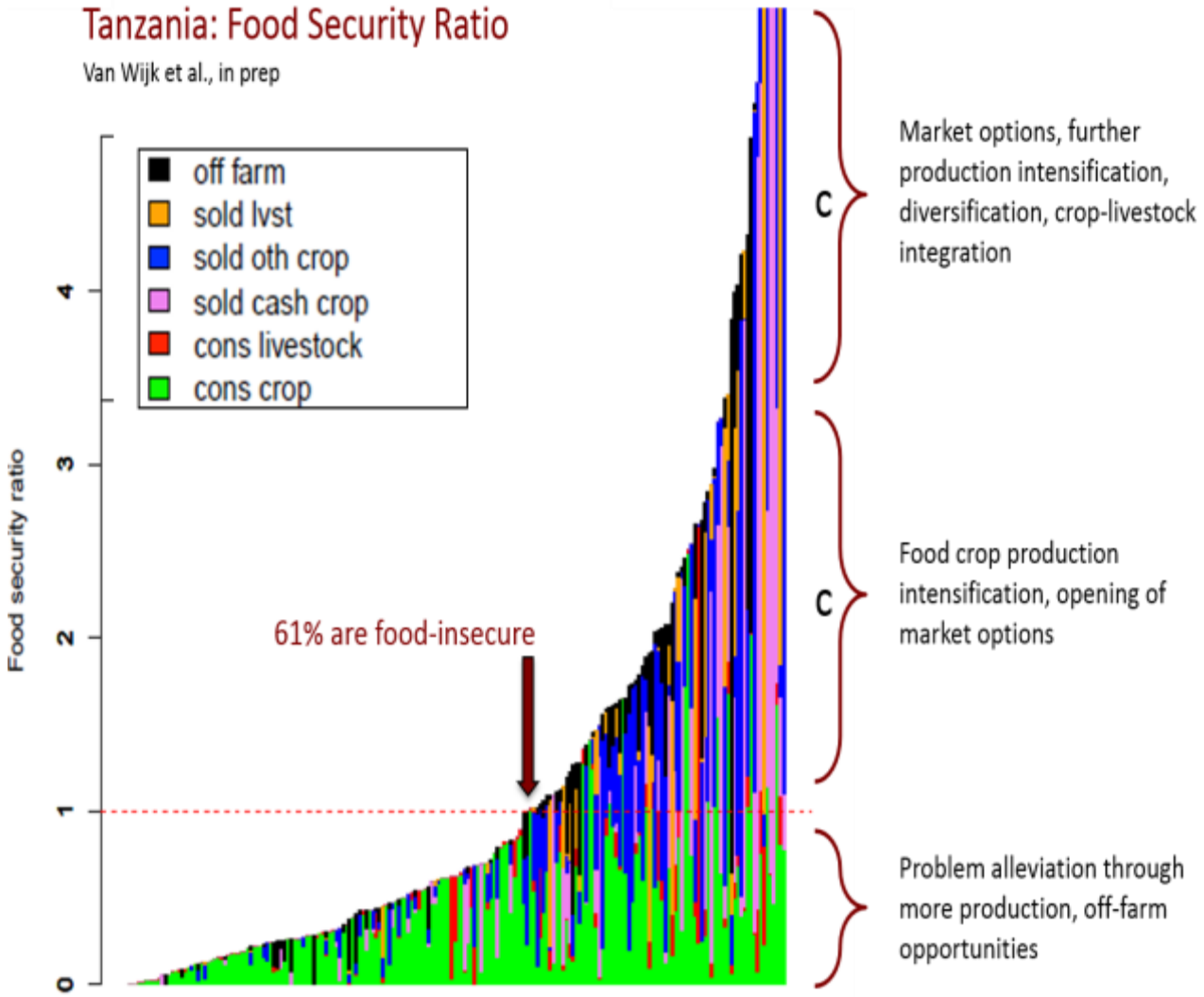
- Crop breeding for improving quality & quantity of residues
  (e.g. sorghum, millet, maize, rice, groundnut)
  (Blümmel 2010; Nigam 2010; Bidinger 2010; Homann-Ke Tui 2013; Blümmel 2013a)
- Identification of innovative & appropriate forage species & varieties
  (gene-bank, e.g. napier varieties , stylosanthes, brachiaria, desmodium, gliricidia)
  (Jorge 2012; Baltenweck 2014; ILRI 2014)
- Knowledge dissemination on processing and utilisation of crop residues
  (cereals, legumes, tubers) (Anandan 2013; Lukuyu 2013; Katjiuongua 2015)
- Quantification of livestock contributions to household livelihoods and
  opportunity costs of feed
  (Klapwijk 2014a; Valbuena 2015; Henderson 2015)

ILRI research – production diversity

- Nutrition impact of production diversification (Korir 2015)
- Distribution of food security amongst households (Silvestri 2015; van Wijk 2014; Ritzema 2015)
- Evolution of food sources (Douxchamps 2014)
- Farm typologies, food security and diet diversity (Hengsdijk 2014; Teufel 2015)

ILRI CGIAR

Example: Distribution of food security



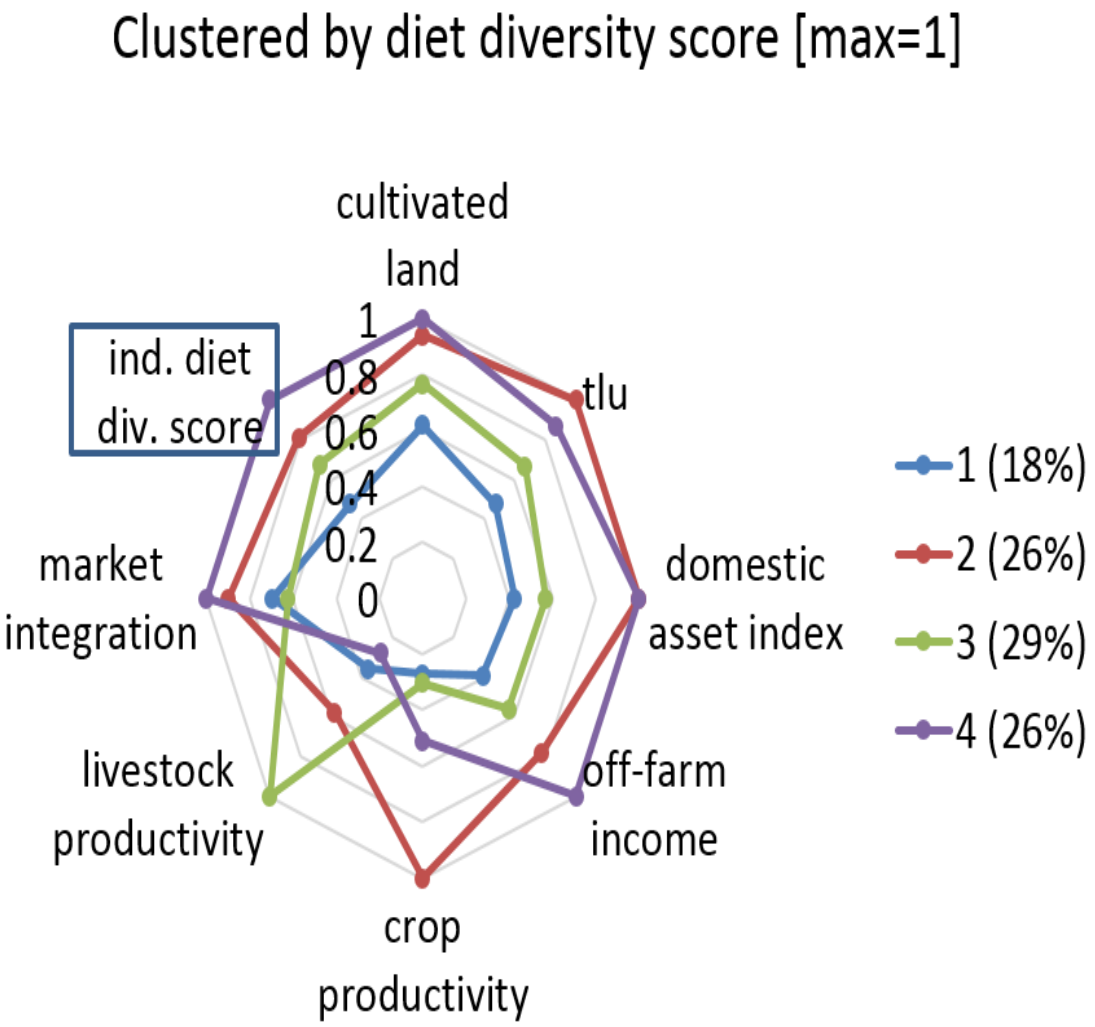
ILRI CGIAR

ILRI research – production diversity

- Nutrition impact of production diversification (Korir 2015)
- Distribution of food security amongst households (Silvestri 2015; van Wijk 2014; Ritzema 2015)
- Evolution of food sources (Douxchamps 2014)
- Farm typologies, food security and diet diversity (Hengsdijk 2014; Teufel 2015)

ILRI CGIAR

Example: Farm typologies by diet diversity



ILRI research – interactions and trade-offs

Increasing and decreasing demand for crop residues as feed
livestock density ↑ - *draft power* ↓ - *crop productivity* ↑
(Valbuena 2014; Mekasha 2014; Blümmel 2013b)

Contribution and market value of crop residues
(Klapwijk 2014b; Wright 2010; Teufel 2011)

More market integration leads to changes in food sources

- ❑ More resources to acquire food (ETC/Heifer 2013; Kidoido 2014)
- ❑ Higher opportunity costs of subsistence consumption (Duncan 2013)

Limits of intensification

- ❑ Resource limitations to food security; focus on off-farm income (Frelat 2015)
- ❑ Intensification may threaten sustainability (Duncan 2015)

References – efficient resource use

S. Anandan, A.A. Khan, D. Ravi, M.S.B. Rao, Y. Ramana Reddy and M. Blümmel (2013): Identification of a superior dual purpose maize hybrid among widely grown hybrids in South Asia and value addition to its stover through feed supplementation and feed processing. Field Crops Res 153 52-57.

I. Baltenweck, A. Jorge, J. Poole, B. Lukuyu, C. Marita and E. Kinuthia (2014): Napier grass uptake and disease assessment report. ILRI, Nairobi.

F.R. Bidinger (The Late), M. Blümmel, C.T. Hash And S. Choudhary 2010: Genetic Enhancement for Superior Food-Feed Traits in a Pearl Millet (Pennisetum glaucum (L.) R. Br.) Variety by Recurrent Selection. Anim Nutr Feed Tech 10S 61-68.

M. Blümmel, E. Grings and O. Erenstein (2013): Potential for dual-purpose maize varieties to meet changing maize demands: Synthesis. Field Crops Res 153 107-112.

M. Blümmel, A. Vishala, D. Ravi, K.V.S.V. Prasad, Ch. Ramakrishna Reddy and N. Seetharama 2010: Multi-environmental Investigations of Food-Feed Trait Relationships in Kharif and Rabi Sorghum (Sorghum bicolor (L) Moench) Over Several Years of Cultivars Testing in India. Anim Nutr Feed Tech 10S 11-22.

B. Henderson, M. van Wijk, C. Godde, S. Silvestri, S. Douxchamps, B. Power, C. Rigolot and M. Herrero (2015): Closing system-wide yield gaps to increase food supply and mitigate GHGs among mixed crop-livestock smallholders in Sub-Saharan Africa. On-going study at CSIRO.

H. Katjiuongua (2015): Enhancing competitiveness of smallholder livestock in Botswana. Study ongoing.

S. Homann-Kee Tui, M. Blümmel, D. Valbuena, A. Chirima, P. Masikati, A.F. van Rooyen and G.T. Kassie (2013): Assessing the potential of dual-purpose maize in southern Africa: A multi-level approach. Field Crops Res 153 37-51.

ILRI (2014): Using forage germplasm to improve livestock feeds and rural livelihoods: an impact narrative. ILRI Research Brief 29 39-48.

A. Jorge, J. Hanson, A. Tedla and A. Abdena (2012): Promoting forages for livestock feed through germplasm and knowledge. In: Assefa, G., Dejene, M., Hanson, J., Anemut, G., Mengistu, S. and Mengistu, A. 2012. Forage seed research and development in Ethiopia. Addis Ababa: EIAR: 45-58.

L. Klapwijk, C. Bucagu, M.T. van Wijk, H.M.J. Udo, B. Vanlauwe, E. Munyanziza and K.E. Giller (2014a): The 'One cow per poor family' programme: Current and potential fodder availability within smallholder farming systems in southwest Rwanda. Agricultural Systems 131, 11-22.

B.A. Lukuyu, A.J. Murdoch, D. Romney, D.M. Mwangi, J.G.M. Njuguna, A. McLeod and A.N. Jama (2013): Integrated maize management options to improve forage yield and quality on smallholder farms in Kenya. Field Crops Res 153 70-78.

S.N. Nigam and M. Blümmel (2010): Cultivar-Dependent Variation in Food-Feed-Traits in Groundnut (Arachis hypogaea L.). Anim Nutr Feed Tech 10S.

D. Valbuena, S. Homann-Kee Tui, O. Erenstein, N. Teufel, A. Duncan, T. Abdoulaye, B. Swain, K. Mekonnen, I. Germaine, B. Gérard (2015): Identifying determinants, pressures and trade-offs of crop residue use in mixed smallholder farms in Sub-Saharan Africa and South Asia. Agricultural systems 134 107-118.

ILRI CGIAR

References – production diversity

S. Douxchamps, M.T. van Wijk, S. Silvestri, A.S. Moussa, C. Quiros, N.Y.B. Ndour, S. Buah, L. Somé, M. Herrero, P. Kristjanson, M. Ouedraogo, P.K. Thornton, P. van Asten, R. Zougmoré and M.C. Rufino (2014): Linking agricultural adaptation strategies and food security: evidence from West Africa. Tropentag 2014, Prague 17-19/09/2014.

R. Frelat, S. Lopez-Ridaura, K. E. Giller, M. Herrero, S. Douxchamps, A. Djurfeldt, O. Erenstein, M. Kassie, B. Paul, C. Rigolot, R. Ritzema, D. Rodriguez, P. van Asten and M.T. van Wijk (2015): Estimation of the minimum farm size for food secure smallholder farmers in Sub-Saharan Africa. Evidence from more than 13000 farm households. Agricultural Systems, to be submitted.

H. Hengsdijk, A.C. Franke, M.T. van Wijk and K.E. Giller (2014): How small is beautiful? Food self-sufficiency and land gap analysis of smallholders in humid and semi-arid sub Saharan Africa. Report 562, Wageningen University and Research Center.

L. Korir, M. Kidoido and N. Teufel (2015): Impacts of Dairy Goat Production on Nutrition and Income Security of Smallholder Farmers in Tanzania. Tropentag 2015, submitted.

R.S. Ritzema, R. Frelat, S. Douxchamps, S. Silvestri, M. Rufino, M. Herrero, K. Giller, S. Lopez-Ridaura, N. Teufel, B. Paul and M.T. van Wijk (2015): A simple food security analysis across smallholder farming systems from East and West Africa: is production intensification likely to make farmers food-secure? Agriculture and Food Security, to be submitted.

S. Silvestri, S. Douxchamps, P. Kristjanson, W. Foerch, M. Radeny, I. Mutie, C. Quiros, M. Herrero, A. Ndungu, N. Ndiwa, J. Mango, L. Claessen and M.C. Rufino (2015): Household and food security: lessons from food secure households in East Africa. Agriculture and Food Security, under review.

N. Teufel, E. Kihoro, C. Adoyo, C. Quiros, J. Poole, M. van Wijk and A. Karimov (2015): Farming system patterns: cluster analysis from a Humidtropics baseline survey in Western Kenya. Integrated systems, Ibadan 03-06/03/2015.

M.T. van Wijk, R. Ritzema, D. Valbuena, S. Douxchamps and R. Frelat (2014): A rapid, quantitative assessment of household level food security: description of the data collection tool and the analysis. ILRI. https://mahider.cgiar.org/handle/10568/56694.

ILRI CGIAR

References – interactions and trade-offs

A. J. Duncan, K. Mekonnen, F. Bachewe, D. Valbuena, G. Rachier, D. Lule, M. Bahta and O. Erenstein (2015): Crop residue allocation to livestock feed, soil improvement and other uses along an intensification gradient in Eastern Africa. Agriculture Ecosystems and Environment, under review.

A. J. Duncan, N. Teufel, K. Mekonnen, V.K. Singh, A. Bitew and B. Gebremedhin (2013): Dairy intensification in developing countries: effects of market quality on farm-level feeding and breeding practices. Animal 7 2054-262.

ETC/Heifer, 2013: EADD final evaluation report. Nairobi

M. Blümmel, S. Homann-Kee Tui, D. Valbuena, A. Duncan and M. Herrero (2013b): Biomass in crop-livestock systems in the context of the livestock revolution. Secheresse 24: 330-339

M. Kidoido and L. Korir (2014): Do low-income households in Tanzania derive income and nutrition benefits from dairy innovation and dairy production. Food Security, published on-line.

L. Klapwijk, M.T. van Wijk, P. van Asten, P.K. Thornton and K.E. Giller (2014b): Trade-off Analysis in (Tropical) Agricultural Systems. COSUST 6, 110 – 115.

A. Mekasha, B. Gerard, K. Tesfaye, L. Nigatu and A. J. Duncan (2014): Inter-connection between land use/land cover change and herders'/farmers' livestock feed resource management strategies: a case study from three Ethiopian eco-environments. Agriculture Ecosystems & Environment 188:150-162.

N. Teufel, N. Johnson and D. Singh (2011): The adoption and impact of an improved groundnut variety in mixed crop-livestock systems in Southern India. Asian Society of Agricultural Economics. Hanoi Oct 13-15 2011.

D. Valbuena, S. Homann-Kee Tui, O. Erenstein, N. Teufel, A. J. Duncan, T. Abdoulaye, B. Swain, K. Mekonnen, I. Germaine, and B. Gerard (2014): Identifying determinants, pressures and trade-offs of crop residue use in mixed smallholder farms in Sub-Saharan Africa and South Asia. Agricultural Systems, published online

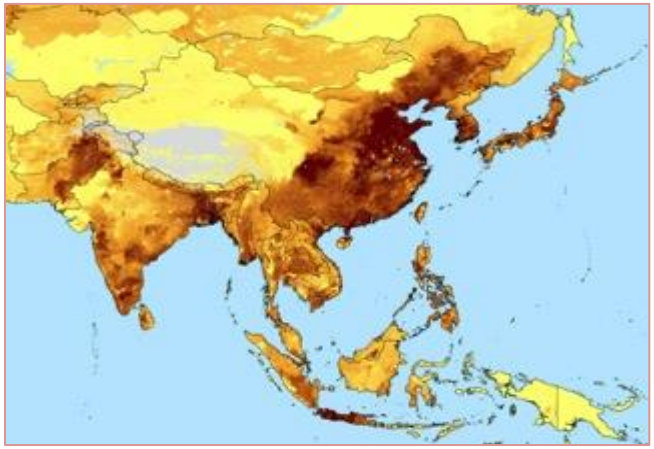
I. Wright, D. Singh, V. Kumar, N. Teufel, M. Blümmel, I. Baltenweck, T.F. Randolph, K.M. Singh (2010): Improvement of Fodder Markets and Identification of Crop Varieties with Improved Fodder Characteristics in Selected Disadvantaged Areas of India. Project report to OFID pp 30, ILRI Nairobi.

ILRI CGIAR

Livestock and Environment

Mats Lannerstad

Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015



ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

CFS Committee on World Food Security

HLPE High Level Panel of Experts

Environmental scale of livestock

Land

30 percent global terrestrial biomes (Foley et al 2005)

33% all croplands (Steinfeld et al 2006)

Water

~ 4,000 km^3 evapotranspiration - feeds, fodder & grazing

(3,200 km^3 evapotranspiration - food crops) (Heinke et al manuscript)

Feed biomass

~4.7 billion tons - feed biomass

- grasses	48 %	
- grains	28 %	
- occasional feed & stover	24 %	(Herrero et al 2013)

GHGs

14.5 % anthropogenic GHG emissions, 65% cattle (meat/milk/manure/draft power)

- feed production & processing	45 %	
- enteric fermentation	39 %	
- manure storage & processing	10 %	(FAO 2013)

Livestock & Environment – multiple dimensions impacting nutrition

Natural Resources Use

- Local degradation and scarcity
- ”Carrying capacity”
- Planetary Boundaries
- Natural resource use footprints

Emissions / Pollution

- GHGs
- Nutrient leakage
- Antibiotics, etc.
- Pollution/emission footprints

Livestock & Environment – multiple dimensions impacting nutrition

Natural Resources Use

- Local degradation and scarcity
- ”Carrying capacity”
- Planetary Boundaries
- Natural resource use footprints

Emissions / Pollution

- GHGs
- Nutrient leakage
- Antibiotics, etc.
- Pollution/emission footprints

Global Environmental Change

- Livestock contribute to CC
- CC impact livestock production

Vertical chain perspective

- Impacts along the Value Chains

System perspective

- Across scales, local → landscape → etc.
- Resource competition, land, water, etc.
- Environmental ”multi-currency” analyses
- Ecosystem services & resilience

Environment and Climate Smart Livestock Production

Natural resource use and Environmental footprints

- Developing country figures – local (lab) to global (modelling)
- Local context relevance – different systems & climate zones
- Multi-currency assessments – trade-offs & synergies

Environment and Climate Smart Livestock Production

Natural resource use and Environmental footprints

- Developing country figures – local (lab) to global (modelling)
- Local context relevance – different systems & climate zones
- Multi-currency assessments – trade-offs & synergies

Evidence based strategies and interventions

- How to mitigate GHGs emission – feeds/manure/etc.
- Improved natural resources use efficiency
- How to adapt to climate change – stakeholder engagement
- Strengthening resilience of entire socio-ecological system

References - Environment & Livestock

Ayantunde A., Rainer Asse, Said, M.Y., and Abdou Fall (2014) Transhumant pastoralism, sustainable management of natural resources and endemic ruminant livestock in the sub-humid zone of West Africa. *Environ Dev Sustain* 16: 1097-1117. DOI 10.1007/s10668-014-9515-z

Bryan E., Ringler C., Okoba B., Roncoli C., Silvestri S., Herrero M. 2013. Adapting Agriculture to Climate Change in Kenya: Household strategies and determinants. *Journal of Environmental Management*, 114: 26-35.

De Leeuw, J., Osano, P.; Said, M.Y., Ayantunde, A.; Dube, S., Neely, C.; Vrieling, A., Ericksen, P. (in review) Pastoral farming systems and food security in Sub-Saharan Africa. Priorities for science and policy.

Douxchamps, S., Ayantunde, A., Panyan, E.K., Ouattara, K., Kaboré, A., Karbo, N. and Sawadogo, B. (2014). Agricultural water management and livelihoods in the crop-livestock systems of the Volta Basin. Water Resources and rural Development.

Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro,D., Silvestri, S., Rufino, M.C. 2013. The roles of livestock in developing countries. Animal 7 Suppl: 3 – 18.

Herrero, M., P. Havlík, H. Valin, A. Notenbaert, M. C. Rufino, P. K. Thornton, M. Blümmel, F. Weiss, D. Grace and M. Obersteiner (2013). Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems. *PNAS*.

Herrero, M., P. K. Thornton, A. M. Notenbaert, S. Wood, S. Msangi, H. A. Freeman, D. Bossio, J. Dixon, M. Peters, J. van de Steeg, J. Lynam, P. P. Rao, S. Macmillan, B. Gerard, J. McDermott, C. Sere and M. Rosegrant (2010). Smart Investments in Sustainable Food Production: Revisiting Mixed Crop-Livestock Systems. *Science* 327(5967): 822-825.

M C Rufino, P Brandt, M Herrero and K Butterbach-Bahl. 2014 Reducing uncertainty in nitrogen budgets for African livestock systems. *Environmental Research Letters.* 9 105008

Murungweni C, M.T. van Wijk, KE Giller, JA Andersson, EMA Smaling. 2014. Adaptive livelihood strategies employed by farmers to close the food gap in semi-arid South Eastern Zimbabwe. *Food Security* 6, 313-326

Robinson, Lance W., Polly J Ericksen, Sabrina Chesterman, and Jeff Worden. 2015. Intensification in Drylands: What Resilience and Vulnerability Can Tell Us. *Agricultural Systems*. 135:133-140.

Rockström, J., Falkenmark, M., Folke. C., Lannerstad, M., Barron, J., Enfors, E. Gordon, L., Heinke, J., Hoff, M., and Pahl-Wostl, C. (2014), *Water Resilience for Human Prosperity*, Cambridge University Press.

Rodrigue D.V.C., Schlecht E., Buerkert A., Rufino M.C., Van Wijk M.T. 2013. Increasing nutrient use efficiency through improved feeding and manure management in urban and peri-urban livestock units of a West African city: a scenario analysis. *Agricultural Systems 114: 64–72*.

Rufino M.C., Thornton P.K., Ng'ang'a S.K., Mutie I., Jones P., van Wijk M.T., Herrero, M. 2013. Transitions in agro-pastoralist systems of East Africa: impacts on food security and poverty. Agriculture Ecosystems Environment 179:215-230

Thornton, P.K., Ericksen, P.J., Herrero, M. and Challinor, A.J. (2014) Climate variability and vulnerability to climate change: a review. Global Change Biology, doi: 10.1111/gcb.12581.

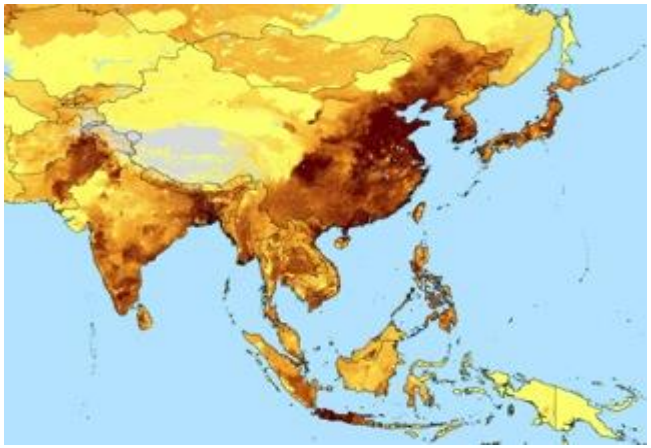
van Wijk, M.T., M.C.Rufino , D. Enahoro , D. Parsons , S. Silvestri , R.O. Valdivia , M. Herrero(2014), Farm household models to analyse food security in a changing climate: A review. Global Food Security , 3 77-84

ILRI CGIAR

Livestock health and food security

Bernard Bett, Johanna Lindahl

Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015



ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

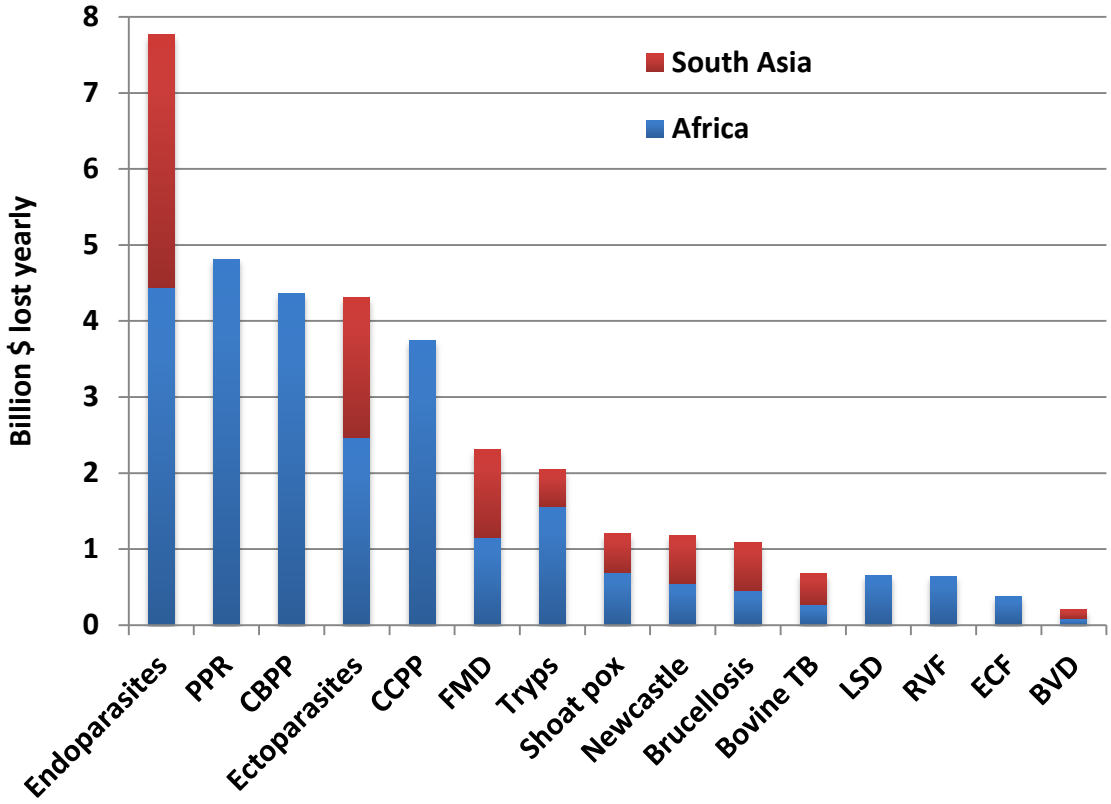
CGIAR

CFS Committee on World Food Security

HLPE High Level Panel of Experts

Impact of livestock diseases

- Livestock diseases – important constraints to livestock production in developing countries
- Predicted to increase with:
  - Agricultural intensification
  - Climate change
  - Inadequate policies
- Challenges on control vary with specific diseases:
  - Endemic diseases
  - Epidemic diseases
  - Emerging diseases

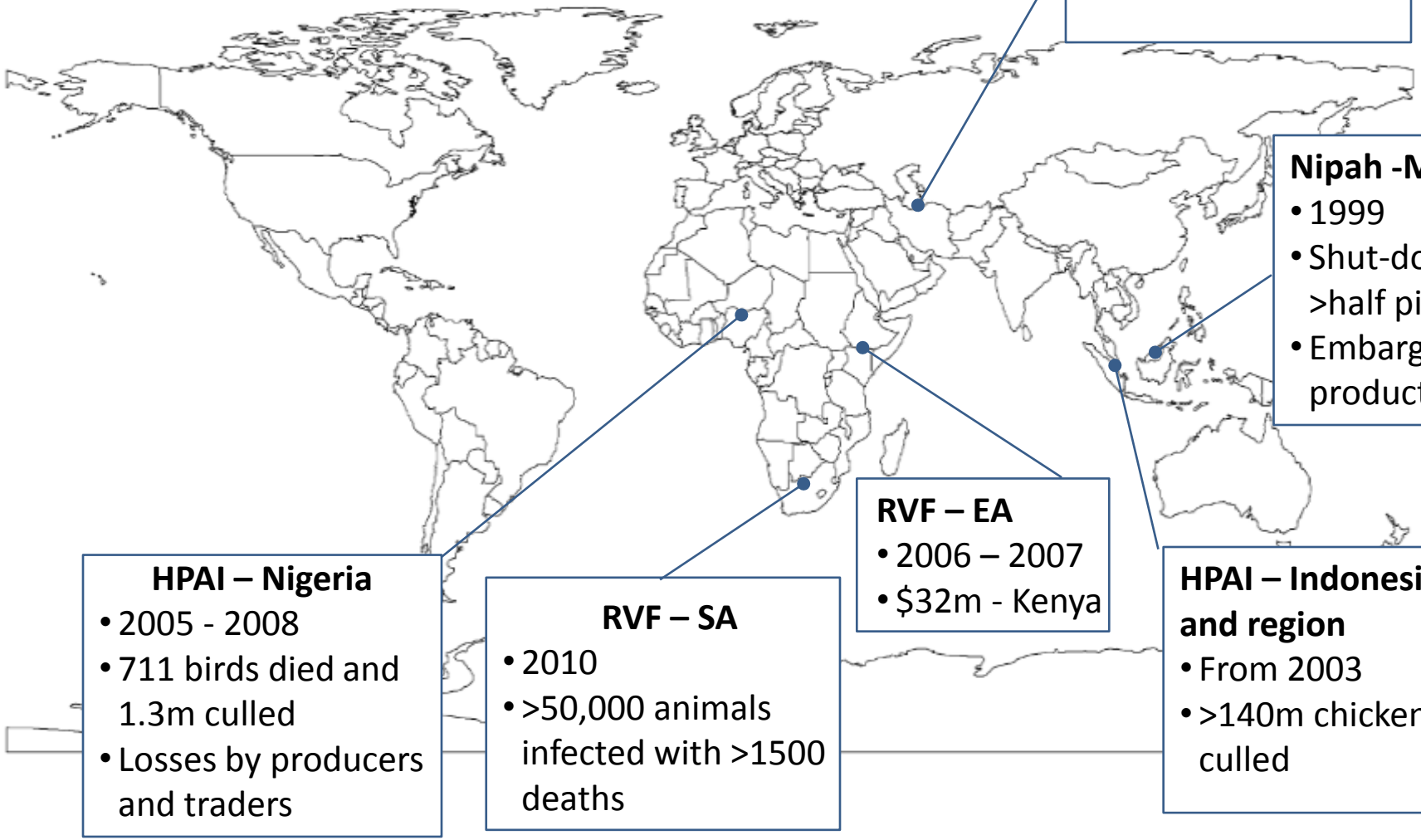


NB: No data for PPR in south Asia but it is widespread in this region

Estimates from BMGF

ILRI CGIAR

EIDs – productivity losses



ASF - Georgia
- 2007 - 2008
- >200,000 pigs slaughtered

Nipah -Malaysia
- 1999
- Shut-down of >half pig farms
- Embargo on pig products

RVF – EA
- 2006 – 2007
- $32m - Kenya

HPAI – Indonesia and region
- From 2003
- >140m chickens culled

HPAI – Nigeria
- 2005 - 2008
- 711 birds died and 1.3m culled
- Losses by producers and traders

RVF – SA
- 2010
- >50,000 animals infected with >1500 deaths

Impact on Food Security

- Availability
  - Productivity losses – meat, milk, eggs
  - Premature mortality, reduced offtake
  - Reduced crop production – draft power, manure
  - Restrictions on types of livestock breeds kept, hence productivity
  - Epidemics and slow recovery rates of livestock populations
- Physical and economic access
  - Control measures – quarantine, slaughter bans
  - Food substitution and price hikes
  - Diseases as non-tariff barriers to trade
  - Livelihoods of market chain actors

Knowledge gaps and on-going research

- Risk detection
  - Disease drivers and interactions
  - EID surveillance – need for biomarkers to identify potential EIDs?
- Risk management
  - Safe and effective technologies - vaccines
  - Improved targeting of interventions
  - Decision Support Tools

ILRI CGIAR

Key references

1. Kavle, J., El-Zanaty, F., Landry, M., Galloway, R., 2015. The rise in stunting in relation to avian influenza and food consumption patterns in Lower Egypt in comparison to Upper Egypt: results from 2005 and 2008 Demographic and Health Surveys. BMC Public Health 15. doi:10.1186/s12889-015-1627-3

2. Alders, R., Awuni, J.A., Bagnol, B., Farrell, P., De Haan, N., 2014. Impact of avian influenza on village poultry production globally. Ecohealth 11, 63–72. doi:10.1007/s10393-013-0867-x

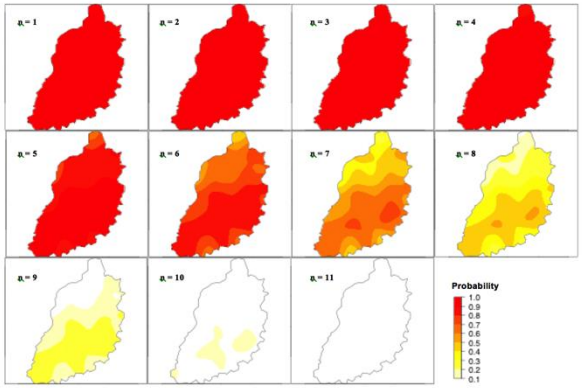
ILRI CGIAR

Livestock & human nutrition; livestock & human health

Prof Eric Fèvre and Dr Silvia Alonso

Agriculture for Nutrition and Health

Sustainable Agricultural Development for Food Security and Nutrition, including the role of Livestock, HLPE Seminar with ILRI, 8 May 2015



ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

CFS Committee on World Food Security

HLPE High Level Panel of Experts

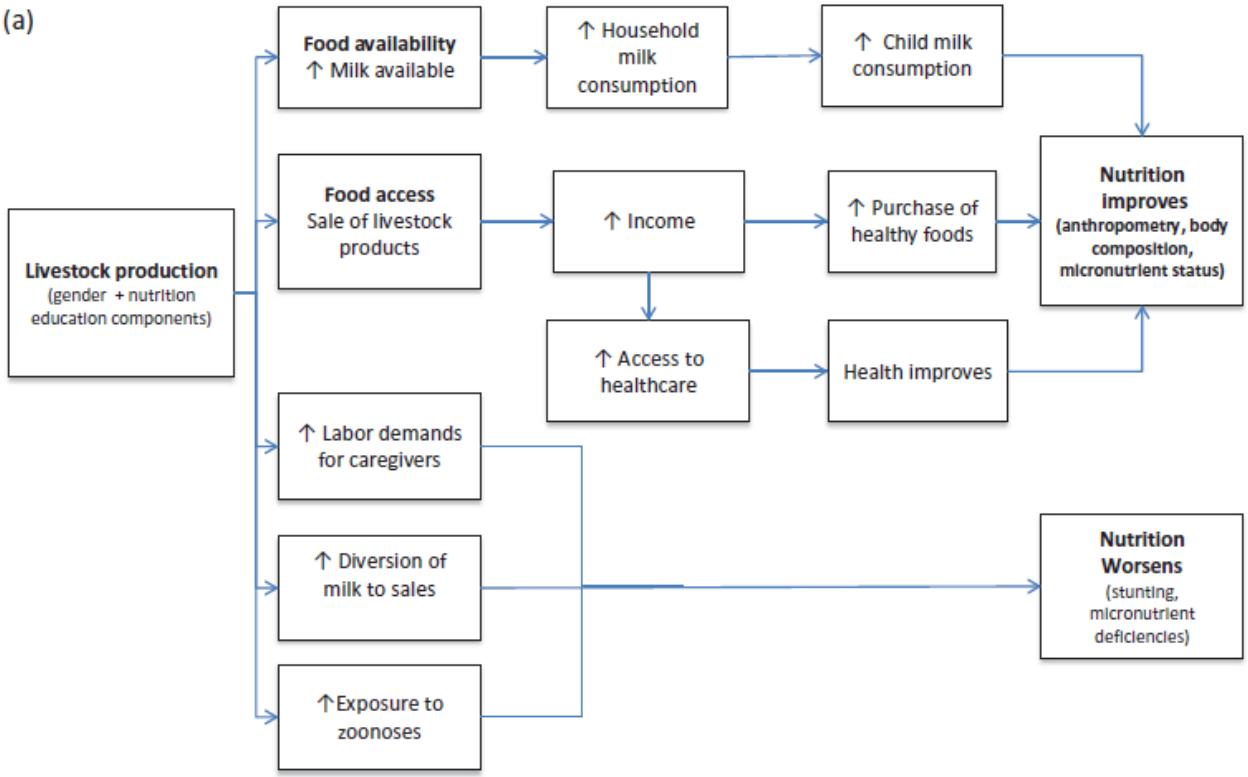
Health – and livestock production

Livestock production is important for general health

- **Products provide cash money for food purchases**
- **Provides income for healthcare expenses**
- **Provides direct access to ASF ****

May also have adverse health outcomes (eg zoonoses)

(a)



Evidence from intervention studies

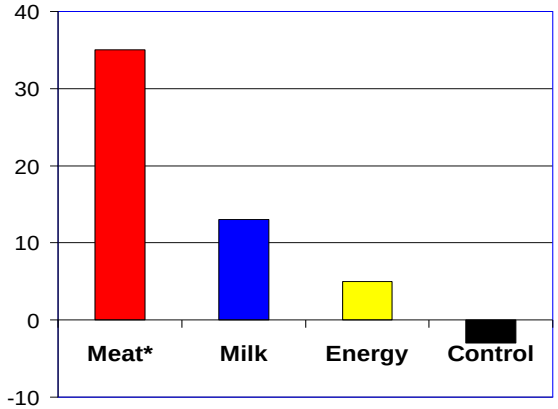
Observational studies

Strong evidence for ASF = improved child growth and micronutrient status

Intervention studies - few

Meat (70 g/d) improved activity and leadership, cognitive function, school tests….

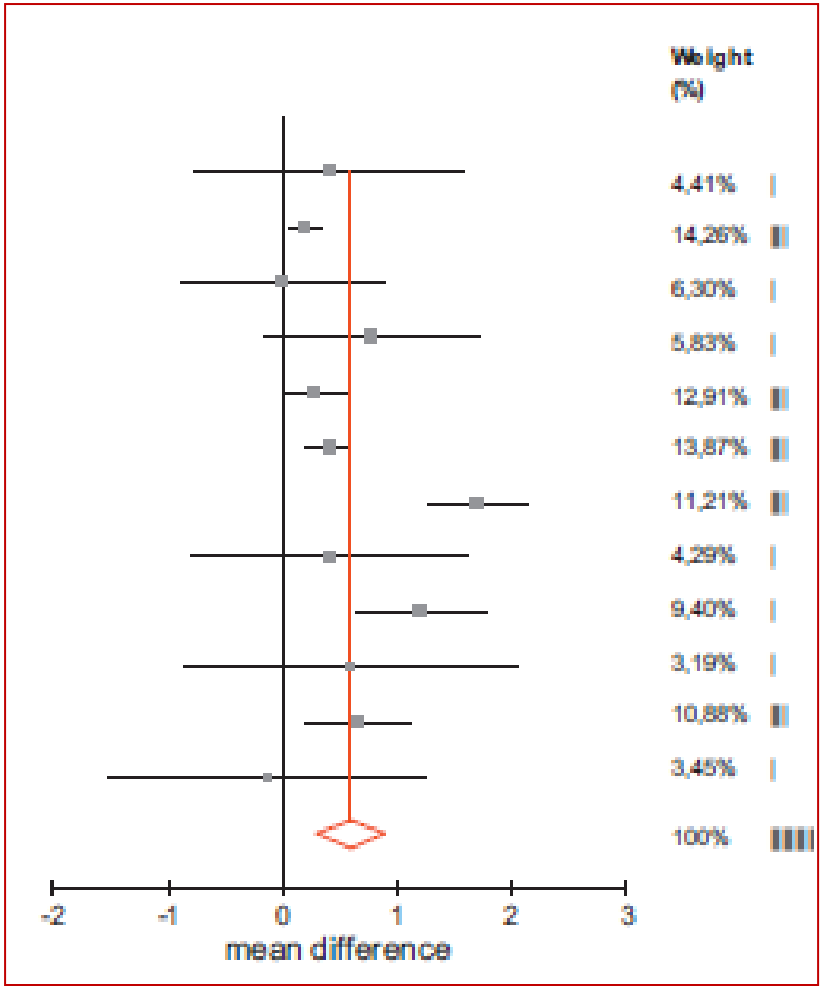
Increasing milk intake improves growth of young children and school children (including in industrialized countries)



End of term test scores

Animal source food interventions in Kenya, 7- 10 y (Neumann, C. et al.)

+750 mL milk → 0.4 cm ↑ height



Meta-analysis of dairy products and physical stature (de Beer et al., 2012)

Research gaps

- Scientific evidence of causative ASF-nutrition link still weak
- Limited evidence for many ASFs; variations by population strata not quantified well (illness, pregnant, breastfeeding)

And essential research questions remain:

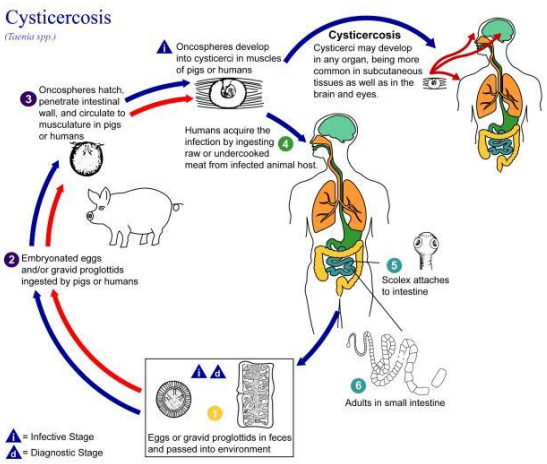
"*which are the most effective ways to increase ASF in the diets in low income populations (livestock VC actors and others)*"

ILRI is currently undertaking studies to assess the impact of livestock interventions on women and children nutritional outcomes in Uganda (pork VC) and Tanzania (dairy VC), and evaluate the mediator role of women's empowerment in livestock systems

Survey completed to assess access to ASF and nutritional outcomes in households in low income areas in Nairobi.

Zoonoses and zNTDs in extensive and intensive livestock systems

- Push-pull benefits of livestock to health
- Focus tends towards the role of livestock in adverse health events
- Mitigation: human health benefit from livestock targeted intervention
- One Health



A concrete example: cysticercosis

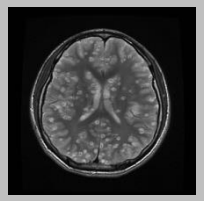
Problems in livestock production leading to adverse health

Most significant parasitic food borne disease (Asia, Africa, S. America) in terms of DALYs

Human infection: inadequate systems of meat inspection at slaughter

Porcine infection: poorly integrated pig husbandry systems with free-ranging pigs

Env. Contamination: lack of sanitation in small-holder livestock production systems



Tools exist: new pig vaccines prevent infection, drugs to kill worms, new diagnostics (ILRI)

Research needs:

How to best deploy these tools on a large scale?

Finding geographical foci of infection in farming systems

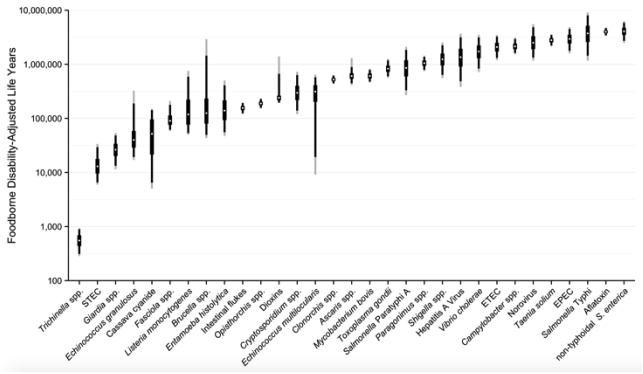
Intervening sustainably to eliminate transmission

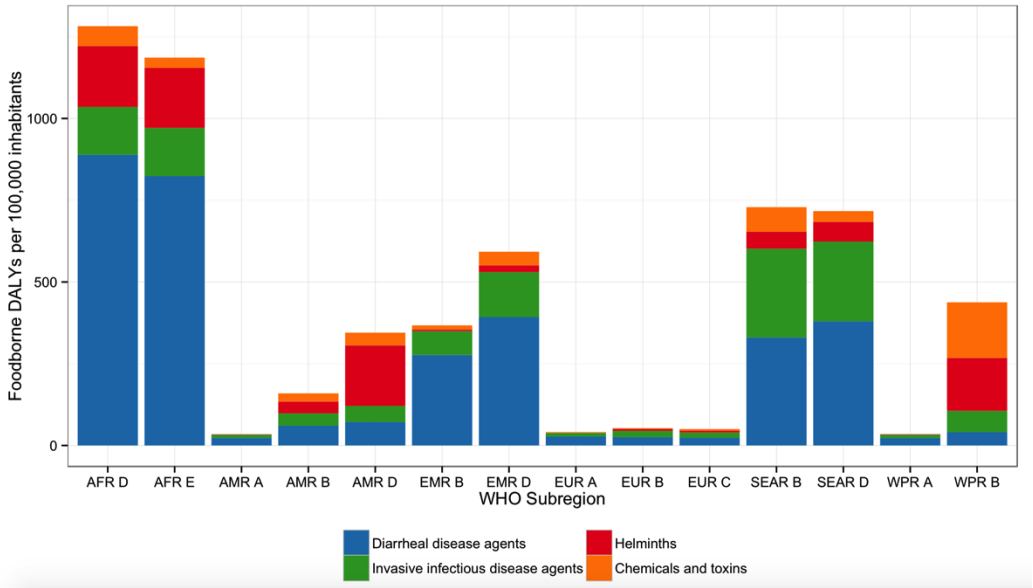
= better food safety and health

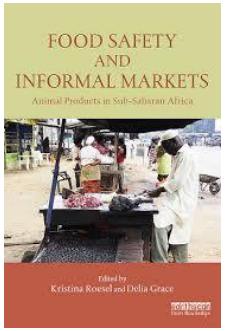
ILRI CGIAR

Food borne disease…and animal source foods

- What do food borne diseases contribute to ill-health globally? Regionally?
- Metrics have been applied at global scale
- Data at country levels are severely lacking
- How can we estimate country-level disease burden, apply better diagnostics?
- How does the disease landscape change in rapidly urbanizing societies?
- Quantifying the contribution of ASF has not been formally undertaken
- Determine risk in formal and informal sectors is important and interesting





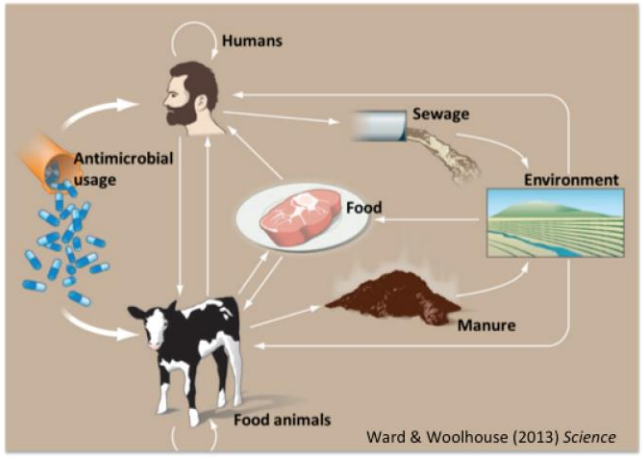


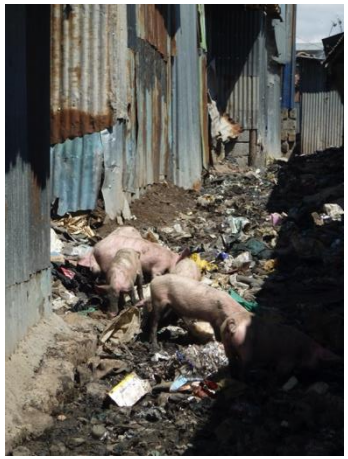
ILRI

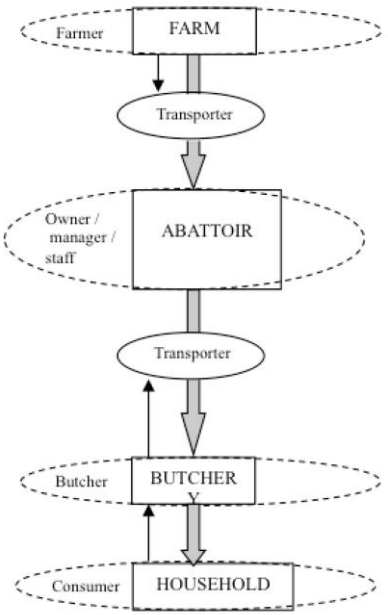
CGIAR

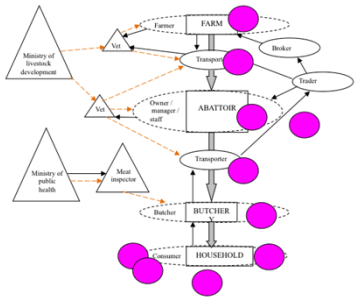
Urbanization

- Urban food production (including livestock) is important for food security, especially for the poorest
- Challenges for veterinary care
- Challenges for hygiene and managing waste
- Challenges for pathogen emergence – cities as ecosystems









- Policy frameworks are – at best - inconsistent
- There is a need for sound evidence for decision-making

ILRI CGIAR