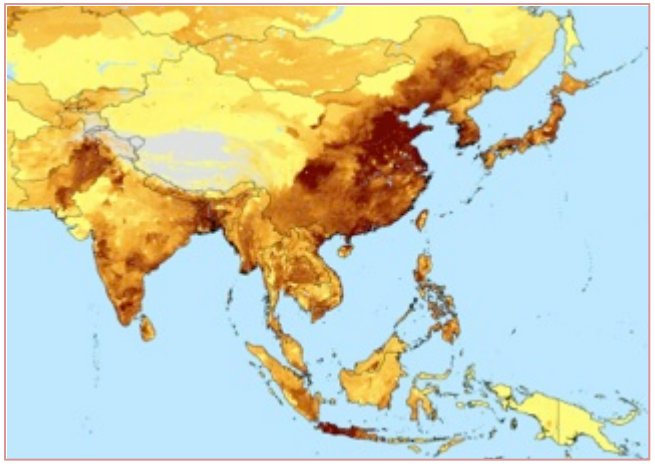
The Livestock Geo-Wiki: Manure management module

Timothy Robinson

Global Agenda for Sustainable Livestock, 5TH Multi-stakeholder Platform Meeting
7-10 October 2014, Cali



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CGIAR

http://www.livestock.geo-wiki.org

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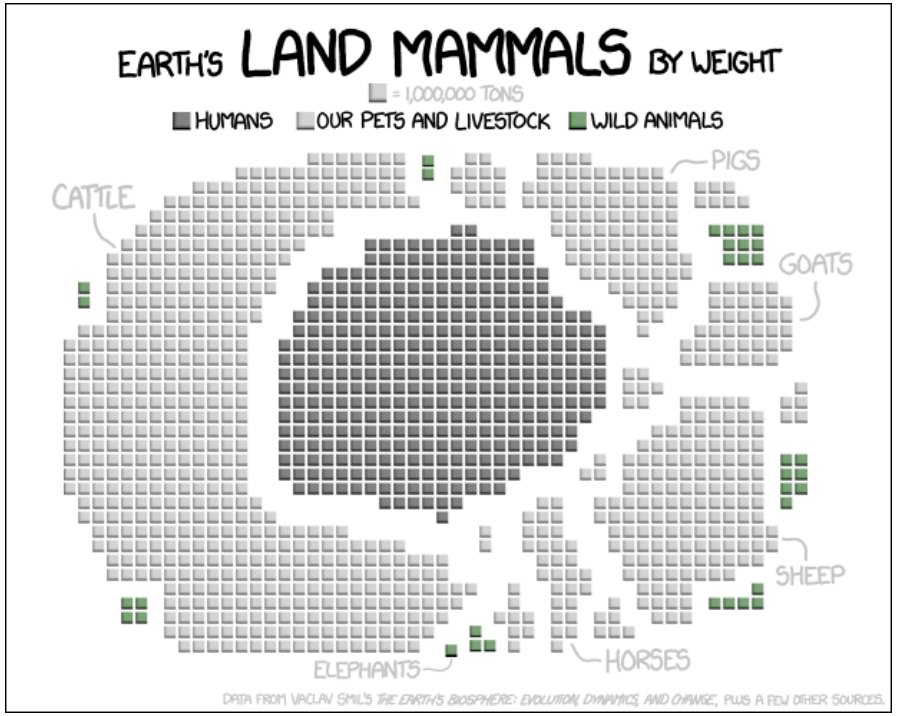
Overview

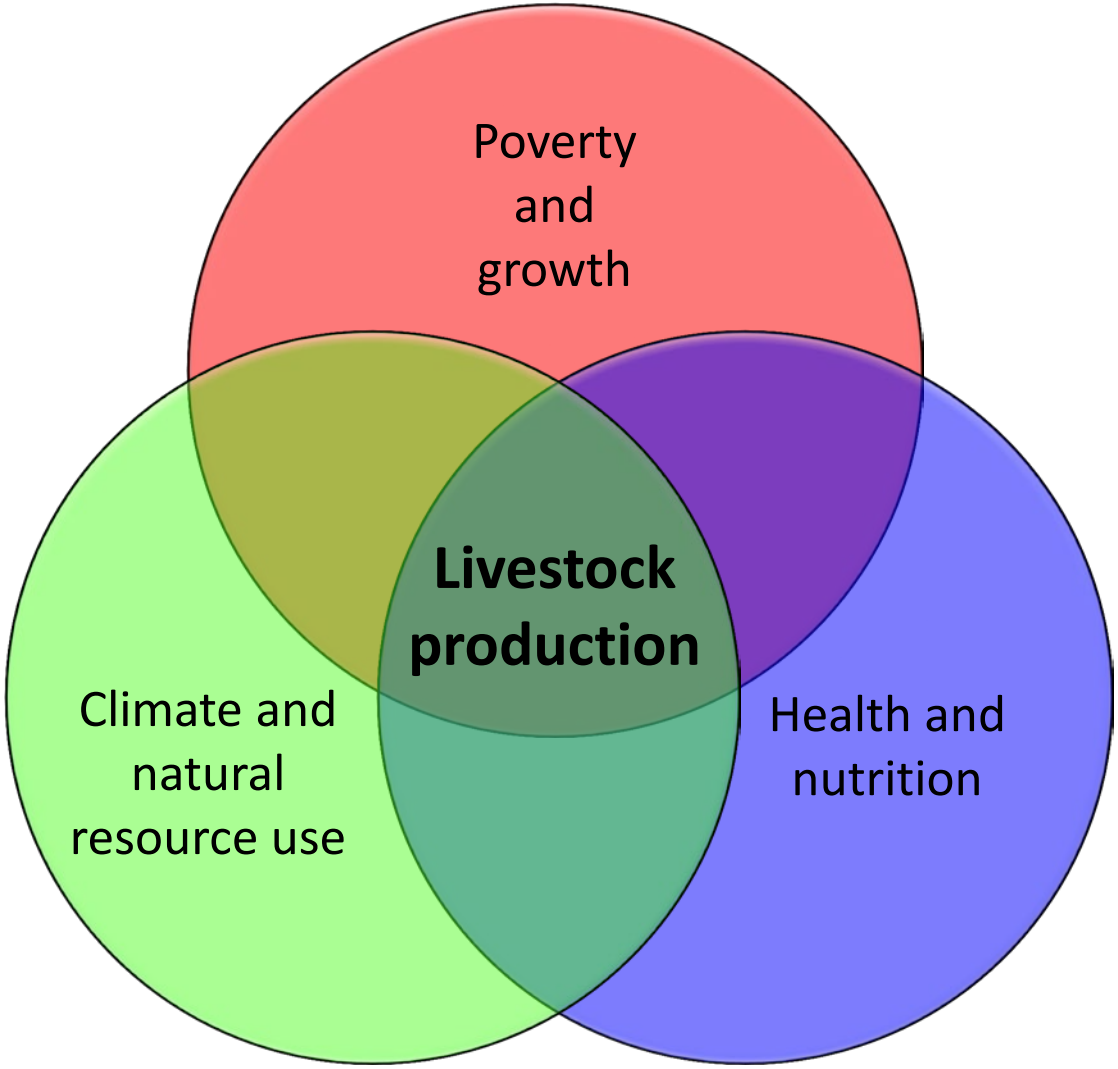
- Context – integrated approach
- Livestock-Geo-Wiki
- Livestock distributions and production systems
- Manure management and mapping
- Feedback methods
- Developments to date and future plans

The global livestock sector

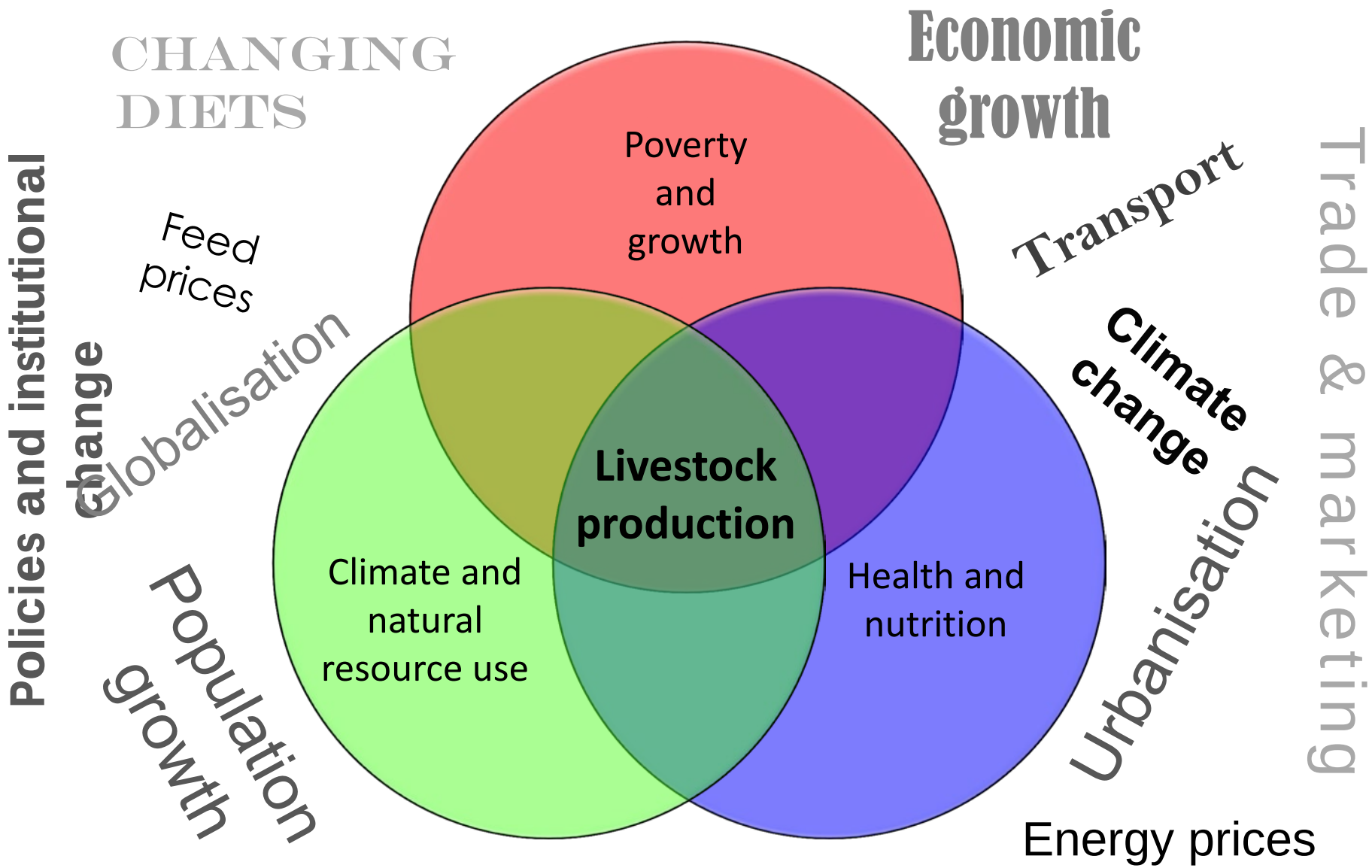
- Livestock numbers (FAOSTAT 2012)
  - 1.8 billion cattle and buffalo
  - 2.5 billion sheep and goats
  - 1.5 billion pigs
  - 30.6 billion poultry
- Sector accounts for 30% of the land surface
- 70% of all agricultural land
- 8% of human water use



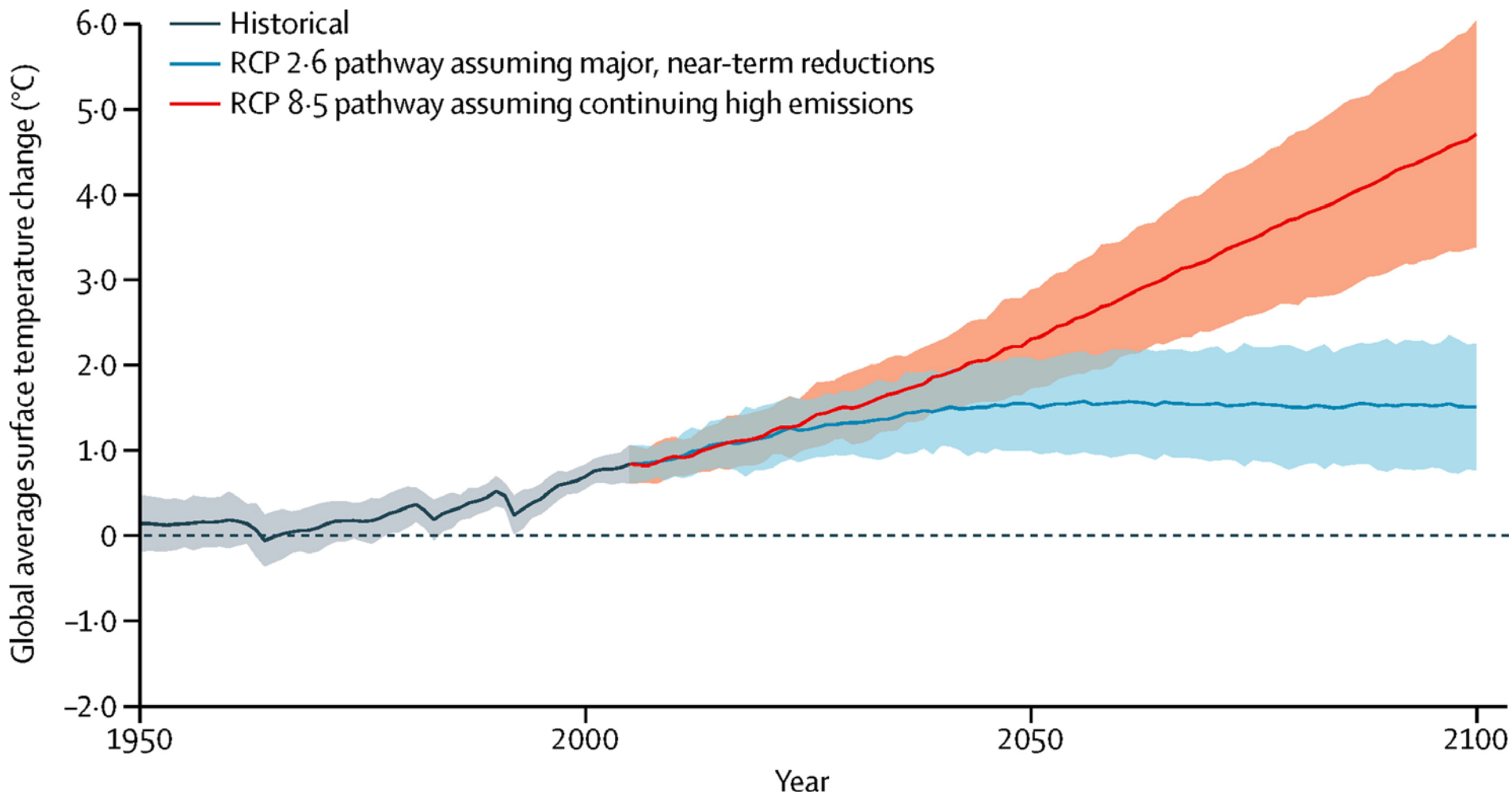
The global livestock sector



The global livestock sector

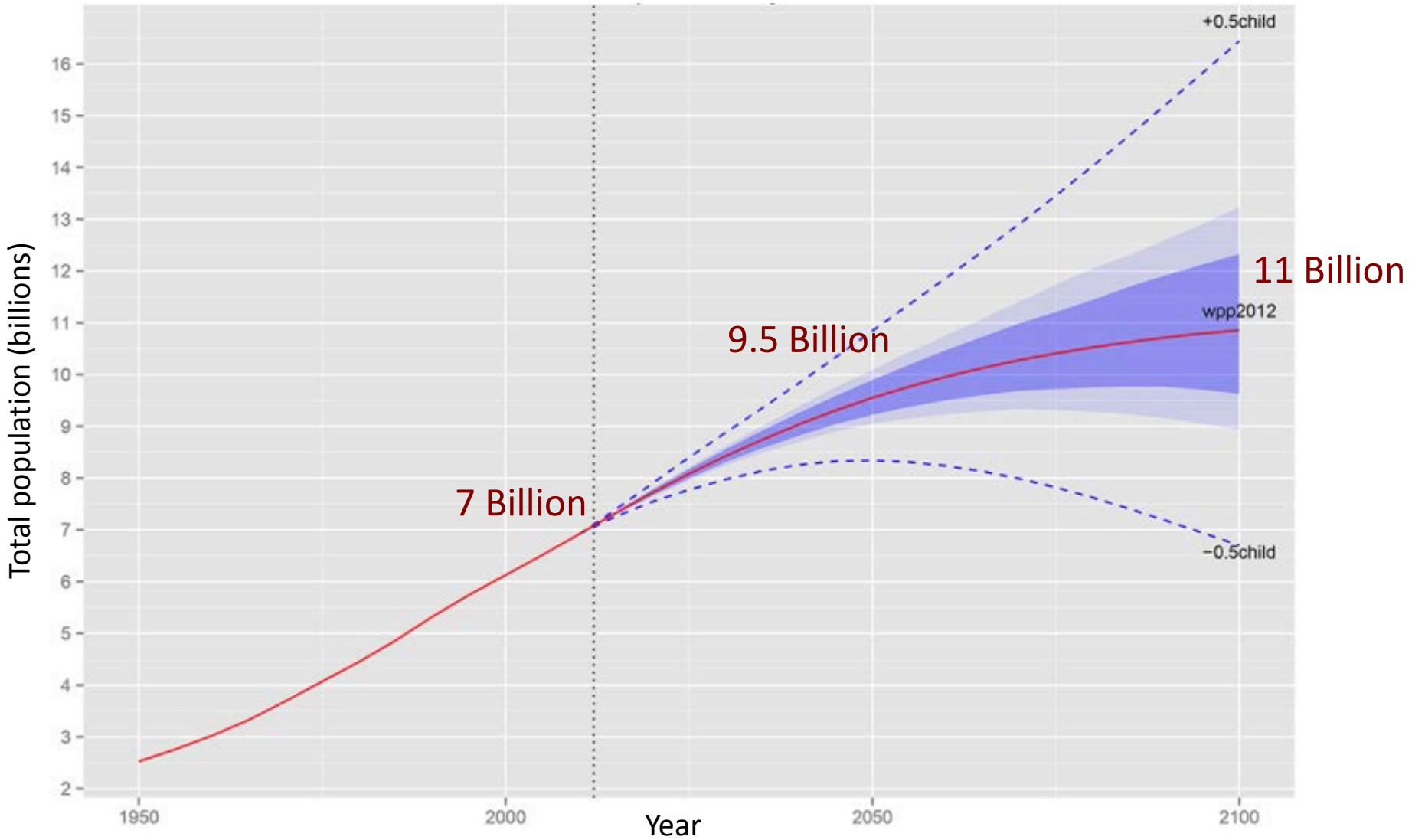


Surface temperature projections



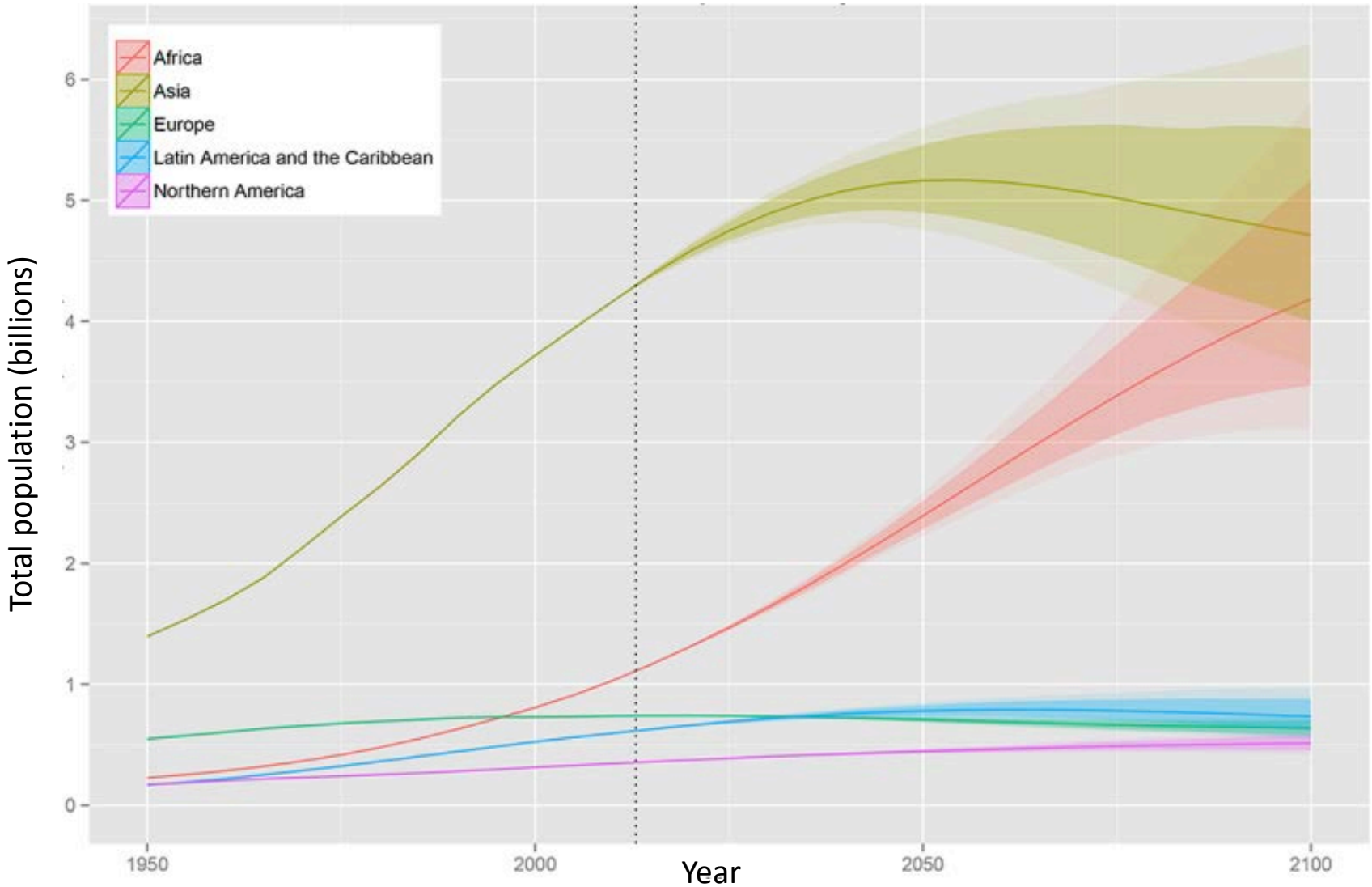
Source: IPCC's Fifth Assessment Report

World population projection (UN 2012)



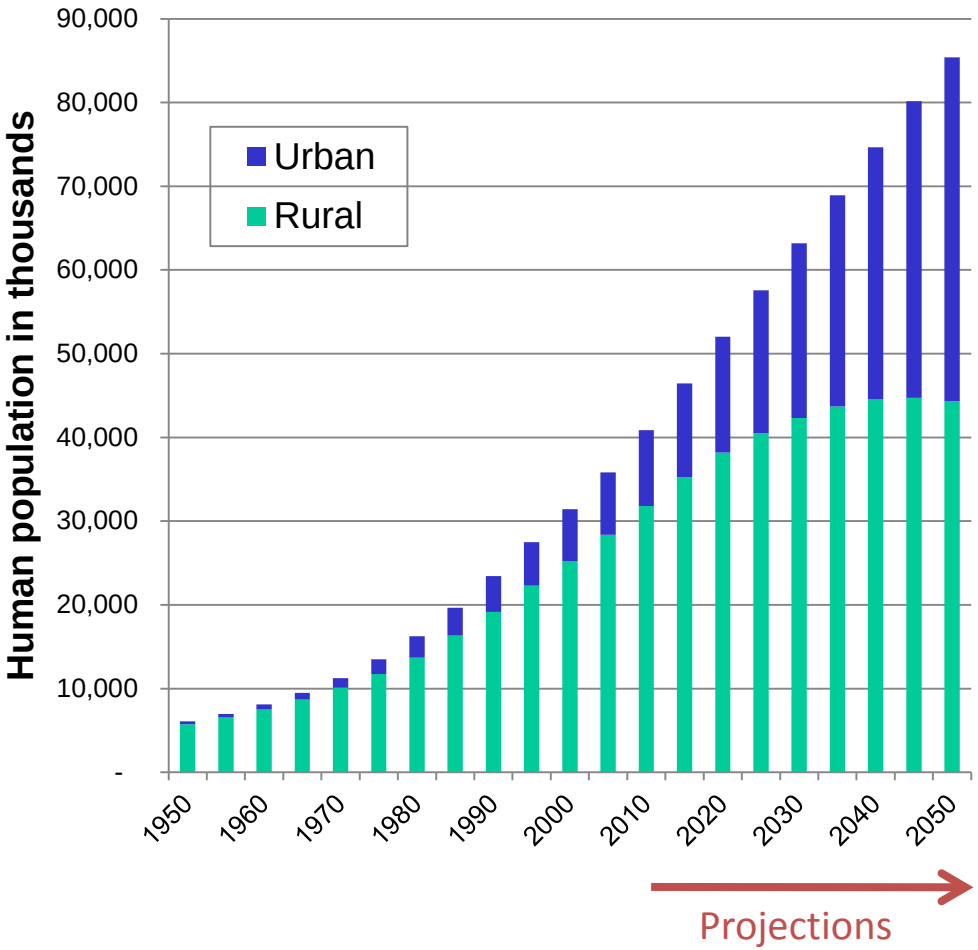
Source: Gerland et al. 2014

Continental population projection

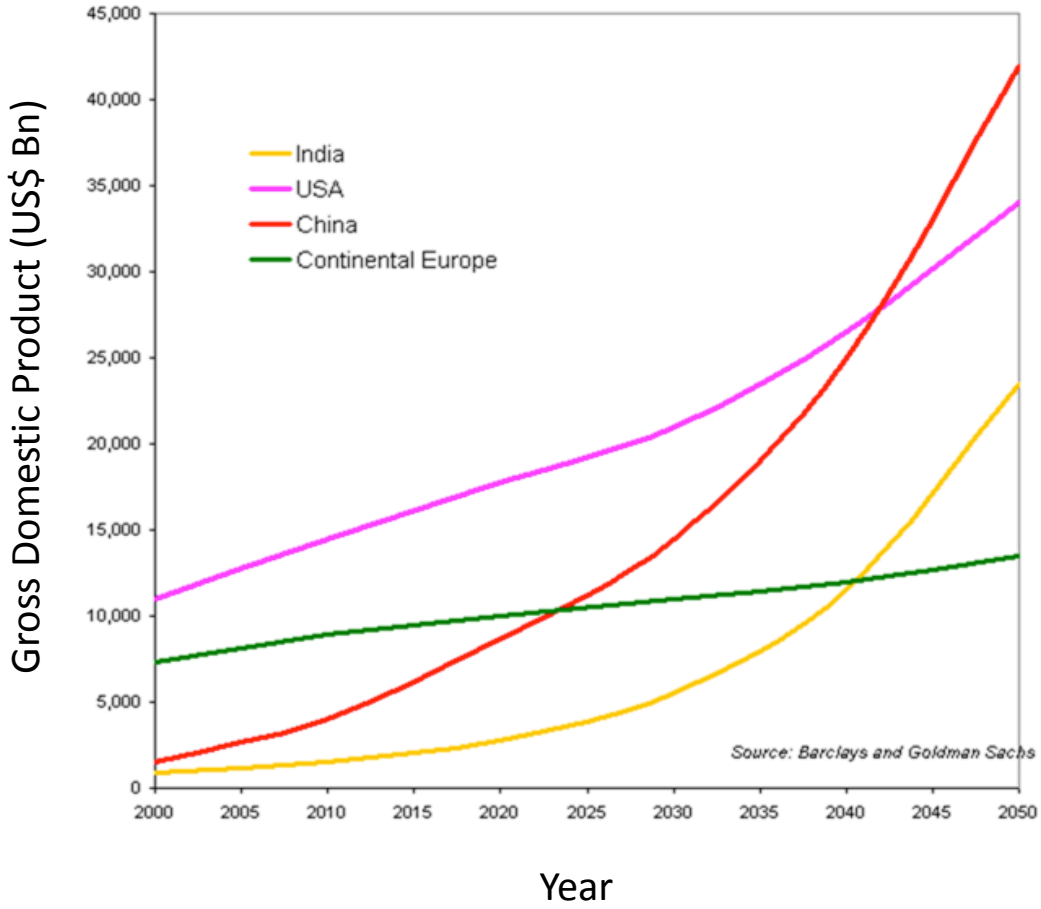


Source: Gerland et al. 2014

Urbanisation

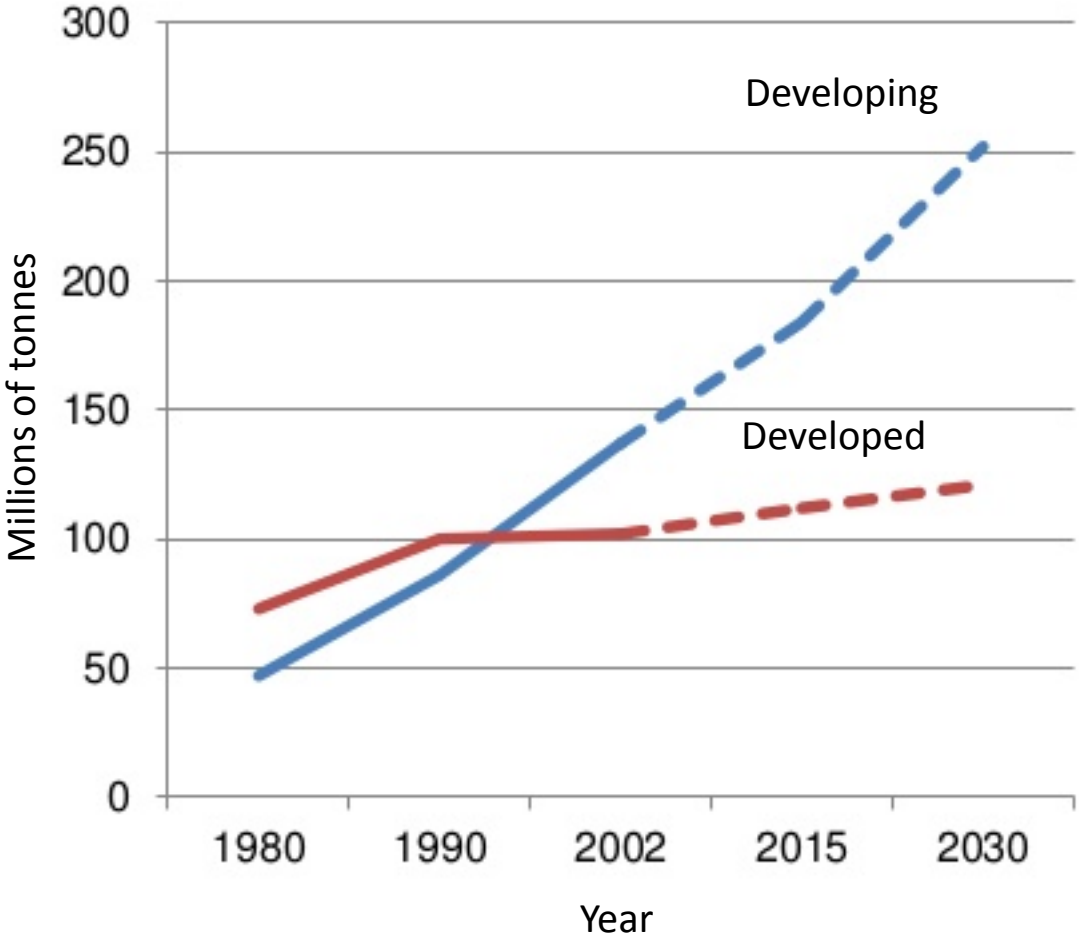


GDP projections



Livestock to 2030 – demand growth

Meat consumption is increasing faster in developing countries than in developed countries



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
  - Climate and natural resources
  - Health and nutrition

- **Integrated approach to socially desirable livestock sector development**
- **Need reliable data and information to guide policy**

Livestock Geo-Wiki

International Livestock Research Institute

Food and Agriculture Organisation of the UN

International Institute for Applied Systems Analysis

Université Libre de Bruxelles

Wageningen University

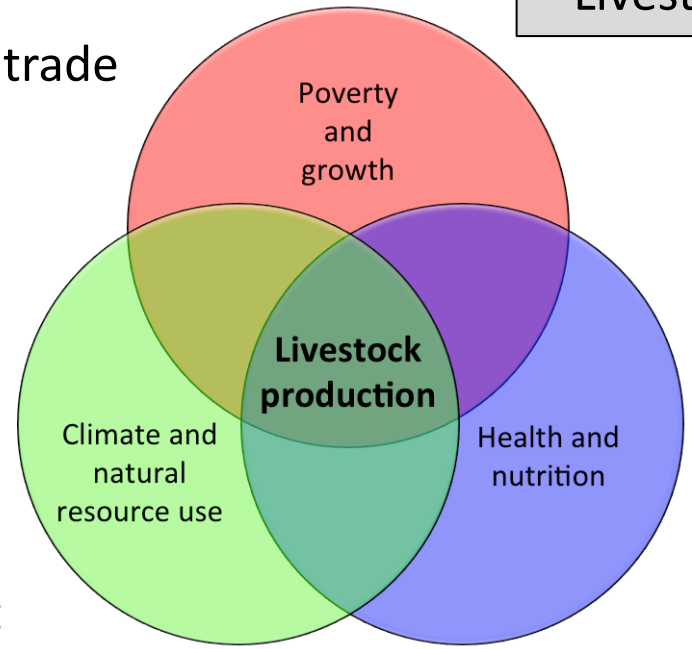
University of Oxford

- Raising awareness
  - Data visualisation
- Data dissemination
  - Open access
- Data validation
  - Crowdsourcing
  - Field studies (CGIAR)
- Impact assessment
  - Scaling up interventions
- Analytical tools
  - Production models
  - Lifecycle assessment (LCA)
  - Risk models

Livestock Geo-Wiki

- Livestock densities
- Livestock production systems
- Feed resources and rations
- Livestock production

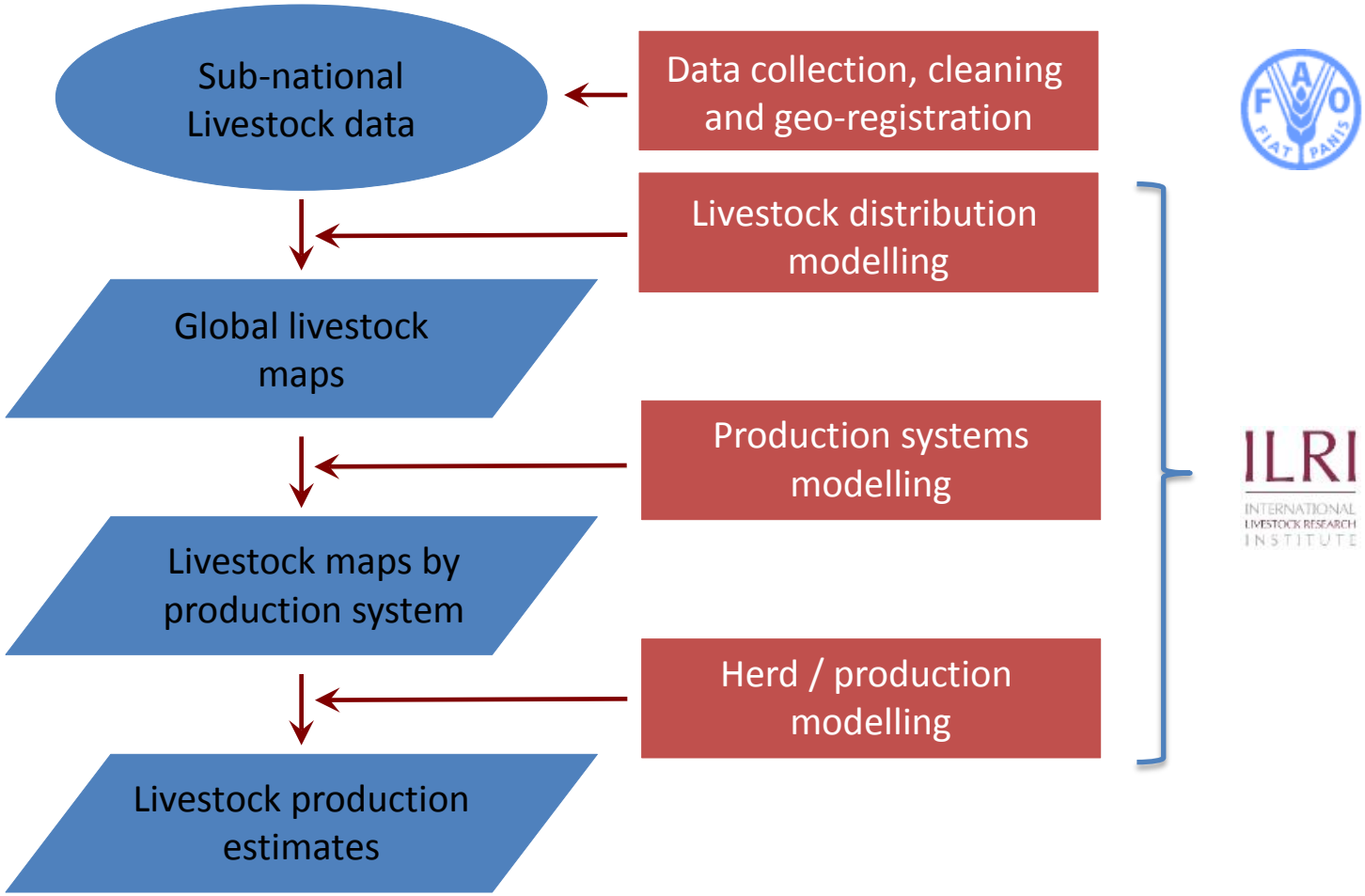
- Poverty and livestock ownership
- Food security
- Marketing and trade



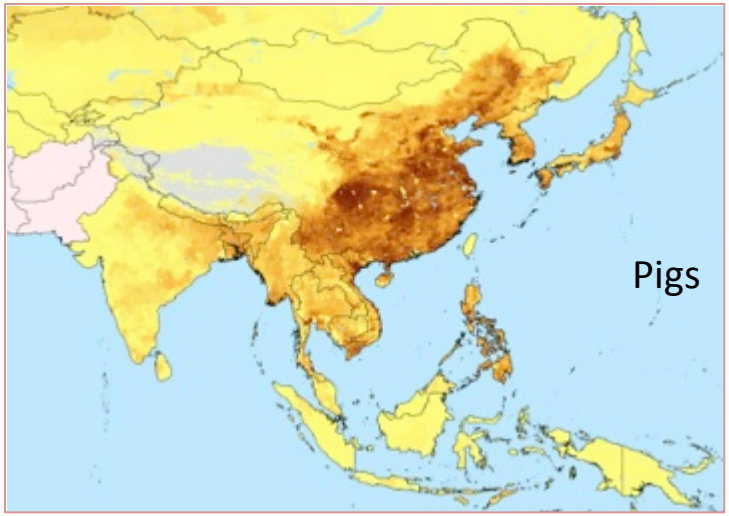
- Land degradation
- Carbon sequestration
- Manure management
- Greenhouse gas emissions

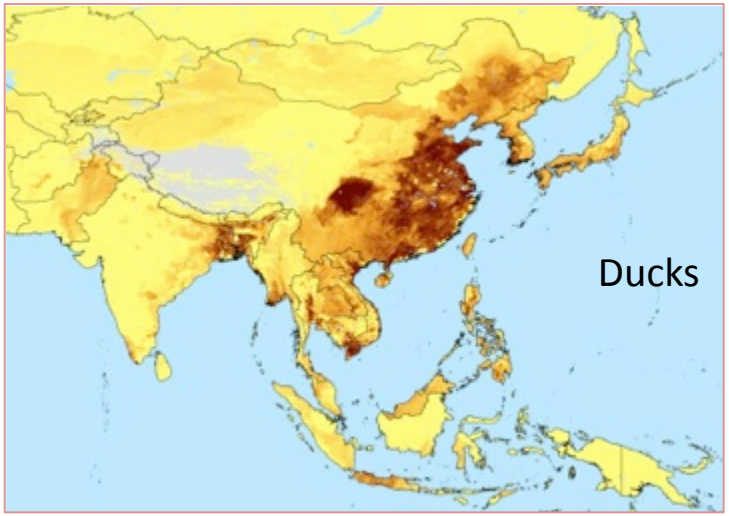
- Consumption of ASF
- Antimicrobial use
- Aflatoxins
- Disease distribution
- Disease risk maps

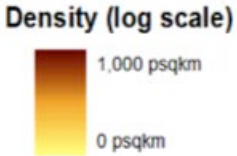
Livestock distribution and production

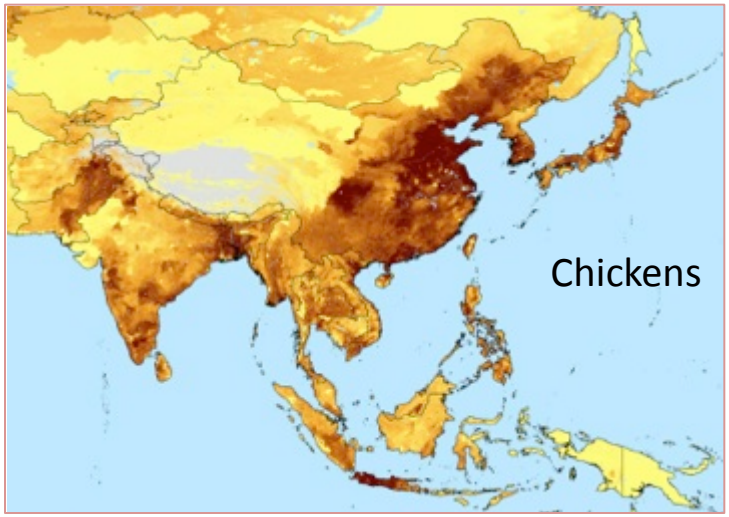


Livestock distributions





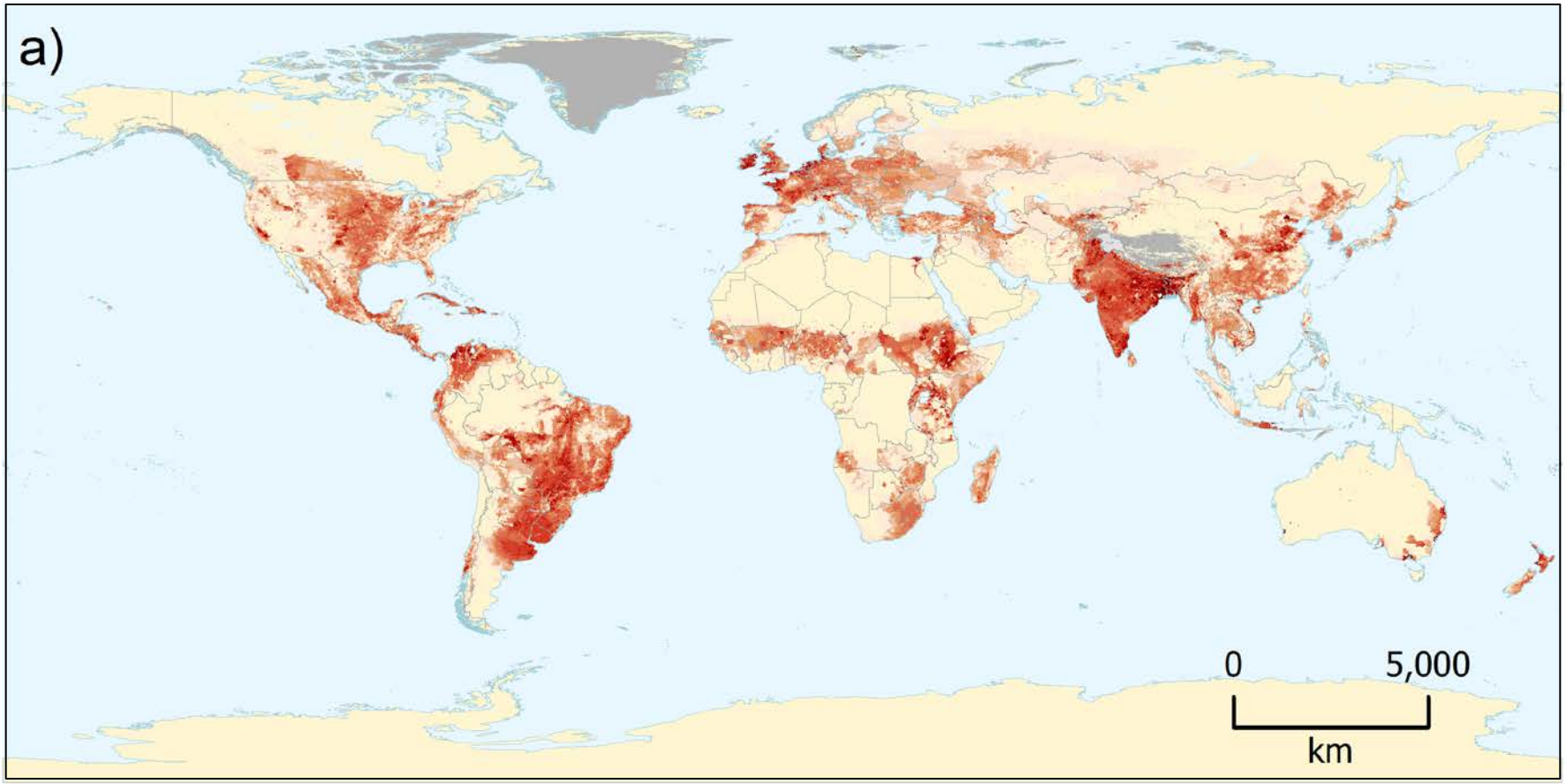




- Updated sub-national statistics
- 1km MODIS data (2001-2008)
- Standardised to FAOSTAT 2006
- New, improved modelling approach
- Accuracy estimates (internal)
- Cluster computing (SIB)

Source: Robinson et al (2014)

Cattle distribution (2006)

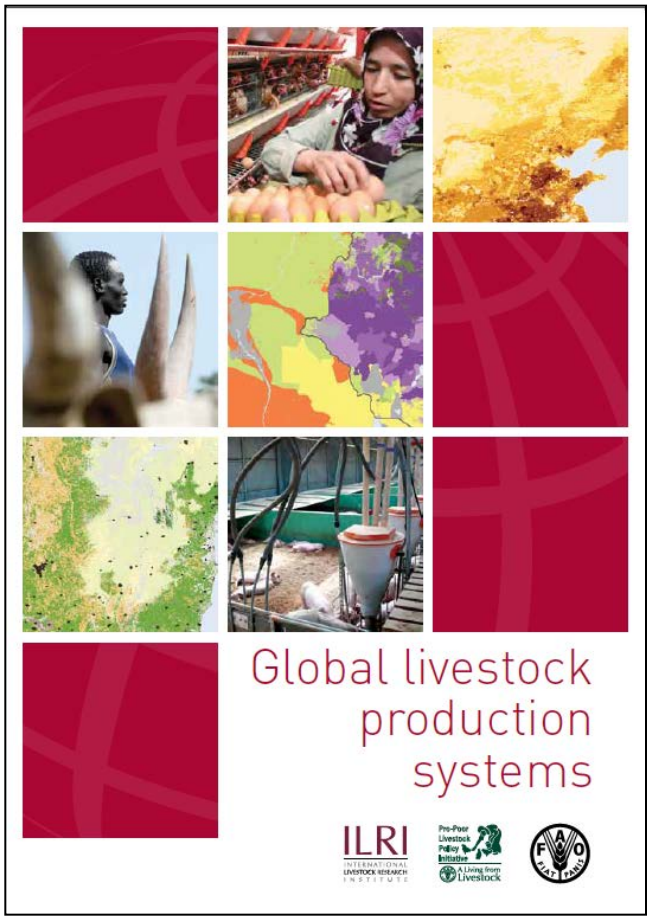


Head per km^2

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

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:

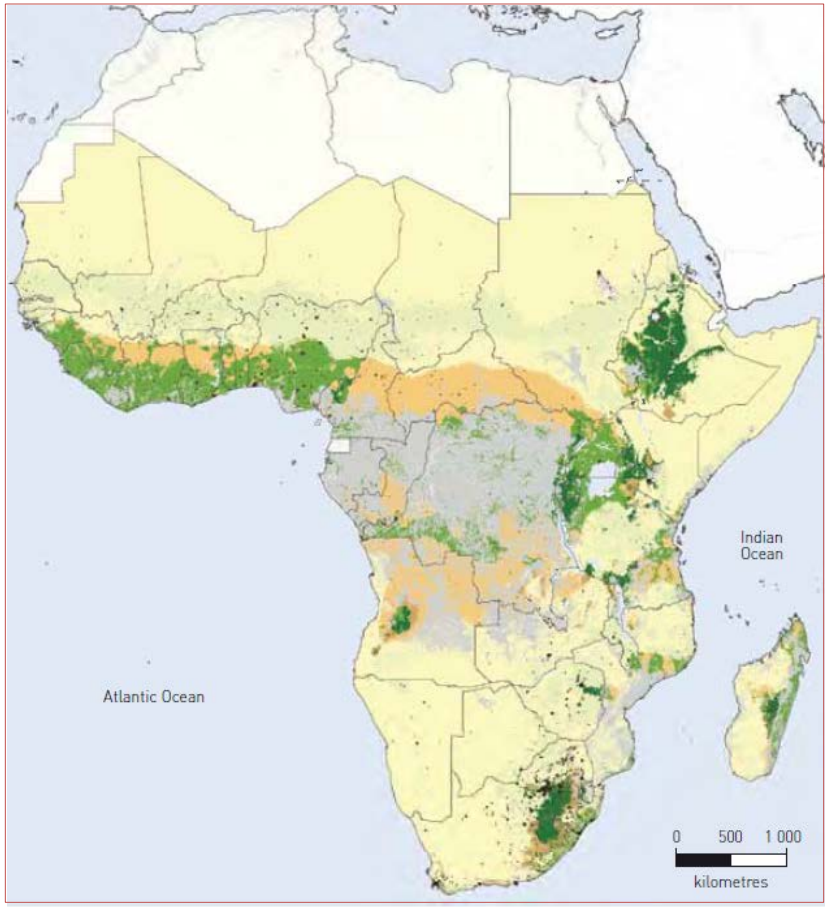
- Based on scale and intensification
- Use livestock densities

Ruminant production systems

Land cover (GLC 2000, Africover)

Agro-ecology (LGP, temperature, elevation)	Rangeland	Cropland		Tree cover	Artificial surfaces
		Rain-fed	Irrigated		
Arid & Semi-arid	LGA	MRA	MIA	Other	Urban
Humid and Sub-humid	LGH	MRH	MIH		
Temperate or Tropical highland	LGT	MRH	MIH		

Ruminant production systems (v5)



LGA MRA MIA Urban areas
LGH MRH MIH Other
LGT MRT MIT

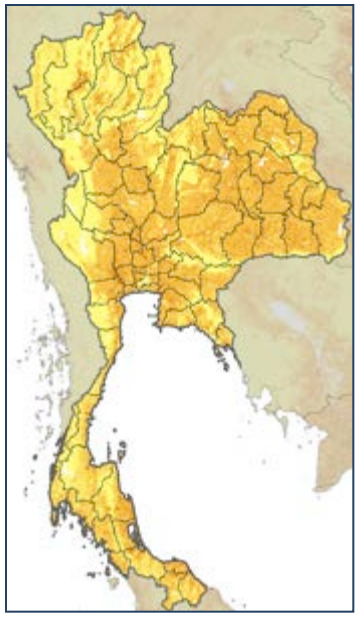
LGA MRA MIA Urban areas
LGH MRH MIH Other
LGT MRT MIT

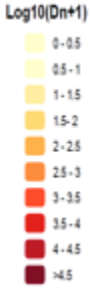
Monogastric production systems

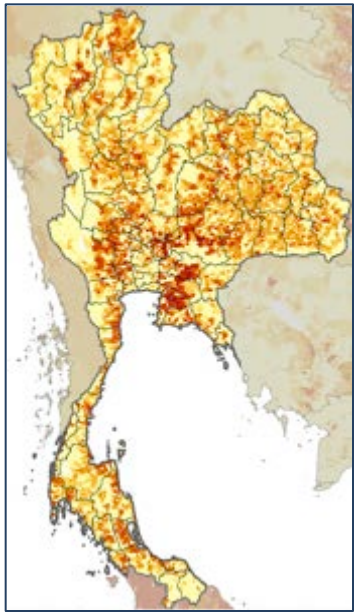
Livestock distribution

% backyard → Extensive production

Mapped based on rural population



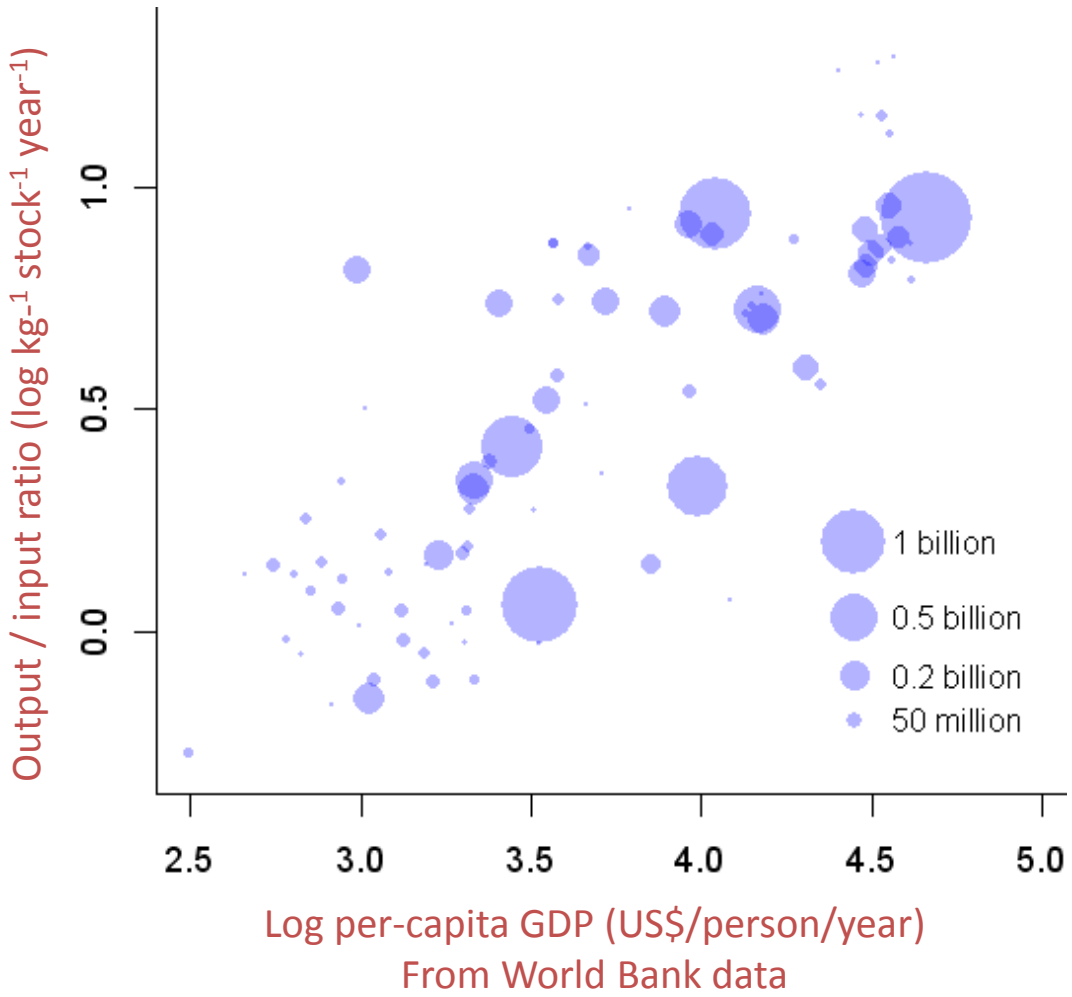


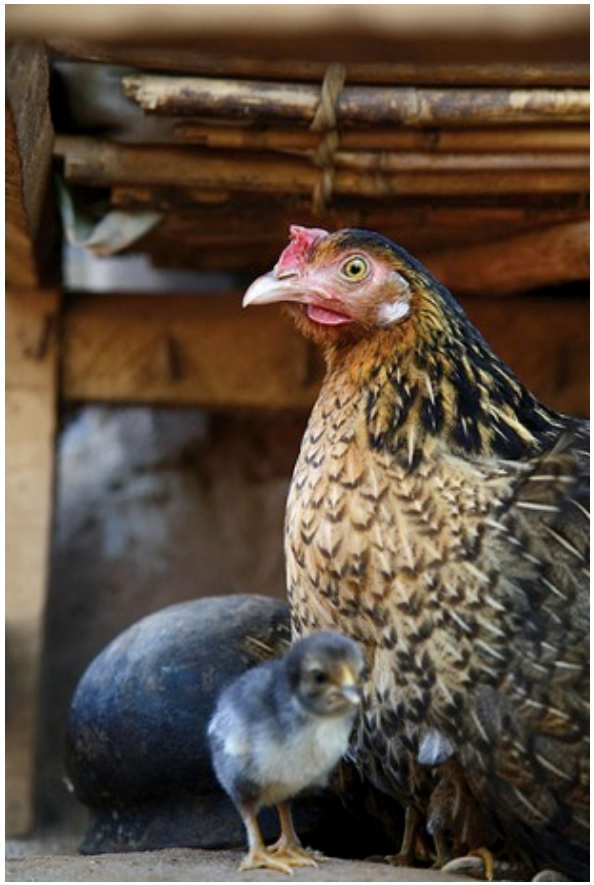


Difference (total – extensive)

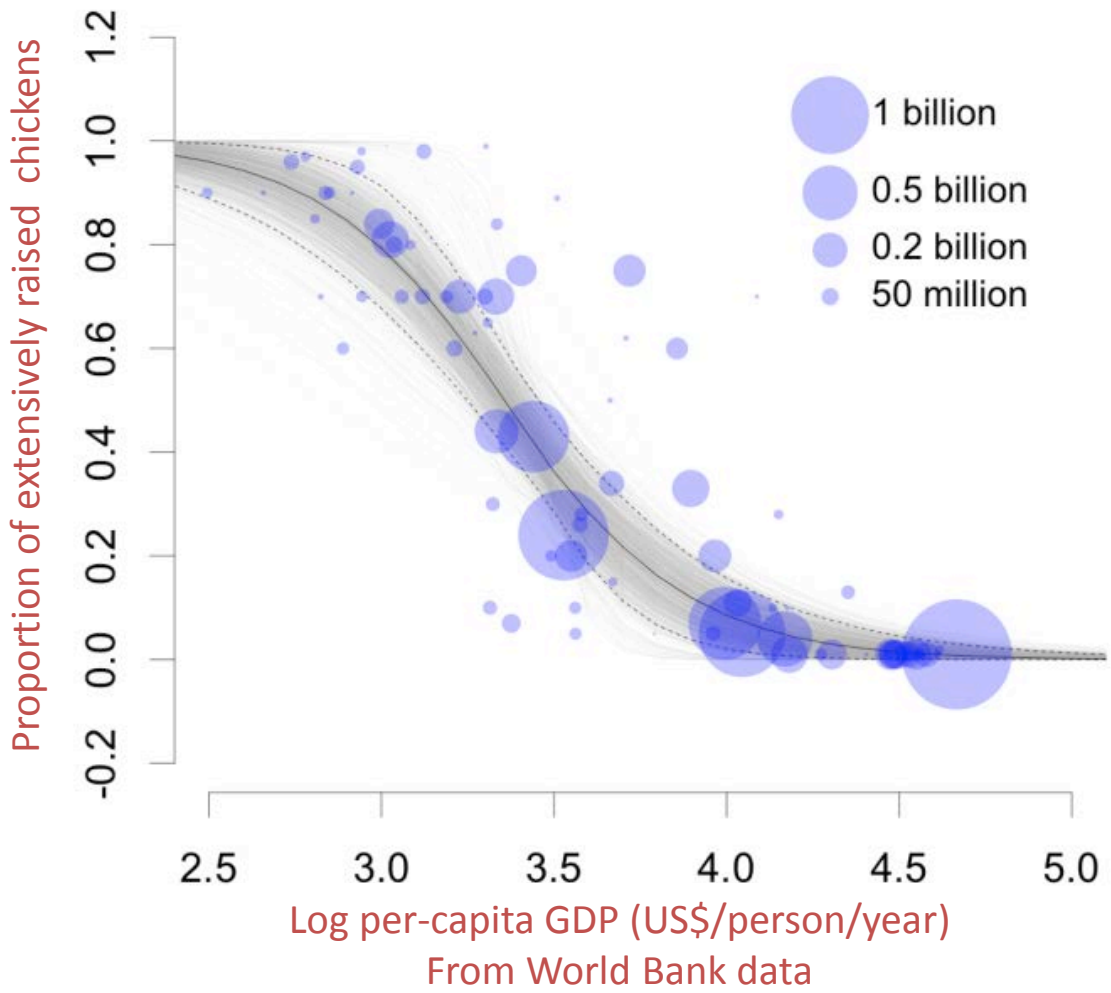
% intensive → Intensive production

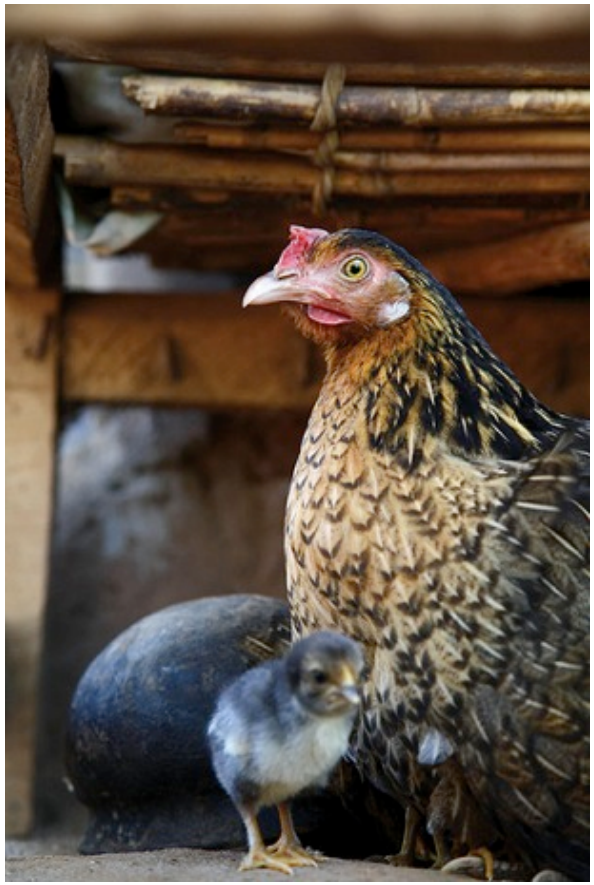
Chicken systems



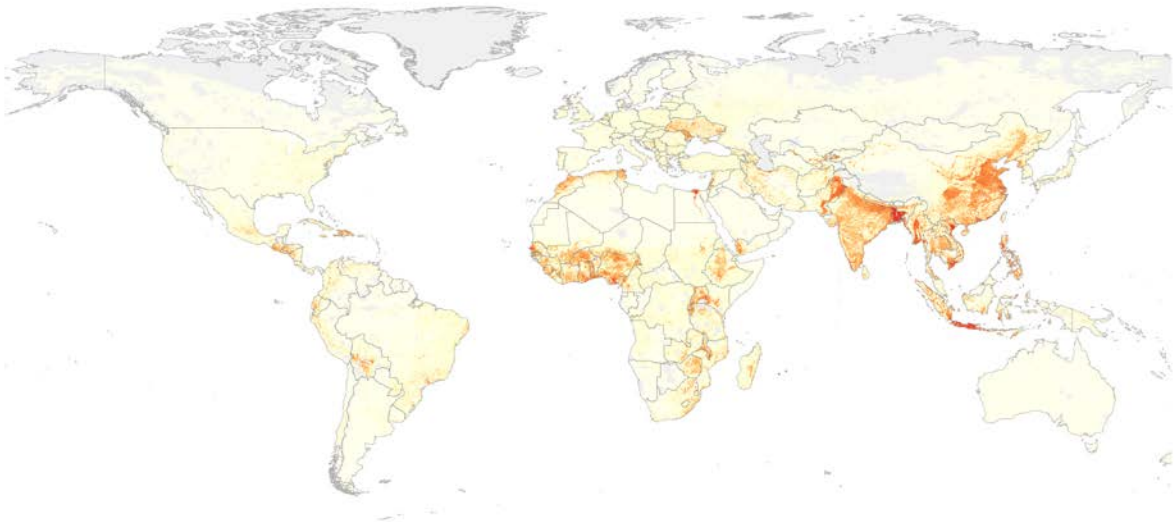


Chicken systems

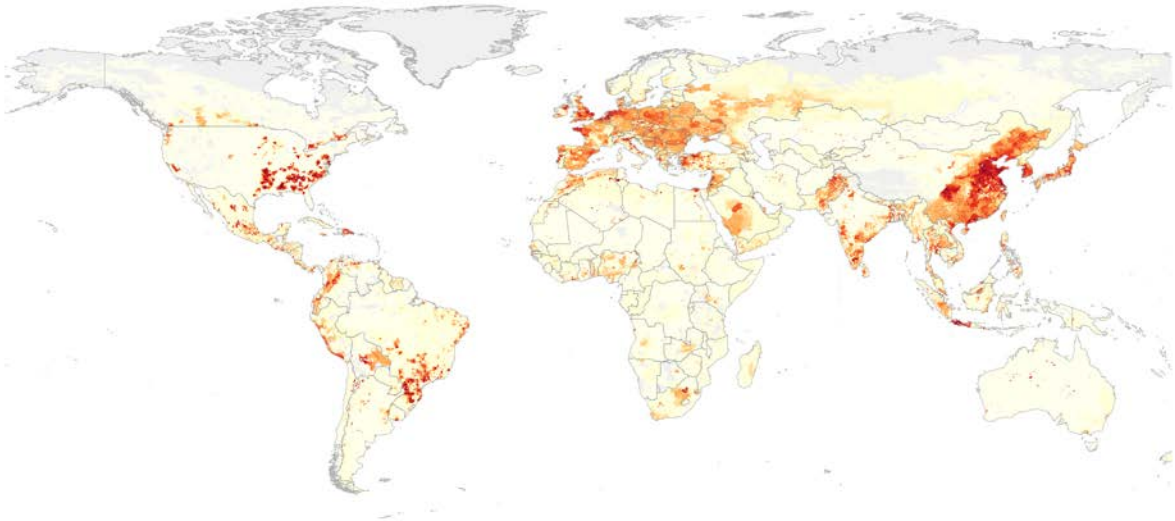




Chicken systems

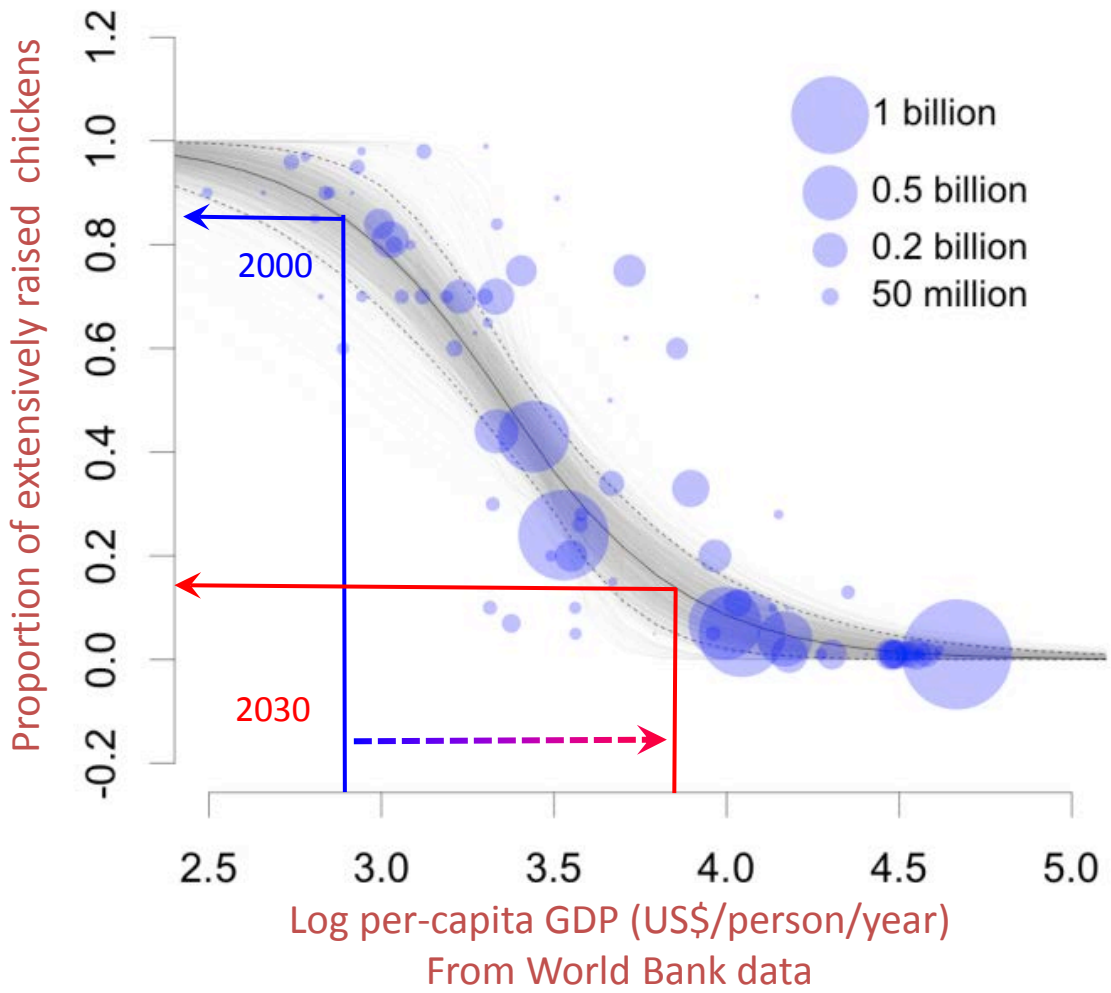


Extensive chicken production



Intensive chicken production

Predicting future livestock systems



Chicken production in China

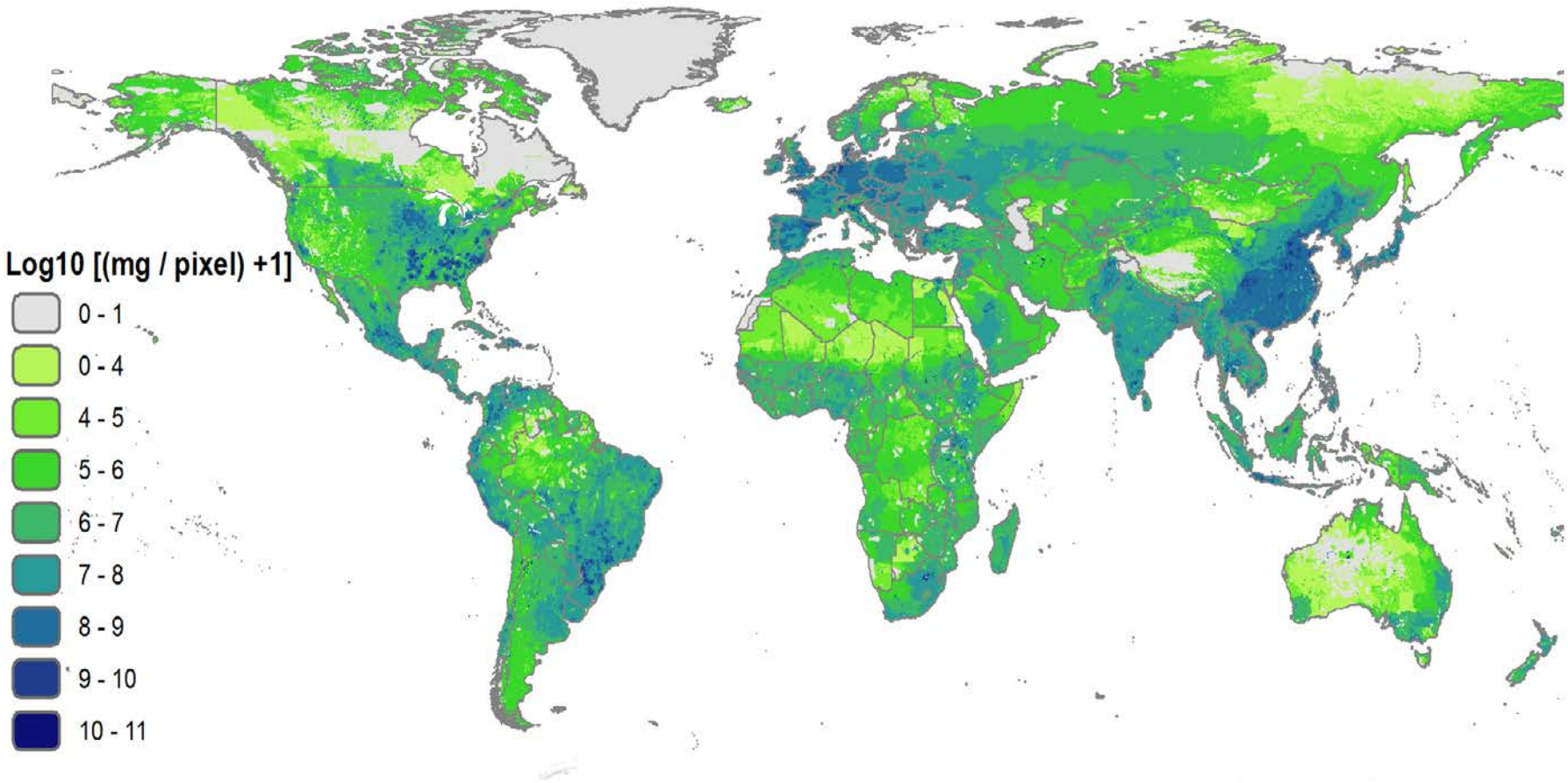
2000
log GDP per capita *c.* $ 2.9
% extensive *c.* 83 %

2030
log GDP per capita *c.* $ 3.8
% extensive *c.* 18 %

Antimicrobial resistance

Global antimicrobial use in food animals

(mg per 10km pixel)

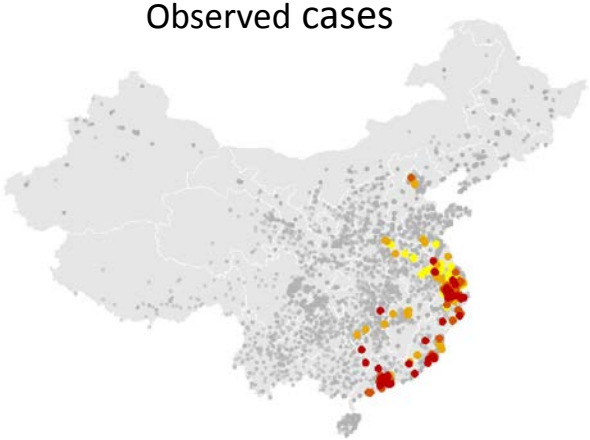


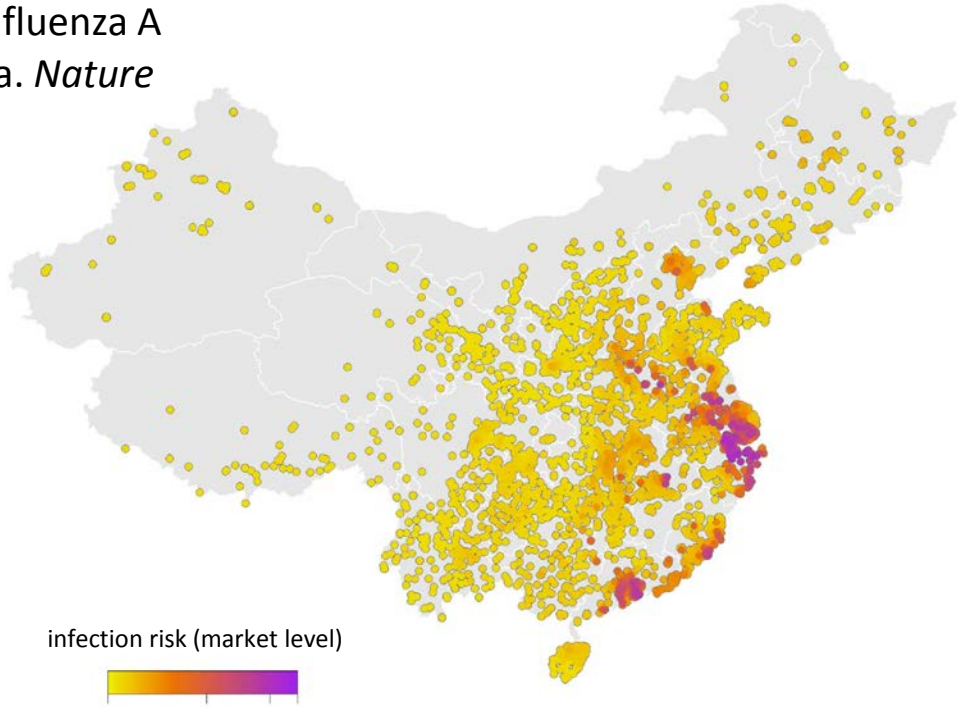
Source: Van Boeckel et al. (under submission)

H7N9 risk

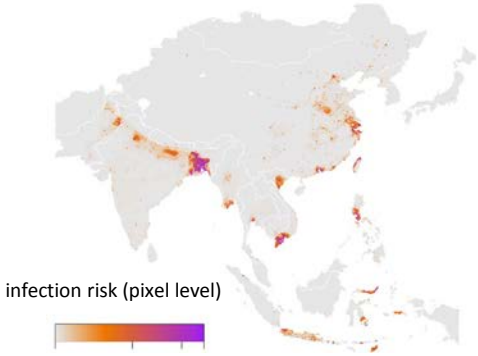
Gilbert et al. (2014) Predicting the risk of avian influenza A H7N9 infection in live-poultry markets across Asia. *Nature Communications* DOI: 10.1038/ncomms5116

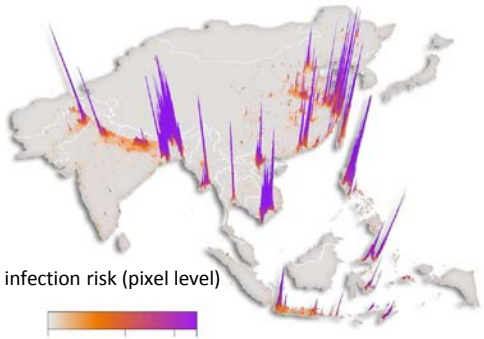
Observed cases



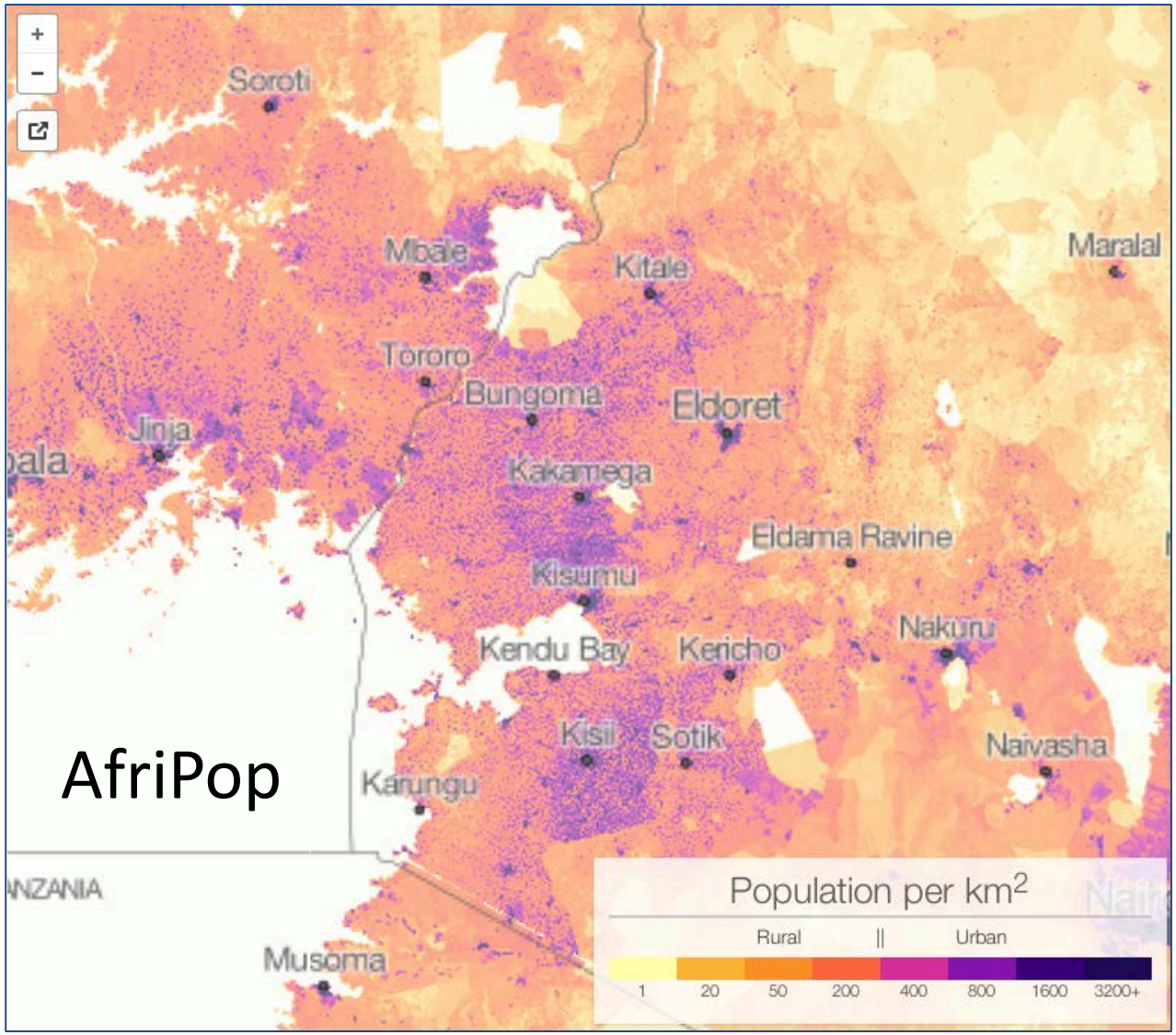


- 8,943 live-poultry markets
- Boosted regression tree models
- Local density of live-poultry markets is the most important predictor of H7N9 infection risk in markets
- This underscores their key role in the spatial epidemiology of H7N9





Poor farmers



Population

↓

Rural Population

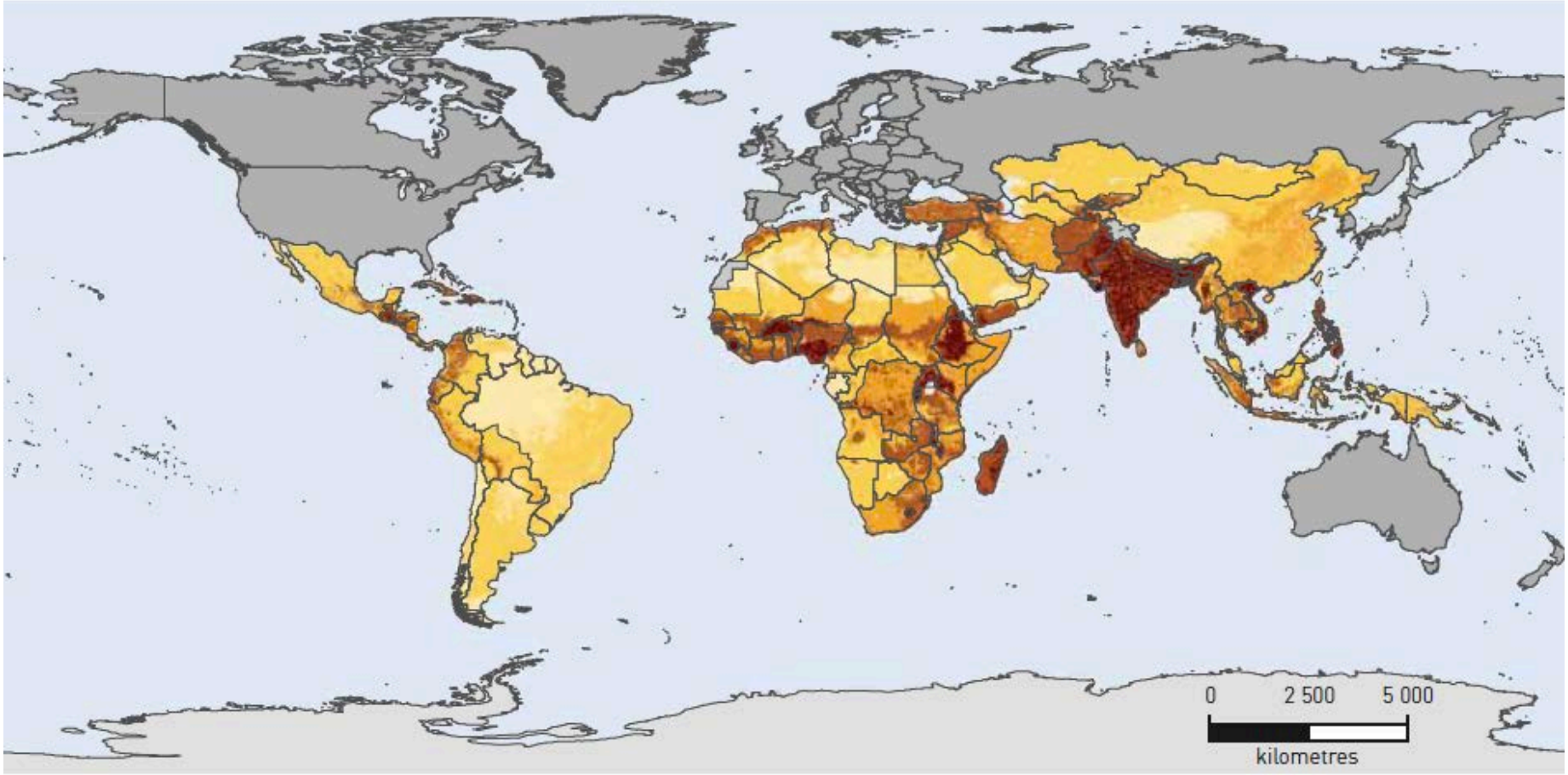
↓

Agricultural population

↓

Poor farmers

Poor livestck keepers

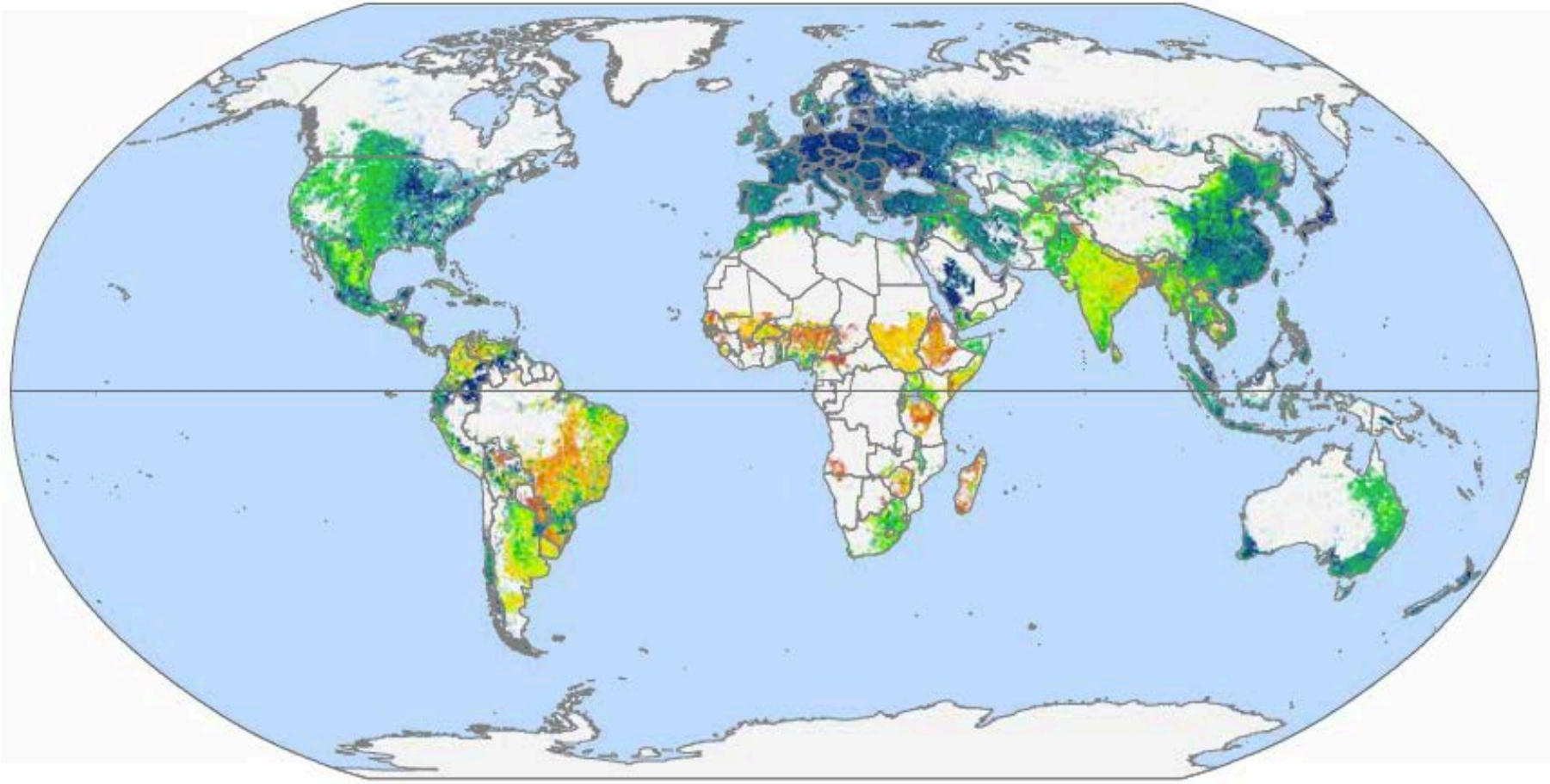


Poor livestock keepers per km²

< 0.2 | 0.2–2 | 2–5 | 5–20 | > 20

Robinson et al. (2011)

GHG emission intensity

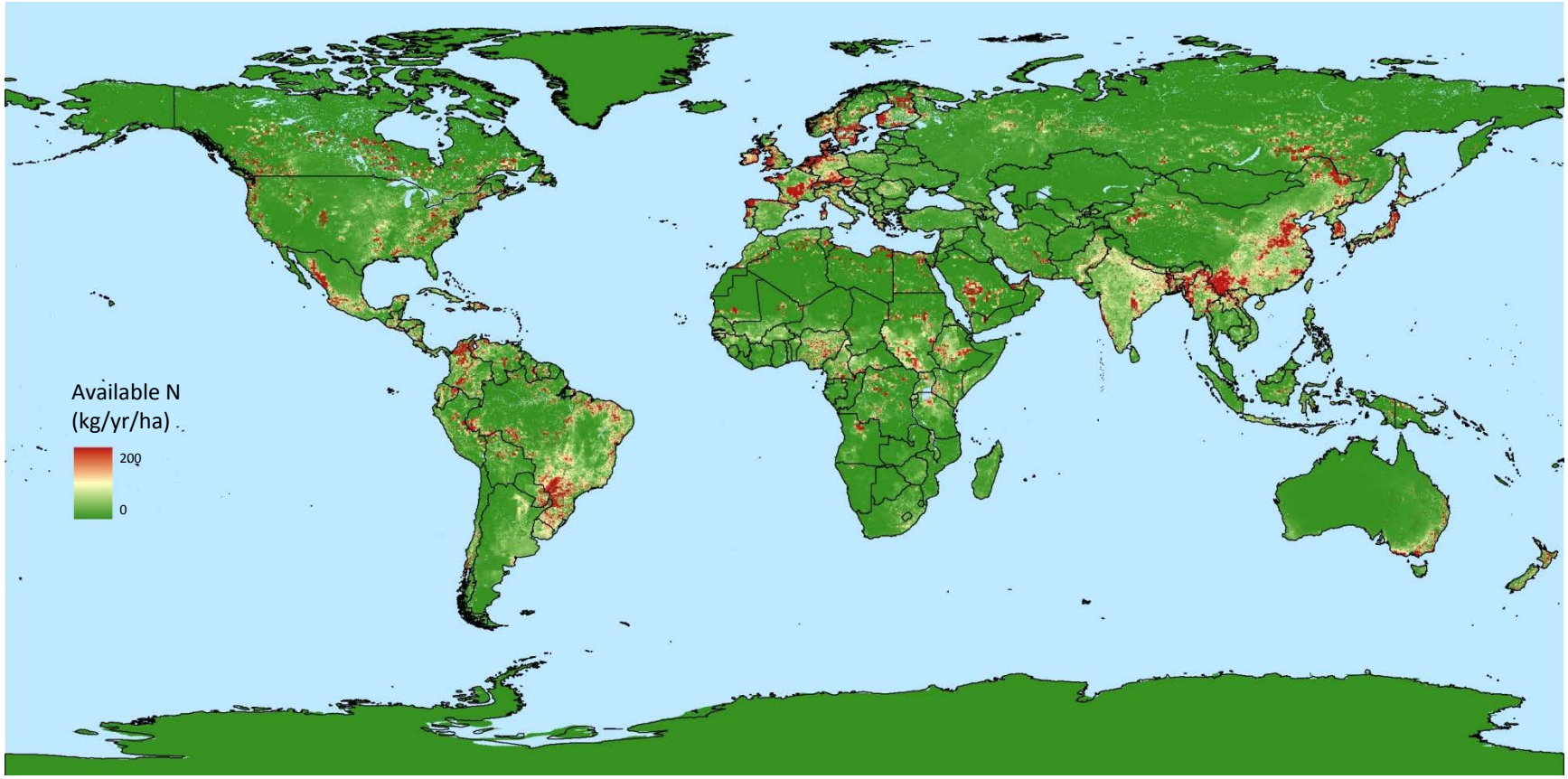


Kg of CO_2 equivalent per kg of edible protein

- < 50
- 50-75
- 75-100
- 100-125
- 125-150
- 150-200
- 200-250
- 250-300
- 300-350
- > 350
- Protein production < 75 kg per square km

Source: Gerber et al. 2013

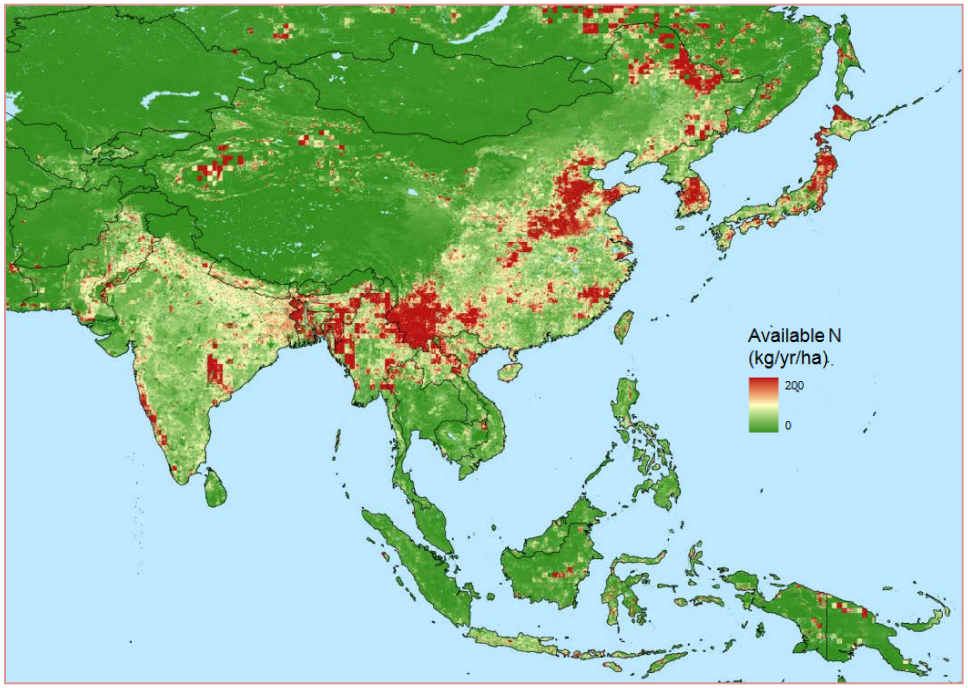
Available N (all livestock species)



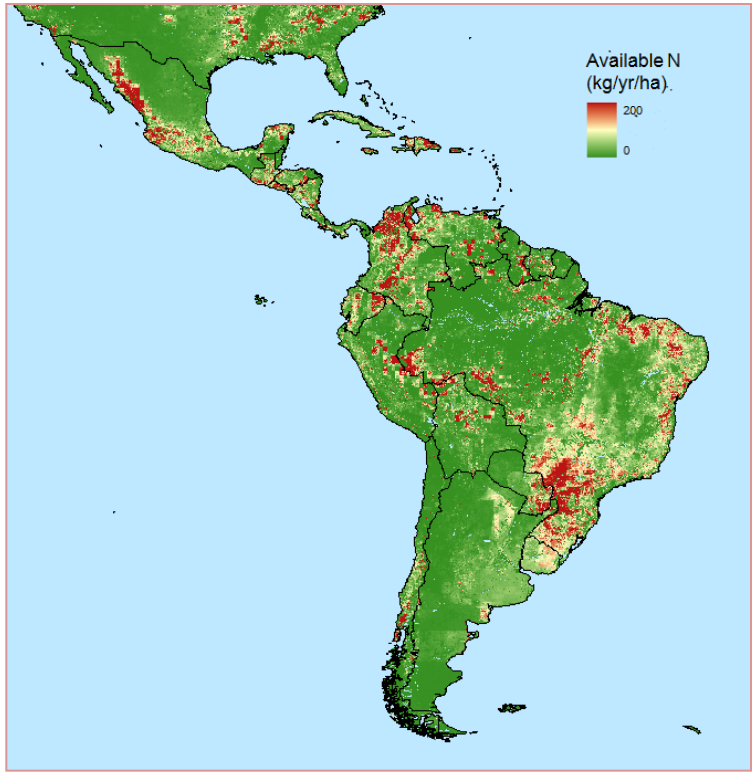
Available N = total N produced - losses

Available N (all livestock species)

Asia

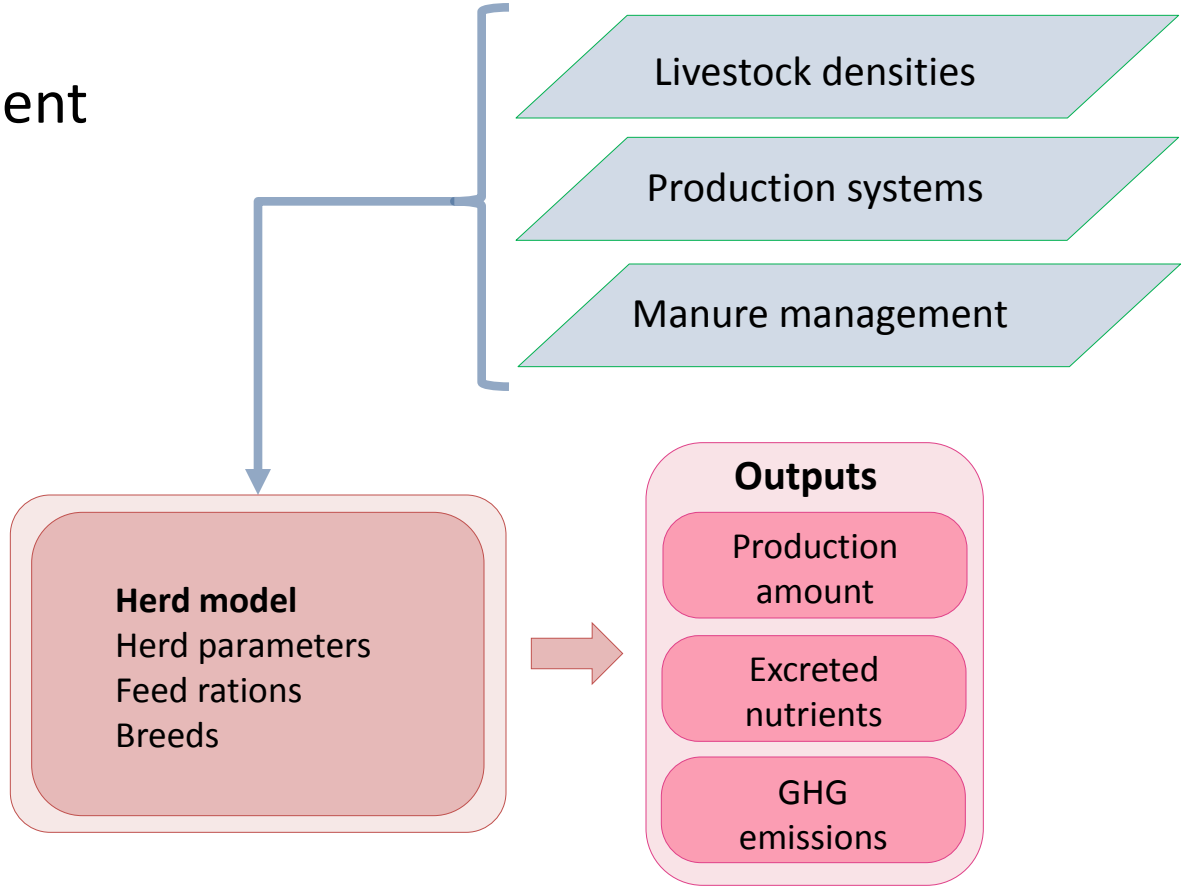


Latin America



Estimating manure production

GLEAM
Lifecycle
Assessment

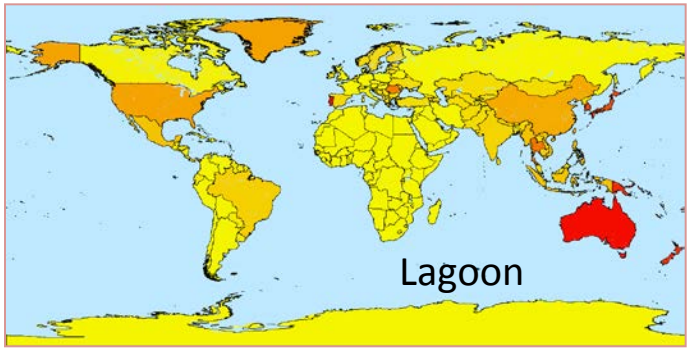


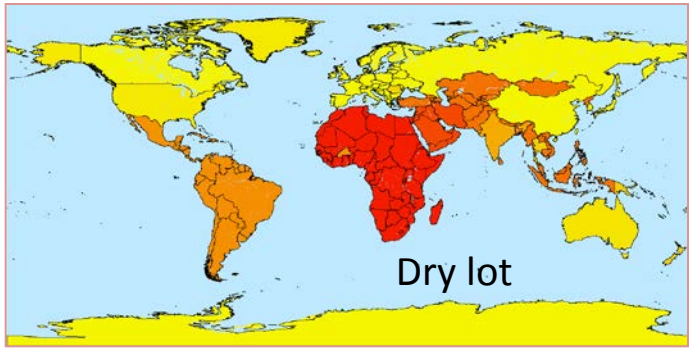
Manure management (pigs)

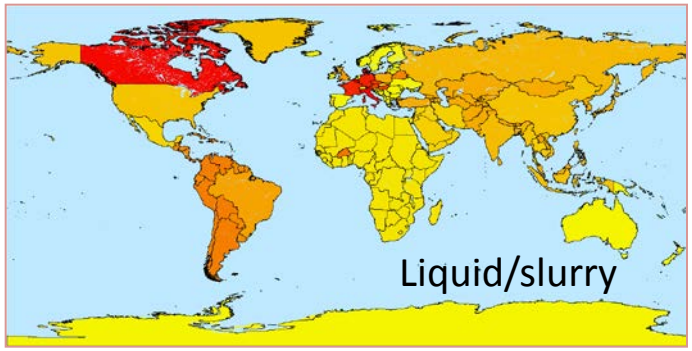
- Lagoon
- Slurry (no digestion)
- Solid storage
- Digester
- Pasture
- Burned

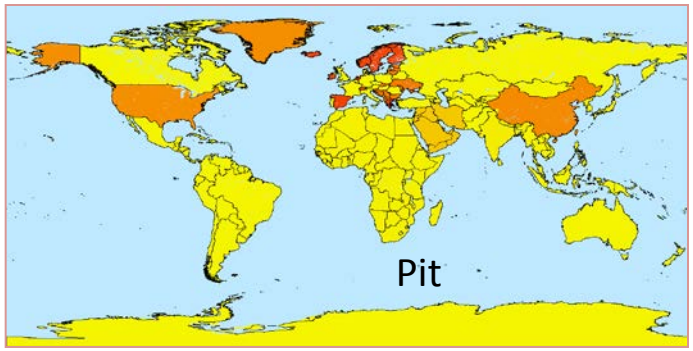
Manure management (int. pigs)

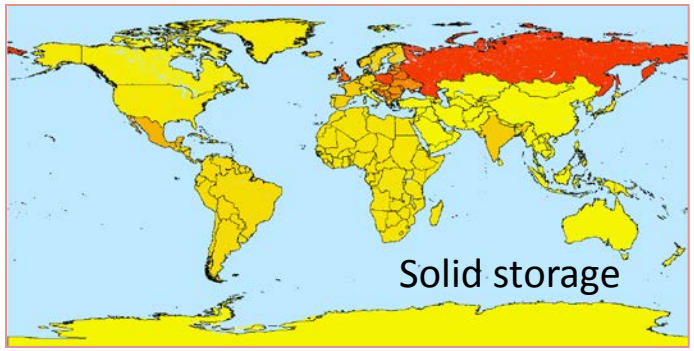
Proportion of manure managed in the five main systems



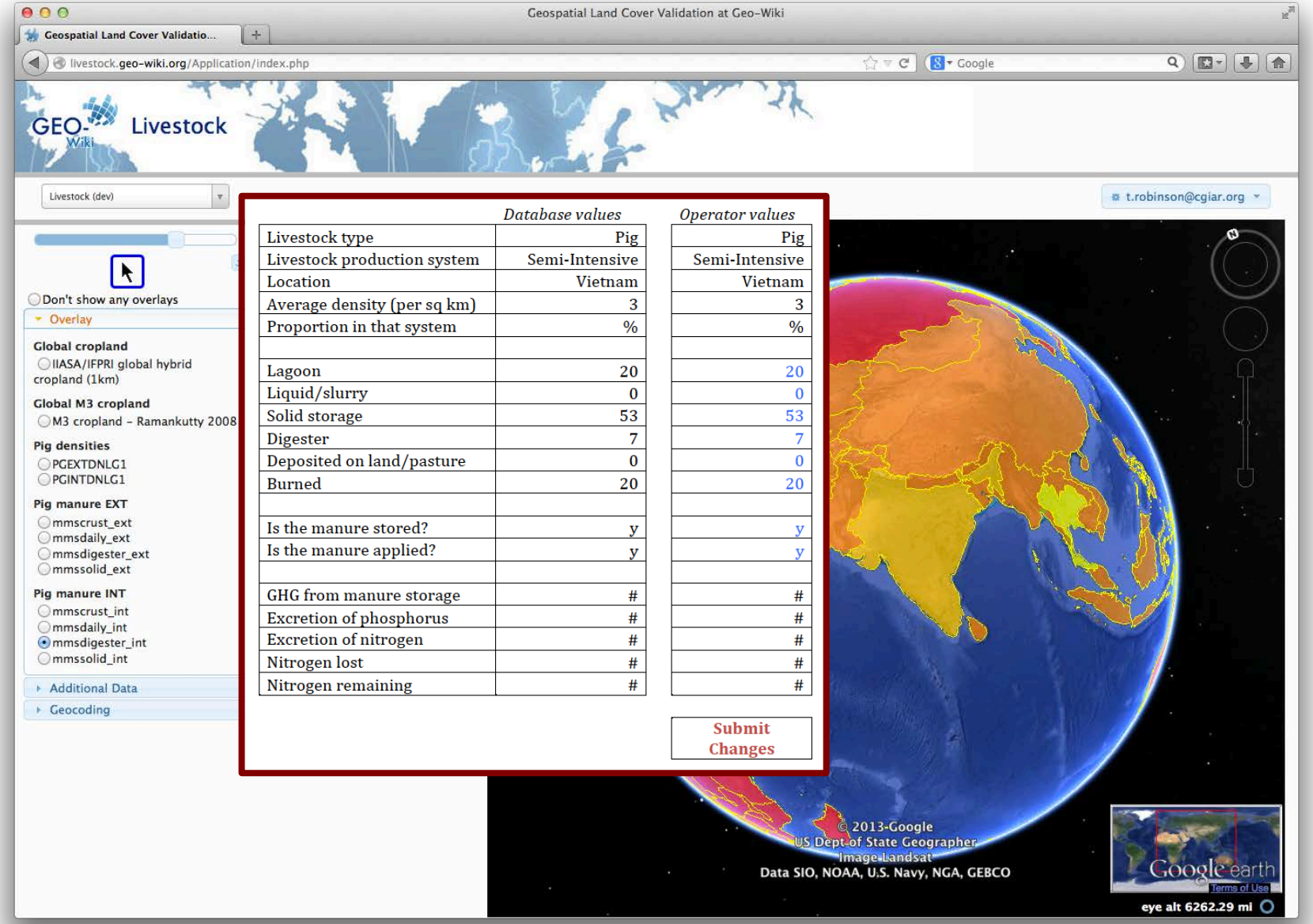








Livestock Geo-Wiki



	Database values	*Operator values*
Livestock type	Pig	Pig
Livestock production system	Semi-Intensive	Semi-Intensive
Location	Vietnam	Vietnam
Average density (per sq km)	3	3
Proportion in that system	%	%
Lagoon	20	20
Liquid/slurry	0	0
Solid storage	53	53
Digester	7	7
Deposited on land/pasture	0	0
Burned	20	20
Is the manure stored?	y	y
Is the manure applied?	y	y
GHG from manure storage	#	#
Excretion of phosphorus	#	#
Excretion of nitrogen	#	#
Nitrogen lost	#	#
Nitrogen remaining	#	#

Submit Changes

Looking forward

- Build the Livestock Geo-Wiki infrastructure (completed)
- Incorporate new livestock and systems maps (completed)
- Design and implement the manure management module for the pig sector (by end of 2014)
- Expand to cover all livestock species (by end of 2015)
- Establish links to CCAC regional networks for ground-truthing (by end of 2015)
- Search for funding to continue development of the manure management module


Thank you !