The Livestock Geo-Wiki: Manure management module

Timothy Robinson

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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

- Poverty and growth
- Climate and natural resource use
- Health and nutrition
- Livestock production
The global livestock sector

- Poverty and growth
- Economic growth
- Changing diets
- Livestock production
- Climate and natural resource use
- Health and nutrition
- Policies and institutional change
- Globalisation
- Population growth
- Transport
- Climate change
- Urbanisation
- Energy prices
- Trade & marketing
- Feed prices
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
GDP projections
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

- 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

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
Livestock Geo-Wiki

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

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

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

- Consumption of ASF
- Antimicrobial use
- Aflatoxins
- Disease distribution
- Disease risk maps
Livestock distribution and production

- Sub-national Livestock data
  - Data collection, cleaning and geo-registration
  - Livestock distribution modelling
    - Production systems modelling
    - Herd / production modelling
  - Global livestock maps
    - Livestock maps by production system
  - Livestock production estimates
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

Source: Robinson et al. (2014)
Livestock production systems

Ruminant systems:
• Based on land use and agro-ecological potential
• No actual livestock data

Monogastric systems:
• Based on scale and intensification
• Use livestock densities

Robinson et al. (2011)
## Ruminant production systems

<table>
<thead>
<tr>
<th>Agro-ecology (LGP, temperature, elevation)</th>
<th>Rangeland</th>
<th>Cropland</th>
<th>Tree cover</th>
<th>Artificial surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arid &amp; Semi-arid</td>
<td>LGA</td>
<td>MRA</td>
<td>MIA</td>
<td>Other</td>
</tr>
<tr>
<td>Humid and Sub-humid</td>
<td>LGH</td>
<td>MRH</td>
<td>MIH</td>
<td>Urban</td>
</tr>
<tr>
<td>Temperate or Tropical highland</td>
<td>LGT</td>
<td>MRH</td>
<td>MIH</td>
<td></td>
</tr>
</tbody>
</table>
Ruminant production systems (v5)
Monogastric production systems

Livestock distribution

% backyard

Mapped based on rural population

Extensive production

% intensive

Difference (total – extensive)

Intensive production
Chicken systems

Output / input ratio (log kg⁻¹ stock⁻¹ year⁻¹)

Log per-capita GDP (US$/person/year)

From World Bank data
Chicken systems

Log per-capita GDP (US$ / person / year)
From World Bank data

Proportion of extensively raised chickens

1 billion
0.5 billion
0.2 billion
50 million
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)
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

- 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
Poor livestock keepers

Robinson et al. (2011)
GHG emission intensity

Source: Gerber et al. 2013
Available N = total N produced - losses
Available N (all livestock species)

Asia

Latin America
Estimating manure production

GLEAM
Lifecycle
Assessment

Herd model
Herd parameters
Feed rations
Breeds

Livestock densities
Production systems
Manure management

Outputs
Production amount
Excreted nutrients
GHG emissions
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

<table>
<thead>
<tr>
<th></th>
<th>Pig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock type</td>
<td>Pig</td>
</tr>
<tr>
<td>Livestock production system</td>
<td>Semi-Intensive</td>
</tr>
<tr>
<td>Location</td>
<td>Vietnam</td>
</tr>
<tr>
<td>Average density (per sq km)</td>
<td>3</td>
</tr>
<tr>
<td>Proportion in that system</td>
<td>%</td>
</tr>
<tr>
<td>Lagoon</td>
<td>20</td>
</tr>
<tr>
<td>Liquid/slurry</td>
<td>0</td>
</tr>
<tr>
<td>Solid storage</td>
<td>53</td>
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<tr>
<td>Digester</td>
<td>7</td>
</tr>
<tr>
<td>Deposited on land/pasture</td>
<td>0</td>
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<tr>
<td>Burned</td>
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<tr>
<td>Is the manure stored?</td>
<td>y</td>
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<tr>
<td>Is the manure applied?</td>
<td>y</td>
</tr>
<tr>
<td>GHG from manure storage</td>
<td>#</td>
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<tr>
<td>Excretion of phosphorus</td>
<td>#</td>
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<td>Excretion of nitrogen</td>
<td>#</td>
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<td>Nitrogen lost</td>
<td>#</td>
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<td>Nitrogen remaining</td>
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[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!