Dynamics of livestock production systems, drivers of change and prospects for animal genetic resources

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Overview of presentation

• Global drivers of change
• Livestock production systems
• Implications for animal genetic resources
• Next steps – Four areas for immediate actions
• Concluding remarks
1. Global drivers of change

- Economic development and globalization
- Market demand & the livestock revolution
- Environment and climate change
- Science and technology
## Economic development and globalization

<table>
<thead>
<tr>
<th>Country</th>
<th>Livestock/AgGDP</th>
<th>GDP growth</th>
<th>Urban pop growth</th>
<th>FDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>44.5</td>
<td>5.8</td>
<td>6.1</td>
<td>50</td>
</tr>
<tr>
<td>Brazil</td>
<td>44.4</td>
<td>2.9</td>
<td>2.3</td>
<td>14,501</td>
</tr>
<tr>
<td>China</td>
<td>24.6</td>
<td>10.4</td>
<td>3.6</td>
<td>60,380</td>
</tr>
<tr>
<td>Vietnam</td>
<td>18.0</td>
<td>8.4</td>
<td>3.4</td>
<td>1,671</td>
</tr>
<tr>
<td>India</td>
<td>30.8</td>
<td>9.2</td>
<td>2.5</td>
<td>5,552</td>
</tr>
</tbody>
</table>
Milk consumption per capita to 2050 (kg/person)

Figure 2.
Meat consumption per capita to 2050 (kg/person)

Figure 3.

- developing countries
- industrial countries
- World
Dynamic livestock sector

- Livestock fastest growing part of the agricultural sector, largely driven by the **Livestock Revolution** in emerging economies.
- Need to **double** livestock production in developing world by 2020 to meet rising demand for livestock products.
- Doubling livestock production puts **pressure on natural resources**: water, land, biodiversity.
Broad trends: soaring output and underlying structural changes

- Growing intensities
- Increasing scales
- Vertical integration/longer food chains
- Geographic shifts / geographic concentration
Livestock sector trends

- A ‘supermarket revolution’ is setting higher standards for food quality and safety.
- Market chains are lengthening, making it more difficult for small-scale producers to participate in markets.
<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>80%</td>
</tr>
<tr>
<td>Brazil</td>
<td>75%</td>
</tr>
<tr>
<td>Kenya</td>
<td>20%</td>
</tr>
<tr>
<td>China</td>
<td>30%</td>
</tr>
<tr>
<td>India</td>
<td>9%</td>
</tr>
</tbody>
</table>
Poverty dimensions

- 1.2 billion people live in absolute poverty (on less than US$1 per day)
- 75% of poor people live in rural areas
- South Asia and sub Saharan Africa – 65- 70% of rural household income comes from farming or farm labour
Livestock, poverty and livelihoods

- Over 600 m poor people depend directly on livestock for their livelihoods
- Many more poor people benefit indirectly
- Multiple roles of livestock in poverty reduction – food, shelter, traction, assets
- Roles of livestock changing with increasing urbanization, market demands.
Environmental effects and climate change
Environmental impacts of livestock production

- “Livestock’s long shadow” – livestock production driving degradation processes and also affected by them
- Livestock negative environmental effects – increasing gas emissions, water depletion, soil erosion, etc
- Need to double livestock production from same natural resource base puts pressure on systems
- Pastoral systems – changing land use for more food crops & biofuels, competition with ecosystem services
- Intensive, large scale industrial systems – negative effects (e.g. increasing methane, effluents, etc)
Livestock and climate change (1)

- Livestock both contribute to and affected by climate change.
- Livestock contribute about 18% of total greenhouse gas emissions.
- Climate change affects farming and livestock production systems.
Livestock and climate change (2)

- Changing climate affects distribution of livestock diseases and vectors
- Increasing cyclones in South/SE Asia – e.g. hotter and wetter weather leads to more livestock helminths diseases
- Shorter growing seasons in Africa leading to reduced crop yields and less feed in rangelands
Science and technology
Science and technology as drivers of change in livestock production

- Science and technology transformed livestock production, mainly in industrial countries
- Labor scarcity led to breeding of small number of higher output breeds of chickens, pigs, cattle
- Multi purpose, disease resistant breeds replaced by specialized breeds for intensive production: risk considerations…
- Animal nutrition research improved feed efficiency, reduced production cycle, led to more efficient use of capital investments
Science and the management of animal genetic resources

- Scientific discoveries in genetics, genomics, bioinformatics, information technologies applicable for -
- **Characterization:** Understanding genetic diversity in livestock breeds and populations through molecular characterization
- **Use:** Understanding, improving and using breed adaptation in different environments (by linking genetics, gene function, and spatial analysis technologies)
- **Conservation:** New technologies for cryopreservation to more species

- More details in subsequent papers at this symposium
2. Livestock production systems
Tropical livestock units by prod system (%)

<table>
<thead>
<tr>
<th></th>
<th>Pastoral</th>
<th>Crop/livestock</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>34</td>
<td>50</td>
<td>14</td>
</tr>
<tr>
<td>Brazil</td>
<td>18</td>
<td>63</td>
<td>17</td>
</tr>
<tr>
<td>China</td>
<td>9</td>
<td>70</td>
<td>19</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2</td>
<td>82</td>
<td>16</td>
</tr>
<tr>
<td>India</td>
<td>2</td>
<td>82</td>
<td>15</td>
</tr>
<tr>
<td>EU</td>
<td>9</td>
<td>67</td>
<td>22</td>
</tr>
</tbody>
</table>
Estimated distribution of livestock production systems
Changes in livestock production systems

- Intensification in industrial systems and crop/livestock systems to meet demand
- Market characteristics, consumer demand
  - Increasing total demand for fresh and processed animal products, especially in developing countries
  - Rising quality preferences and more stringent food safety requirements
Trends in industrial systems

- Changing quickly, expanding globally
- Narrow genetic base, few breeds
- Increasing environmental restrictions due to negative effects (waste disposal, water contamination)
- Competition for feed with alternative demands for cereals (biofuels)
Trends in crop/livestock systems

- Diverse systems, dependent on natural resource base, many breeds
- Systems intensifying in developing countries to meet demand
- Constrained by farm size and lack of access to inputs and services - e.g.
  - Limited provision of high quality feed
  - Increasing competition for land
Trends in pastoral systems

- Pastoral systems in industrial and developing countries; rangelands in marginal environments
- Industrial countries – narrow genetic base
- Developing countries – diverse genetic base, multiple uses, livestock linked to livelihoods
- Increasing competition – land, natural resources
- Policies to settle pastoralists affecting viability
- Increasing role of environmental services for viability
- Generally slower rate of change, with exceptions
3. Implications for animal genetic resources
Implications of system changes for animal genetic resources

- Range and speed of changes mean that livestock production systems and livestock breeds no longer coevolving
- New strategies and interventions required to better manage animal genetic resources at risk
Industrial systems - strategy for animal genetic resources

- Narrow genetic base, few specialized, highly productive, commercial breeds
- Systems will continue to adapt environment to suit genetics
- Exceptions if systems need to respond to future shocks (e.g. zoonotic diseases)
- Conserving diversity of main industrial species (pigs, poultry, cattle) desirable as a public policy to insure capacity to deal with future shocks
Crop/livestock systems - strategy for animal genetic resources

- Heterogeneous systems, many breeds
- Adapt genetics to changing environment
- Sustainable use of breeds to maintain diversity as key to adapt to change
- Incentives to smallholders to maintain diversity e.g. niche markets for products
- Improve productivity of traditional breeds
Pastoral systems – strategy for animal genetic resources

- Adapt genetics to marginal environments
- Maintain diversity to reduce vulnerability of traditional livestock keepers
- Improve productivity of systems to maintain livelihoods; less people likely to be living in marginal areas
- Genetic solutions through hardier animals
- Provide incentives for sustainable use of diversity
4. Next steps
International context

- FAO leading intergovernmental processes to increase international collaboration on management of animal genetic resources
- Some immediate actions possible to address critical issues that will complement and support emerging national and intergovernmental actions
Four immediate actions

1. Provide incentives for on farm, *in situ* conservation of local breeds
2. Facilitate movement of breeds within and between countries, regions and continents
3. Match breeds to environments to better use adapted breeds in new areas
4. Establish gene banks to deep freeze animal genetic resources for future use
(1) “Keep it on the hoof”

- Encourage sustainable use of traditional breeds and *in situ* conservation through market incentives and public policies
- Incentives in developing countries include identifying markets for traditional products
- Better transport / infrastructure in remote areas gives livestock keepers access to new markets
- Enables livestock keepers to maintain genetic diversity & traditional knowledge about livestock breeds
(2) “Move it or lose it”

- Enable access and safe movement of breeds within and between countries, regions and continents
- Maintaining mobility of breeds facilitates their sustainable use and conservation
- Mobility enables flexibility in response to changing climate, disasters, civil strife
- Animal health risks need to be assessed
(3) Match breeds & environments

- Match breeds to environments to better use traditional breeds in new areas
- Undertake systematic analysis of breed characteristics and changing environments
- Understand the genetic basis of adaptation, by linking genomic analysis with spatial analysis of the landscape (as a longer term research challenge)
(4) “Put some in the bank”

- Establish gene banks to deep freeze animal genetic resources for future use
- New technologies make cryopreservation of embryos and semen of most breeds feasible for critical situations
- Long term insurance against future shocks in all livestock systems worldwide
- Critical situation in Africa where breeds at risk and few gene banks yet established
5. Concluding remarks

- The long term conservation of animal genetic resources is a demonstrable global public good

- CGIAR centers concerned about animal genetic resources (Bioversity, ICARDA and ILRI) stand ready to support countries and the international community in the better management of animal genetic resources to maintain future options in an uncertain world
Expected percent changes in per capita consumption of selected food commodities in developing and industrialized countries 2001 – 2030.

Figure 1.
Trends in land-use area for livestock production and total production of meat and milk
### Geographic distribution of livestock (millions of heads)

<table>
<thead>
<tr>
<th>Region</th>
<th>Cattle</th>
<th>Sheep and goats</th>
<th>Pigs</th>
<th>Poultry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>219</td>
<td>365</td>
<td>22</td>
<td>865</td>
</tr>
<tr>
<td>Middle-East and North Africa</td>
<td>23</td>
<td>205</td>
<td>0</td>
<td>868</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>370</td>
<td>112</td>
<td>70</td>
<td>2,343</td>
</tr>
<tr>
<td>North America</td>
<td>110</td>
<td>10</td>
<td>74</td>
<td>2,107</td>
</tr>
<tr>
<td>East Europe and Central Asia</td>
<td>84</td>
<td>121</td>
<td>72</td>
<td>1,160</td>
</tr>
<tr>
<td>West Europe</td>
<td>83</td>
<td>119</td>
<td>125</td>
<td>1,072</td>
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<tr>
<td>East Asia and Pacific</td>
<td>184</td>
<td>514</td>
<td>543</td>
<td>7,168</td>
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<td>South Asia</td>
<td>244</td>
<td>303</td>
<td>15</td>
<td>777</td>
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<td>Industrial World</td>
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<td>390</td>
<td>284</td>
<td>4,663</td>
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<tr>
<td>Developing World</td>
<td>1,046</td>
<td>1,460</td>
<td>659</td>
<td>12,735</td>
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