International Flows of Animal Genetic Resources: An Economic and Biological Analysis

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Central Questions

- SOW briefly discusses AnGR trade and gene flow:
  - How significant are current flows of AnGR?
  - What are the magnitudes and directions of these flows?
  - Are there any policy implications?

- Examine both economic and biological data
Trade Data

- United Nations COMTRADE database reports trade from country to country for a number of categories of animal genetic resources.

- Data on: cattle semen, live cattle for breeding, and live pigs for breeding.
Annual world exports by commodity and region

- Live cattle $300-500 million
- Cattle semen - $130-180 million
- Live swine - $30 – 80 million
- Little trend over time
Leading Exporters

- Global trade in animal genetic resources is dominated by OECD countries.
- US, Canada, Europe, Australia and New Zealand account for almost all of the commercial exports.
Live cattle for breeding: leading exporters

Exports 2005 (percent of world total)

- Germany: 19.5%
- France: 13.6%
- Australia: 10.4%
- New Zealand: 7.8%
- Netherlands: 14.3%
- Austria: 7.4%
- Other OECD: 19.5%
- Other: 7.5%

Other Non-OECD: 19.5%

Panama, Lithuania, South Africa, Colombia, Brazil, Bulgaria, Romania, Other Non-OECD
Bovine semen: leading exporters

Exports, 2005 (percent of world total)

- USA: 32.6%
- Canada: 31.5%
- Netherlands: 7.4%
- France: 6.2%
- Germany: 5.6%
- United Kingdom: 3.8%
- Italy: 2.5%
- Other OECD: 9.2%
- South Africa: 0.5%
- Argentina: 0.3%
- Brazil: 0.3%
- Other: 0.2%
Live swine for breeding: leading exporters

Exports 2005 (percent of world total)

- Netherlands 16%
- France 14%
- United Kingdom 14%
- USA 10%
- Canada 10%
- Spain 5%
- Poland 7%
- Other OECD 12%

Other 5%

- China 1%
- Cyprus 1%
- Lithuania 1%
- Bulgaria 1%
- Colombia 1%
- Thailand 1%
- Costa Rica 0%
- Other Non-OECD 1%
Direction of Trade

- Who are the recipients of AnGR exports?
  - Vast majority are OECD to OECD
  - Some flows OECD to Non-OECD
  - Very little flow from Non-OECD to OECD
Live cattle for breeding

Direction of trade, 1988-2005

- OECD to Non-OECD
- OECD to OECD
- Non-OECD to Non-OECD
- Non-OECD to OECD
Live swine for breeding

Direction of trade, 1988-2005

- OECD to Non-OECD
- OECD to OECD
- Non-OECD to Non-OECD
- Non-OECD to OECD
Cattle semen

Direction of trade, 1996-2005

- OECD to Non-OECD
- OECD to OECD
- Non-OECD to Non-OECD
- Non-OECD to OECD
The high productivity animal agriculture systems of the world engage in busy and competitive trade in genetic resources. These countries are, in general, sources of genetics for the rest of the world, and they make little use of genetic resources originating in the low productivity systems of the developing world.
Genetic Aspects of Gene Flow

- Data on breed importation are not kept at the national level.

- Some data are available on importations of new breeds.

- Pedigree data can be used to shed light on imports within breeds, drawing on records of breed associations.
Examples of New Breed Importations

- In the mid 1980s and early 1990s, a number of breeds were imported to the US from developing countries, with the goal of incorporating them into US production:
  - Meishan pig – prolificacy
  - Tuli cattle – semi-arid adaptability
  - Boer goat – size, growth
Meishan

- Importation conducted by public sector
- Experimentation showed that introgression of prolificacy genes was not an effective strategy
- Industry never adopted the breed
Tuli

- Adaptability was not sufficient to offset lower performance characteristics
- Some enthusiasts but no wide spread adoption

<table>
<thead>
<tr>
<th>Breed</th>
<th>Wn Wt., kg</th>
<th>Tender-ness</th>
<th>Carcass wt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereford</td>
<td>240</td>
<td>9.7</td>
<td>350</td>
</tr>
<tr>
<td>Brahman</td>
<td>246</td>
<td>13.2</td>
<td>333</td>
</tr>
<tr>
<td>Tuli</td>
<td>224</td>
<td>10.1</td>
<td>309</td>
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Boer Goat

- Successful importation due to growth & carcass characteristics
- Producer interest led to successful importation: 45,000 registered in 2000
- Currently causing a contraction of AnGR for Spanish goats in US.
Pedigree Analysis of Gene Flow

- How prominent do imported genes become?
- Pedigrees from breed associations that have imported animals identified
Imports for a well established competitive breed - Jersey

Since 1950, 186 Jerseys have been imported from 6 countries. Canadian exports excluded.

3 generation progeny totals for high bulls:
- Import 10,701
- US-bred 232,494
Registrations of non-US Jersey animals, by year

Percent of non-US progeny, grand progeny, and great-grand progeny.
<table>
<thead>
<tr>
<th>Source</th>
<th>Milk</th>
<th>Productive life</th>
</tr>
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<tbody>
<tr>
<td>Imported</td>
<td>-326.8</td>
<td>+0.05</td>
</tr>
<tr>
<td>US-bred</td>
<td>+194.5</td>
<td>+0.07</td>
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Future Trends

- In the near, medium and potentially long term, OECD-OECD exchanges will dominate AnGR trade as breeders take advantage of existing genetic progress. Current market structures will facilitate such trade.

- There will be few commercial flows of genetics from non-OECD countries to OECD markets. By contrast, high-performance production systems in non-OECD countries will continue to use genetics from OECD sources.
Conclusions

- Producer involvement is necessary for successful exchange of AnGR

- Markets for high-performance genetics appear to be functioning and vibrant

- There seems to be little incentive for OECD producers to seek non-OECD genetic resources for importation

- Given the small trade volume from non-OECD to OECD, benefit sharing mechanisms based on such trade would not yield significant financial support for genetic conservation, nor cover the recurrent costs of administration.
Conclusions

- Non-OECD genetic resources may be of occasional interest to OECD producers. But are unlikely to provide a steady source of revenue.

- Given the substantial costs of negotiating benefit sharing mechanisms, it is questionable whether this should be a priority for genetic conservation.