

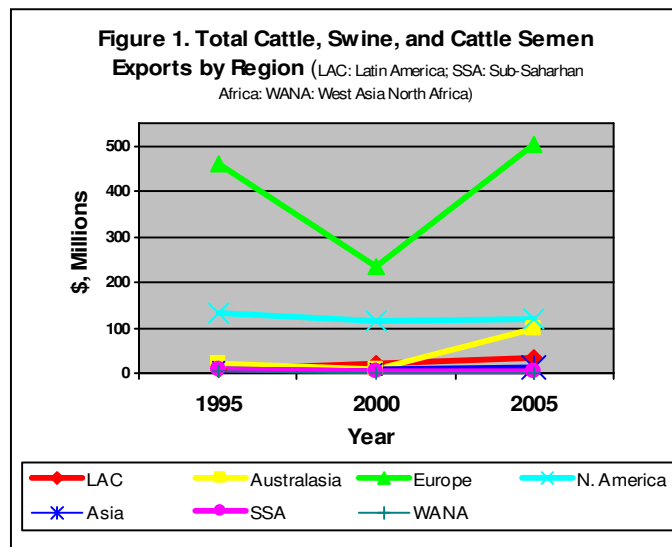
## Economic and Biological Assessment of Animal Genetic Resource Trade Flows.

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Throughout human history, livestock producers have relied on the international exchange of genetic resources. In recent years, the magnitude and extent of these exchanges have prompted questions and concerns. Discussions have revolved around the perceived need for greater regulation of AnGR flows, as well as policies governing access and benefit sharing. An additional area of concern is the potential displacement of indigenous animal genetic resources in developing countries by modern commercial breeds. Much of this discussion, however, has been based upon loose perceptions of trade flows and the utilization of genetic resources, rather than on a careful analysis of data.

Our research analyzes AnGR trade flows from 1990 to 2005 and draws on national-level data from 150 countries that reported information to the United Nations Statistics Division. Three major trade categories were evaluated for breeding animals only: live cattle and pigs for breeding, and cattle semen. The analysis suggests that the vast majority of trade in AnGR is being conducted primarily among members of the OECD. There is very little gene flow from developing to developed countries the trade that exists in this category is principally between neighboring countries. The data suggest that farmers, breeders, and researchers in OECD countries make little use of developing country genetics.



To examine this question further, we extended our study to evaluate the biological impact of imported AnGR arriving in the United States, focusing on several recent cases. This component of our study was based on information drawn from breed associations, including use of their pedigree (parentage) records, along with published literature. We looked both at the importation of new breeds (Tuli cattle, Boer goats, Meishan pigs) and new animals within existing

breeds (Jersey and Limousin cattle). Our biological analysis suggests that new germplasm is often poorly suited to the production settings in the United States, so that imported germplasm has very little impact, even when it comes from production systems that appear fairly similar (e.g., other OECD countries).

## Results

**Figure 2. Direction of trade between OECD and Non-OECD countries.**

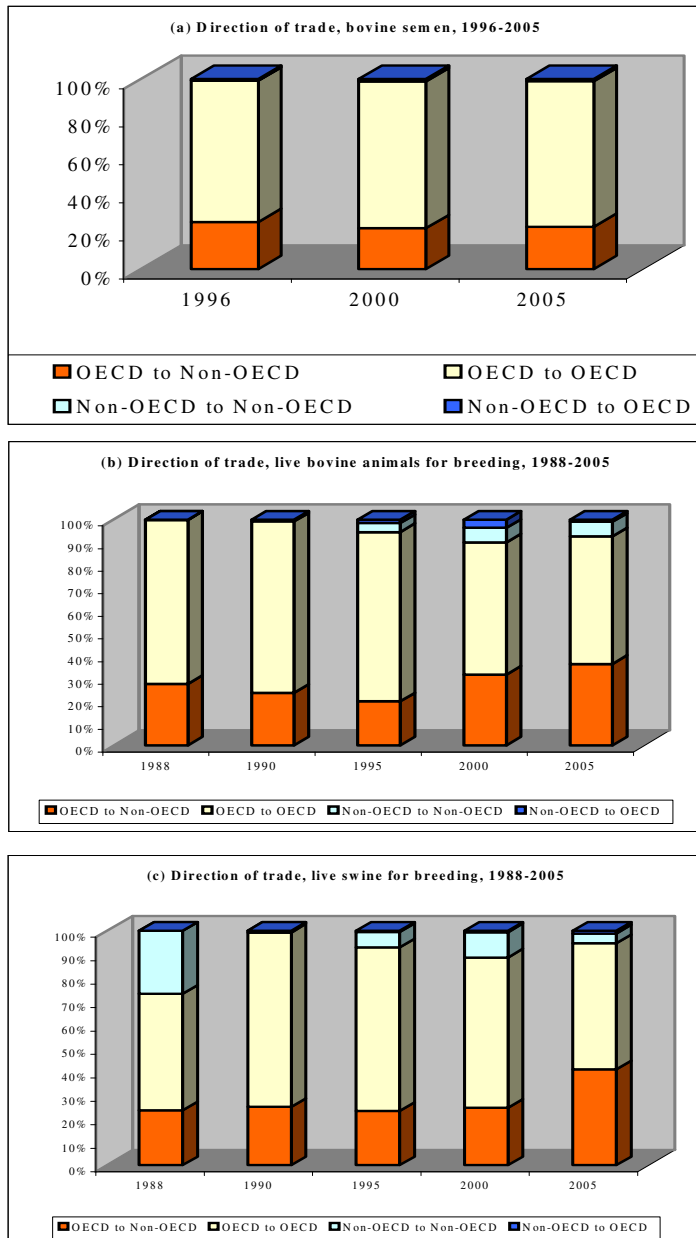


Figure 1 illustrates that the total global trade of live breeding animals (cattle and swine) and cattle semen sales are relatively small compared to the global value of the livestock industry. This trade is principally conducted by the private sector, indicating that markets for genetic resources are established and functioning. OECD countries play the dominant role in this trade; as Figure 1 shows, non-OECD countries play a very minor role in terms of total value exchanged through formally reported channels. The direction of trade (Figure 2) demonstrates that genetic resources flow principally from developed countries to other developed countries. To a lesser extent, they also flow from developed countries to developing countries (non-OECD).

Non-OECD to OECD trade flows are very

small, both in terms of the quantities of germplasm moving across international boundaries and in terms of the monetary value of these flows (Figure 2). The non-

OECD to OECD trade that occurs is principally between neighboring countries, implying that OECD producers were not searching widely among non-OECD countries for genetic resources to utilize.

An interesting comparison of countries that trade and do not trade based upon GDP is provided in Table 1 and indicates that the poorest countries play essentially no role in AnGR trade.

**Table 1. Per capita GDP classified by import &/or export activity for the year 2000.**

Activity	Cattle – live	Cattle - semen
Import & export	\$14,385 (48)*	\$18,578 (37)
Export only	\$ 6,719 (15)	\$ -- (0)
Import only	\$ 8,128 (56)	\$ 8,576 (89)
No trade	\$ 6,819 (69)	\$ 7,400 (51)

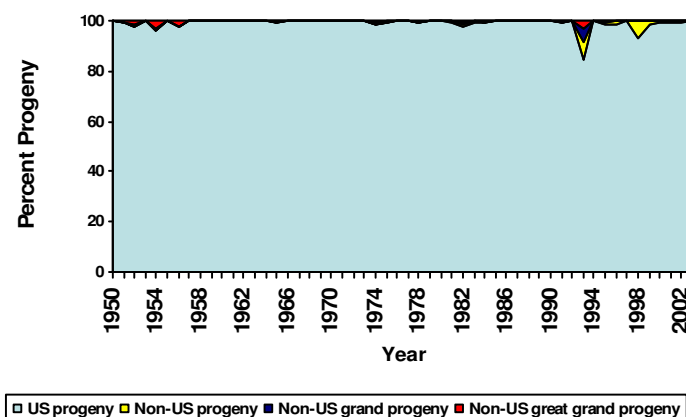
\* Number of countries

**New Breed Importation (U.S. examples):** Retrospective analysis was carried out on three episodes of breed importation: Meishan pigs (China), Tuli cattle (Zimbabwe), and Boer goats (South Africa). All three of these breeds were imported to the U.S. for the first time in the 1980's or early 1990's.

For all three breeds, performance studies have compared them to other commercial breeds prevalent in the U.S. In general, the Meishan and Tuli were not competitive in the U.S. The results suggest that importation for a specific trait (i.e., prolificacy in Meishan's; arid environment production as in the Tuli) is not sufficient to lead to long-lasting genetic impact, unless other productivity traits are competitive with breeds presently in the U.S. Conversely, the Boer goat -- which excels in body size, growth rate, and body conformation -- has been successfully introduced into the U.S., and currently more than 40,000 animals have been registered. Interestingly and importantly, the Boer was imported without public sector involvement, which may suggest that initial producer involvement with the importation was a necessary element for success.

**Importations of an Existing Breed:** The Jersey breed of dairy cattle, first imported in the 1800s, was used because the association could identify imported animals in its pedigree records for the last 50 years. Our analysis indicated that imported bulls did not have a significant impact upon the breed, producing relatively small numbers of progeny, grand progeny, and great-

**Figure 3. Percent of non-US progeny, grand progeny, and great-grand progeny Jersey registered by year.**



grand progeny (Figure 3). Examination of imported bulls' progeny performance indicated they had significantly lower milk production levels than their U.S. counterparts, which is likely the reason for their lack of acceptance. In addition, it was clear that over the last 50 years no significant sire has been imported that profoundly impacted the breed, underscoring the difficulty in identifying such animals.

### **Future Trends for Germplasm Exchange:**

Based on the findings of this study, we make the following assessments of future trends and directions in international movements of animal genetic resources:

- In the near, medium and potentially long term, OECD-OECD exchanges will dominate AnGR trade as breeders take advantage of existing high-performance genetics. 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 benefit from commercial importation of genetics from OECD sources.
- South-South trade has potential for expansion as stronger breeding programs may have useful germplasm to offer to neighboring countries and/or countries with similar production systems.

Other factors influencing the trade of animal genetic resources include:

- Private sector importation of new breeds or individual animals of existing breeds is highly speculative, as demonstrated in the second part of our analysis. Limitations on germplasm exchange will add costs that may slow or stop useful exchanges.
- Importation of new genetic resources for a single trait (or gene) does not appear to be a viable avenue for livestock, as illustrated by the Meishan and Tuli experiences.
- It has been speculated that breeds in developing countries may have an advantage in conferring resistance to some animal diseases. There is little past evidence that such traits have been used in OECD countries, where producers seem inclined to use drugs and other disease control measures, rather than to import AnGR that may simultaneously confer disadvantages in productivity. As a result, concerns expressed by developing countries about the North expropriating desirable genes from their genetic resources appear not to be well founded, given the current state of technology.

### **Conclusions:**

Based on this assessment we offer the following conclusions:

- Markets for high-performance genetics appear to be functioning and vibrant.
- There is little current 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.
- Given the small volume of trade from non-OECD to OECD and the substantial costs of developing international agreements covering such exchange, it is questionable if revenues generated can capture the cost of developing various agreements.
- The U.S. examples demonstrate the important role that producers play in accepting and utilizing genetic resources. They are well placed to make the best determination about the genetic resources they wish to use.