A stakeholder view on fair and equitable exchange of AnGR; an industry perspective

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Conclusions

The major part of the bovine semen trade, and of the porcine trade in breeding stock, is an exchange between developed countries. Additional to this, the trade from western countries into Russia and China is increasing.

The semen exported to developing countries has estimated breeding values for most of the economical important traits, including functional traits. This gives the importers a possibility to select a trait profile suitable for local conditions. The interaction between genotype and environment is still a challenge that causes reranking between animals in the new location.

The quantity of germplasm from developing countries in the developed countries' cattle and pig breeding programs is at the moment unimportant and a regulation of the exchange is unnecessary.

Genomic Selection can be a tool to facilitate the adaptation of synthetic breeds to local conditions.

Introduction

In cattle the by far largest trade of semen is between developed countries. The export of semen from developed to developing countries was also shown to be substantial by Blackburn & Gollin, 2007. The exchange of semen between developing countries is very limited as well as the export from developing countries to developed countries.

Table 1 Export of bovine semen 2005 from Blackburn & Gollin, 2007

Exporting country	Percent of world trade
USA	32.6
Canada	31.5
The Netherlands	7.4
France	6.2
Germany	5.6
Other OECD	15.5
None OECD	1.3

Characteristics of developed and developing countries

In **developed countries** well-functioning recording schemes are present for most traits of economic importance and new traits are added after requirement. The information is transformed into breeding values by local breeding organizations and utilized in systematic breeding programs. In most countries the breeding companies are organized as farmers' cooperatives, and a few companies operate transnationally. In dairy cattle, a comparison between breeding values of different origin is possible via Interbull's evaluations. Conventional semen, sex sorted semen and embryo transfers are reproductive techniques widely used.

In **developing countries** recording schemes are not common and the numbers of traits recorded are limited. In many countries no breeding value estimation is performed and the countries do not participate in Interbull's activities. The same reproductive techniques that are available in developed countries are also present in many developing countries.

Dairy cattle: international breeding values

The number of traits, participating countries and breeds has increased over the years. Breeds included in the evaluation in August 2010 were Holstein, Brown Swiss, Jersey, Red Dairy Cattle, Guernsey and Simmental, www.interbull.org. Estimated breeding values from Interbull are comparable on each country's national scale and reranking of the bulls occur due to a genetic correlation between countries less than 1.0.

Table 2. Traits evaluated by Interbull in August 2010, www.interbull.org

Trait	Number of countries	Number of breeds
Production	27	6
Conformation	20	5
Udder health	22	6
Direct longevity	21	6
Calving traits	13	3
Female fertility	18	6
Temperament and milkability	6	4

Different markets

The semen **trade between developed countries** is the largest and most important for the dairy cattle AI industry. Holstein is the breed with the largest international exchange. Examples of other breeds with large semen trade are Red Dairy Cattle and Jersey. Most of the semen is used for pure breeding, but an increasing interest of cross breeding has developed during the last years. Breeding values are expressed on the domestic scale and are the source of price differentiating.
In pig breeding, the situation is similar but breeding value estimation is not harmonized between countries, and much of the trade involves live breeding stock rather than semen.

The **export of semen to developing countries** is important for many cattle and pig breeding companies. Holstein is the major cattle breed in this trade. Holsteins are used in pure breeding, but also for crossing with domestic breeds. The interest of color breeds are also increasing in developing countries. Breeding values are often expressed and marketed on the exporting countries' scale. Genotype x environmental interaction is a big source of reranking between bulls and breeds. Functional traits might be more important during harsh condition and this is favoring colored breeds.

The **exchange between developing countries** and the **export from developing countries** is very limited. The access to reliable breeding values is one reason hampering the exchange.

Sourcing for novel traits

New traits must be recorded to be able to estimate merit of individuals and breeds. New traits must have an economical value to be considered for introduction in a breeding program. Results from

Blackburn & Gollin (2007) suggested that during US conditions importation for specific traits is not sufficient to lead to long-lasting genetic impact in dairy cattle, unless other productivity traits of the animals/breeds are competitive. Furthermore, Blackburn & Gollin (2007) also found that very small quantities of germplasm are moved from developing to developed countries, implying that developing countries are not widely searching for genetic resources in developing countries.

Knap & Neeteson-Van Nieuwenhoven (2006; see there for more references) present a case study on the immigration of exotic germplasm (the Chinese Taihu breeds) into western pig breeding programs. The interest was in reproductive traits, set off by a disadvantage due to high body fat levels and slow growth rates. Several commercial breeding organisations in France, UK and Canada have invested in the introgression of Jiaxing and particularly Meishan pigs into their dam lines, the only recent example of introgression of a non-western exotic pig or poultry genotype that we are aware of. This was accompanied by studies into the trade-off between improved fertility and reduced leanness. These suggested that the feasible way to commercially exploit these genotypes would be as composite lines at the grandparental level after six to eight generations of selection for growth and body composition traits. In accordance with this, several introgressions were made, leading to commercial parent sows mostly holding 12.5 % Taihu genes.

The trade-off between enhanced fertility and reduced leanness of Taihu-based genotypes was a serious obstacle towards large-scale commercial exploitation, although persistent genetic improvement in the latter trait solved the problem. A complicating factor was that a few years after the Taihu imports, improved statistical methods allowed for a much faster genetic change of reproductive traits in pigs than ever before, while genetic improvement of leanness continued at the same rate as before. This has reduced the initial advantage of the Taihu genotypes: the contrast in reproductive performance with the established genotypes has gradually decreased after a decade of hyperprolific selection in the European breeds.

Western commercialisation of the Taihu breeds has been successful to the extent that somewhat less than 100.000 Taihu-based parent gilts (carrying 12.5 % Taihu genes each) are currently sold per year in Europe and North America, about three quarters of these in France. This represents less than 1.5 % of the total market volume in this area, illustrating the difficulty of large-scale commercialisation of exotic animal genotypes.

Genomic Selection

The implementation of Genomic Selection in several breeding programs in developed countries has been exceptional rapid. The number of available genetic markers have increased from a couple of hundreds micro satellites to 3 K, 50 K and for dairy cattle recently to 800 K SNPs. The number of animals in the reference population has increased from a couple of thousand to more than 18 500 bulls, as the situation is in the EuroGenomics case. Calculated Direct Genetic Values (DGVs) for candidates are based on the Estimated Breeding Values (EBVs) for the animals in the reference population that are DNA-typed. The expected result from Genomic Selection is an increased genetic progress with 50-100 %. The enlarge progress is due to higher reliabilities for DGVs than for pedigree index and due to a shortening of the generation interval. Only traits that are recorded and information is processed into EBVs can receive DGVs.

Genomic Selection might give a valuable tool to facilitate the adaptation of exotic breeds into local conditions. A prerequisite for this is that the relevant traits are recorded in the local environment, on animals with a known (exotic) sire.

References

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