Data Retrieval Committee Report 2006

Data Retrieval Committee statistics of Embryo Transfer- Year 2006.

New records in the numbers of both in vivo-derived and in vitro-produced bovine embryos around the world in 2006.

By Professor Michel Thibier - Chairperson
In: IETS Newsletter, 2007, 25, (4), ..

Summary
The numbers of both in vivo-derived and in vitro-produced bovine embryos reported have again broken records. A total of 670,711 in vivo-derived embryos and 291,845 in vitro-produced bovine embryos, a total of almost 1 million cattle embryos were transferred in 2006. The distribution of in vivo-derived bovine embryos is worldwide and North America takes into account approximately 44% of the total ahead of Asia, South America and Europe and lastly Oceania and Africa. A little more than 50 % of these embryos were transferred as frozen-thawed embryos. For in vitro-produced embryos, the vast majority of the embryos transferred come from South America (Brazil) and Asia (the People Republic of China, Japan and Korea). The strategy for transferring embryos as fresh or frozen-thawed differs totally between the major countries: almost all are fresh in Brazil and in Korea, they are about equally fresh or frozen-thawed in Japan and mostly frozen-thawed in the PR China.
Embryo Transfer (almost exclusively in -vivo-derived embryos) is also widely used in other ruminant species but with lower numbers than in cattle. In total, 43,000 sheep embryos, 24,000 goat embryos (mostly frozen-thawed) and 696 Cervid embryos have been reported. Equine and swine embryos were also recorded with15,695 equine embryos, almost all fresh, and 33,779 swine embryos, all transferred as fresh embryos. These figures are underestimated due to lack of national collectors in some countries or retrieval of partial data in a few others. However, they prove that the ET industry continues to grow and hence continues to bring benefits to the farming industry.

Introduction
The IETS Data Retrieval Committee is happy for the 16th year in a row to present the world statistics of Embryo Transfer in farm animals for the year 2006. This is a tremendous effort of very many practitioners and also of the national or regional collectors to put all those data together, many thanks to them. The charts used this year have only been slightly modified after our committee meeting in Kyoto (January 2007) regarding the collection of oocytes for bovine in vitro-produced embryos, thanks to the members who proposed and tested those marginal modifications. All the rest of the charts have been maintained identical so that everyone knows at the end of the year what he /she is to collect: just simple and few data.
The committee committed itself to improving our network by finding people able to collect data from one given country or region that were not yet included in the network. Some progress has been made but there is still a long way to go. Quite a few data are just missing, either partially or completely in countries where we know some ET are performed. We have no data from India or Pakistan for example, or from the Middle East where even ET on Camels has been incidentally reported. So it should be kept in mind that although the principle of this survey is not a sampling procedure but a strict calculation from numbers collected all around the world, the data presented here below are with no doubt underestimated. However this gives the order of magnitude of what really occurs in the world and in addition allows us to follow on a year-to-year basis the evolution of this industry. Clearly for those who may be far from it, this industry is well and doing quite fine, as the majority of data collected here are in numbers higher than the previous years.
It is also of some pride for IETS in putting all these data together, to be able to respond to all enquiries from many Universities or Research Institutions worldwide or else Inter Governmental or Non-Governmental

Organizations. To some practitioners who sometimes complain -usually kindly- that it is a bit of a burden - which is not quite correct, it is of importance to note that this information is being picked up by many around the world and so gives a true reflection of the dynamics of the ET industry.

1. Another record for the number of in vivo derived bovine embryos transferred in 2006.

Once more this year the numbers of flushes, of transferable embryos and of transferred embryos have broken the records. In total (Table 1), more than 670,000 embryos have been transferred (increase of + 9% as to the 2005 data). In the same year, more than 121,000 flushes have been performed successfully and a little more than three quarters of a million transferable embryos have been processed. The majority of the transferred embryos were frozen but only by a 53% vs. 47% for fresh. There are quite significant differences according to regions or countries. For example, South America and in particular Brazil transfer the vast majority of their embryos as fresh. So do the few teams from Australia and New Zealand that have sent their data.

TABLE 1. Overall Activity of *In Vivo*-Derived Bovine Embryos in 2006.

CONTINENTS	FLUSHES	TRANSFERABLE EMBRYOS	NUMBER OF TRANSFERRED EMBRYOS			
			FRESH	FROZEN	TOTAL	
AFRICA	1,607	13,660	2,063	3,118	5,181	(0.8%)
N. AMERICA	64,711	415,596	131,510	161,095	292,605	(43.6%)
S. AMERICA	18,000	99,627	76,521	11,740	88,261	(13.2%)
ASIA	18,919	139,534	60,730	123,195	183,925	(27.4%)
EUROPE (*)	15,859	94,090	36,033	51,808	87,841	(13.1%)
OCEANIA	2,816	15,240	7,849	5,049	12,898	(1.9%)
TOTAL	**121,912**	**777,747**	**314,706**	**356,005**	**670,711**	

(*) Those European data are derived from the statistics of AETE, 2007 and a few recorded later. In addition, one country did not split the figures between fresh and frozen (total = 4,249). By convention, they were all included in the frozen column so as to take them into account in the gross total.

Percentage wise, from the various areas, North America has increased its number of embryos transferred and takes now into account almost 44% of the total. Asia shows also a remarkable increase in numbers and account for more than 27% of the total. Ranking behind those two regions, South America and Europe with close numbers with a little more than 13% each before Oceania and Africa. Some detailed features have been given in the regional reports and are interesting to share. From Africa, although the total number is slightly lower than that of last year, the regional collector has been able to provide data from several countries such as Kenya with several practitioners and Namibia in addition to those from the Republic of South Africa which has transferred close to 4 000 embryos, the two thirds of them approximately being of beef breeds.

In North America, thanks to the most remarkable report provided each year, a lot of information is available, including the transfers that have been made by Canadian teams abroad, which fill a gap sometimes for some missing countries. The more than 50,000 embryos transferred are almost identical in numbers between fresh and frozen and almost three quarters of them are from dairy breeds. The vast majority of frozen embryos are transferred by direct transfers and close to 1,000 have been previously sex-determined. The Canadians also report the transfer of close to 1,000 split embryos and 34 cloned embryos transferred. The number of embryos in storage is very large and more than 63,000. Interestingly enough, 22,176 in vivo-derived embryos have been exported overseas and only 327 imported. Data from the USA have again this year been quite exhaustive with more than 120 teams responding. Conversely to the Canadians, two thirds of the embryos transferred are from beef breeds. Here too the majority of frozen-thawed embryos are put in place by direct transfer. The number of stored embryos is huge and greater than 120,000. Although the number of exported embryos might not cover entirely the reality, the number reported is close to 12,000 with approximately half from dairy and half from beef breeds.

Data from South America this year derive from Argentina, Brazil, Uruguay and indirectly Venezuela. Brazil has again increased its number and again a striking feature of this report is the 95% of those transfers reported as fresh. This is of course associated with the fact that 88% of those embryos were collected from beef breed females. However quite a significant number of frozen embryos, close to 10,000, are in storage. In Argentina and Uruguay, most of the embryos are from beef cattle (86% for Argentina) but even in excluding the imported embryos (close to 2,000) the number of frozen is exceeding that of fresh (58% frozen).

The data reported by the Asian collectors show a significant increase in numbers of more than 30%. The People Republic of China and Japan account for 85% of the total number of embryos reported across the continent (with some major countries missing). The PR China reports more than 123,000 embryos transferred with one third as fresh and almost all (fresh and frozen) of dairy breeds. By contrast Japan, in relation to its famous and special Kobe breed, transfers close to 90% of its embryos from beef cattle. Seventy per cent approximately of the embryos are transferred as frozen.

Data for Europe have been collected by the "Association Européenne de Transfert Embryonnaire" (AETE) and data from Israel have been kindly added to them. Close to 60% of the embryos that have been transferred in 2006 were frozen but the distribution between dairy and beef breeds has not been reported. On the whole, the number of embryos transferred has increased slightly compared to the previous year but irregularly according to countries as further shown on Table 2. As shown in this table, France remains first in numbers almost identical to those of the previous year. The Netherlands rank second with almost 19,000 transfers and this is very significant increase as compared to last year. The Czech Republic and the United Kingdom have also significantly increased their activity during 2006.

TABLE 2. The top Twelve European Countries ranked according to numbers of *In Vivo*-derived Embryos Transferred in 2006 (AETE, 2007).

COUNTRIES	NUMBER OF FLUSHES	NUMBER OF EMBRYOS TRANSFERRED	
FRANCE	5,915	28,442	≅
NETHERLANDS	2,991	18,935	↗
GERMANY	2,445	13,106	↘
CZECH Republic	1,210	6,032	↗
ITALY	725	5,283	↘
UNITED KINGDOM (*)	/	4,249	↗
DENMARK	580	3,470	↘
FINLAND	399	2,305	≅
SWITZERLAND	321	1,959	↗
BELGIUM	280	1,596	↘
IRELAND	271	1,523	↗
SPAIN	339	1,257	↘

(*)This is the only data available for this country this year.

↘↗≅ = evolution as compared to the previous year

From the data collected in Oceania, more numerous this year particularly from Australia, thanks to the teams who responded, it is obvious that most of the embryos transferred had been collected from beef dams and logically, a majority of them (about 60%) were transferred as fresh. The top six countries outside Europe and North America are listed in the Table 3. The People Republic of China ranks now first with its more than 123,000 embryos transferred and reported. Brazil is second and has seen its number decreased but this could be in part related to some difficulties in retrieving data from certain teams. Japan has seen its activity increased with more than 58,000 embryos transferred. Argentina, Australia and the Republic of South Africa rank fourth, fifth and sixth with more than 16,000 transfers for the former and more than 5,000 for the latter. It is of note that

for the first time, this report managed to get quite a few data from Australia, which allows one to realize that this country takes the fifth place in this section with more than 10,000 embryos transferred, i.e. a number close to that of Germany for example.

TABLE 3. The top Six Countries outside Europe and North America in 2006.

		Number of Transferred Embryos			
COUNTRIES	NO. FLUSHES	FRESH	FROZEN	TOTAL	
P R CHINA	8,785	42,470	81,202	123,672	↗
BRAZIL	13,837	69,886	500	70,386	↘
JAPAN	9,548	17,001	41,529	58,530	↗
ARGENTINA	3,917	6,151	10,587	16,738	≅
AUSTRALIA	2,388	6,350	4,175	10,525	↗
SOUTH AFRICA	1,258	2,016	3,000	5,016	↘

↘↗≅ = evolution as compared to the previous year

It should also be mentioned that some buffaloes embryos are transferred and in particular in the People Republic of China. It is close to 1,000 transferable embryos from 162 donors that have been reported in this species and the 800 embryos that were transferred were half fresh and half frozen-thawed.

2. The number of in vitro-produced bovine embryos transferred in 2006 also breaks a record.
After a most significant jump in 2004 and again the increase noted last year, this year's figure is again a + 10% increase compared to 2005 with a total number of close to 292,000 embryos transferred (Table 4). This plus the total of in vivo-derived embryos leads to more than 950,000 bovine embryos transferred, i.e. very close to one million recorded.

TABLE 4. The Number of Bovine *In Vitro*-Produced Embryos Transferred in 2006.

	TRANSFERABLE	Number of Transferred Embryos			
REGIONS	EMBRYOS	FRESH	FROZEN	TOTAL	
AFRICA	-	-	-	-	
N.AMERICA	134,162	4,306	3	4,309	(1.5%)
S.AMERICA	204,469	196,759	32	196,791	(67.4%)
ASIA	86,945	20,859	61,448	82,307	(28.2%)
EUROPE	13,942	2,763	4,082	6,845	(2.4%)
OCEANIA	1,846	1,390	203	1,593	(0.5%)
TOTAL	441,364	226,077	65,768	291,845	

In vitro-produced embryos are transferred all around the world with the exception of Africa this year. South America, Brazil account for more than the two thirds of the total activity. Asia has slightly reduced its activity but has transferred more than 80,000 embryos and accounts for 28% of the total. The People Republic of China, Korea and Japan are the main countries in this region, involved in in vitro produced embryos. The three other regions play a minor role in this in vitro production. It is of notice that in North America quite a large number of embryos have been produced in vitro, essentially from Canada and few have been transferred in this country. Indeed many of them (30,000) have been exported and transferred overseas, notably in China. However, Oceania has reported more than 1,500 in vitro-produced embryos transferred, which is a slight decrease from last year, probably related to some teams having not reported. North America has increased slightly its numbers and so has Europe with a majority of them being transferred as frozen notably due to the activity recorded in Italy.

Regarding the percentages of fresh and frozen embryos, the contrast is striking between Brazil on one hand of which the almost 200,000 embryos are transferred as fresh for a transfer of so-called “proximity” and on the other hand the People Republic of China, where more than the two-thirds are transferred frozen-thawed including those imported. Most of the Korean embryos like in Brazil are almost exclusively transferred as fresh but in Japan the distribution is close to 50/50.

3. The results in other species are also increasing for the ruminants.

Data for the three species of ruminants investigated: sheep, goats and cervids are reported in Table 5. Although here again, some data are still missing, it is of satisfaction to see that in all those three species, there has been an increase in the numbers of embryo collections, transferable embryos and embryos transferred. The wider response of Australian practitioners, thanks to them, has increased significantly both the numbers and the credibility of the figures here reported. In sheep, more than 43,000 embryos transferred were recorded in this data retrieval network. The three major countries contributing to this activity are in the decreasing order, Australia (accounting for 47% of the total), the People Republic of China and New Zealand. Some hundreds of transfers have been also reported in South Africa, North America and in Europe. Globally, a little more than 55% of those were transferred as fresh as it is the majority of those in Australia (85% of them as fresh), but by contrast in China, 88% are transferred as frozen. It is of note that more than 3,000 embryos are in storage and that the export has been very active as close to 20,000 embryos have been shipped from one country to another, mainly from Australia and New Zealand.

TABLE 5. Small Ruminant ET Activity in 2006.

SPECIES	Transferable Embryos	Number of Transferred Embryos	
		FRESH	FROZEN
SHEEP TOTAL	56,519	24,293	18,966
GOAT (*) TOTAL	23,826	7,966	16,423
CERVIDS TOTAL	791	493	203

(*) the number of transferred embryos exceeds that of collected due to international movements, which have not always been recorded consistently.

The numbers in goats are also in great increase due essentially to the activity reported in the Republic of China which takes into account close to 80% of the total approximately: close to 25,000 embryos transferred and two-thirds as frozen-thawed. New Zealand and to a lesser extent Australia contribute also to some transfers in this species. The Republic of South Africa, North America and Europe have also transferred a few hundreds of such embryos either fresh or frozen-thawed (~one-third).

Some Cervid embryos have also been collected in 2006 and transferred in North America, China, New Zealand and Europe. Only the People Republic of China has reported having transferred frozen-thawed embryos, all the other teams only transferred fresh ones.

The equine activity also suffers from some lack of responses so that the numbers are here too underestimated. In equine, the number of flushes has increased by about + 10% as compared to last year and this is due to the major countries involved in this technology, Brazil and USA. The total of number of flushes is over 27,000 (Table 6).

TABLE 6. Equine ET Activities in 2006

Countries	Flushes	Transferable Embryos	Number of Transferred Embryos	
			FRESH	FROZEN
ARGENTINA	N D			
BRAZIL	12,000	6,700	6,700	
CANADA	45	38	36	2
EUROPE		428	884 (*)	
P R of CHINA	2	2	2	
SOUTH AFRICA	20	15	15	
NEW ZEALAND	70	50	50	6
USA	15,000	7,600	7,600	400
TOTAL	**27,138**	**14,833**	**15,287**	**408**

(*) including 12 *in vitro*-Production.

Unfortunately, the Argentineans have not sent their data this year, so it is not known if this trend is also of value in this country. Europe and New Zealand to a lesser extent are the two next contributors to the total numbers. The numbers of transfers exceed that of transferable embryos due to some import from countries or teams that did not report their data. On the whole, more than 15,000 embryos have been transferred according to the reports received and 93% are put in place in Brazil and the US. Quite a significant number of frozen-thawed embryos are now moved from one place to another and even from one continent to another, with more than 400 such embryos recorded in 2006. Even more than for equine, retrieval of transfers in swine seems very difficult. Only scarce reports indicate that ET does exist and is feasible. Data have been collected in Canada, Korea, the Republic of China and Europe. Close to 60,000 transferable embryos (Table 7) have been reported.

TABLE 7. Swine ET Activity in 2006.

COUNTRIES	FLUSHES	TRANSFERABLE EMBRYOS	TRANSFERRED EMBRYOS		RECIPIENT FEMALES
			FRESH	FROZEN	
CANADA	114	2,013	4,419		
KOREA (1)	34	531			
KOREA (2)	-	54,688	29,351		
PR CHINA	2				
EUROPE (3)		296			
TOTAL	150	57,537	33,779		

(1) *In Vivo* derived. (2) *In vitro* produced and clones. (3) From AETE statistics

In conclusion, the IETS data retrieval committee has been able for the 16th time in a row to show the overall picture of the ET industry in numbers. This industry continues to grow and bring all its genetics and health advantages to the farmers worldwide. This is particularly true where the numbers reported both for in vivo-derived and in vitro -produced embryos have broken records. The geographical distribution is consistent with that of the previous years; ET is being used, at least in cattle, in all regions of the world. The between or even within region or country distributions of breeds collected or procedures used, fresh or frozen show that this ET technology is also quite flexible, able to meet specific and regional requirements and demands. Regarding the committee, its members would like to see new people from countries not yet within the network to participate and so expand our network so as to even have a more accurate picture of the industry whose figures here given are yet underestimated.

Acknowledgments: It is the privilege of the Chairman to gratefully acknowledge the most valuable help of all who participated to this worldwide network of the IETS ET data retrieval and more particularly all of the AETE, S. Merton and all the European collectors and also, M. Alvarenga, G. Bo, A. Cover, O. Dochi, Dong Soo Son, C. Grant, M. A. Hidalgo, D. Kihurani, R. Mapletoft, J. M. Munoz, T. Nagai, D. Osborn, R. Remillard, M. de la Rey, J. L. Rigo Rodrigues, T.-F. Shiao, E. Squires, B. Stroud, J. H. M. Viana, Xu Zizhong, V. Yiengvisavakul. I would also like to especially acknowledge M. B. Wheeler for his careful review of this manuscript.