

2024 Statistics of embryo production and transfer in domestic farm animals

Over two million cattle embryos were produced *in vitro* worldwide, more than sevenfold the number of those collected *in vivo*

By Joao HM Viana, Chair – IETS Data Retrieval Committee (henrique.viana@embrapa.br)

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Summary

The data of the embryo industry in 2024 for the four most representative farm animal species are summarized in Table 1 (total embryos produced or collected) and Table 2 (number of transferred embryos). The number of *in vitro*-produced (IVP) embryos increased by +8.1% in cattle, overtaking two million for the first time. On the other hand, the number of IVD embryos collected decreased by 20.1% compared with 2023 [1], and now accounts for less than 13% of the overall embryo activity in cattle. Similar trends were observed for the number of IVP and IVD embryos actually transferred (+10.6% and -16.2%, respectively, compared with 2023). There was a small decrease in both the number of IVD and IVP embryos in horses (-2.8% and -3.1%, respectively). Nevertheless, the number of IVP embryos transferred increased by +20%, compared with 2023. A similar scenario was observed for goats, with a decrease in the number of embryos collected or produced (-24.6% and -38.0%, respectively), in contrast to an increase in the number of IVP embryos transferred (+109.0%). In sheep, both the number of IVD embryos collected and actually transferred decreased (-44.3% and -4.8%, respectively). Conversely, the number of IPV embryos produced and transferred increased (+104.6% and +57.0%). Overall, there was a small increase in the total number of embryos collected or produced in farm animals in the year 2024 (2,468,877 vs. 2,411,329 in 2023, +2.4%).

Table 1. Total production (transferable embryos) of IVD and IVP embryos in 2024 in cattle, sheep, goats, and horses, by region

Region	Cattle		Horses		Sheep		Goats	
	IVD	IVP	IVD	IVP	IVD	IVP	IVD	IVP
Africa	0	8,697	0	0	0	0	0	0
Asia	18,242	34,082	0	0	0	41,248	0	580
Europe	113,136	58,404	942	6,083	227	62	656	0
North America	126,389	1,162,338	439	634	19,432	991	9,932	4,732
Oceania	11,074	51,209	0	0	10,523	0	1,328	0
South America	27,679	714,277	23,614	9,150	12,212	215	73	0
Total 2024	296,520	2,029,007	24,995	15,867	42,394	42,516	11,989	5,312
Total 2023	371,138	1,876,591	25,703	16,369	76,084	20,785	15,893	8,568
% Change	-20.1	+8.1	-2.8	-3.1	-44.3	+104.6	-24.6	-38.0

Table 2. Transfers of IVD and IVP embryos in 2024 in cattle, sheep, goats, and horses, by region

Region	Cattle		Horses		Sheep		Goats	
	IVD	IVP	IVD	IVP	IVD	IVP	IVD	IVP
Africa	94	8,678	0	0	0	0	0	0
Asia	24,476	45,743	0	0	0	7,321	0	1,615
Europe	102,909	31,886	854	356	383	5	93	0
North America	109,117	632,046	417	3	19,238	978	9,850	4,731
Oceania	9,949	47,043	0	0	10,607	0	1,328	0
South America	27,789	654,936	22,902	9,150	11,132	132	195	0
Total 2024	274,334	1,420,332	24,173	10,322	41,360	8,436	11,466	6,346
Total 2023	327,498	1,284,164	26,006	8,322	43,450	5,372	15,254	3,036
% Change	-16.2	+10.6	-7.0	+24.0	-4.8	+57.0	-24.8	+109.0

1. Introduction

The Data Retrieval Committee (DRC) is the committee of the International Embryo Technology Society (IETS) in charge of gathering, organizing, and publishing the statistics on the embryo industry in domestic farm animals. This year, we present our 34th Annual Report, presenting data on global activities related to *in vivo* embryo collection, *in vitro* embryo production (IVEP), and embryo transfers during the year 2024. The results shown in the present report represent the main overview of the embryo industry worldwide in ruminants and horses.

Data collection has followed the standard methodology used in previous years, as defined by the DRC and reported annually in the December issue of the Embryo Technology Newsletter. In summary, embryo technology activity in each country was either reported by a local data collector or reported individually by practitioners or commercial companies (e.g., IVEP laboratories). In several countries, the data collector is a member of the national embryo transfer/technology association: Argentina (*Sociedad Argentina de Tecnologías Embrionarias*, SATE); Brazil (*Sociedade Brasileira de Tecnologia de Embriões*, SBTE); Canada (*Canadian Embryo Transfer Association*, CETA/ACTE); Mexico (*Mexican Embryo Transfer Society*, META); Peru (*Asociación Peruana de Reproducción Animal*, ASPRA); the United States (*American Embryo Transfer Association*, AETA). For the member states of the European Union and other European countries, data has been submitted by a regional collector on behalf of the Association of Embryo Technology in Europe (AETE). Data have also been reported to IETS by embryo transfer (ET) teams or companies working abroad. In a few countries, this was the sole source of information on embryo-related activity. However, when similar data were reported by a local representative, submissions from such teams or companies were discarded to avoid double-reporting. The list of data collectors and local collaborators is shown in Appendix 1.

A summary of the results is presented in Tables 3 to 14, categorized by region, technology (*in vivo*-derived [IVD] or *in vitro*-produced [IVP]), and species. South American numbers include those collected from countries in South and Central Americas. Data have also been used to build historical series and ranks, shown in Figures 2 to 4 and in Table 15. Detailed country information will be available as supplemental files on the [IETS website](#).

2. Results

Data Retrieval

The number of countries reporting embryo activity data has remained relatively stable over the years, with no change in 2024 (41 vs. 41 in 2023). However, in 2024 fewer countries reported data on sheep (10, compared with 15 in 2023), including countries with substantial activity in the previous year, such as the UK.

In Europe, the main change from 2023 to 2024 was the absence of data from the Russian Federation. In South America, thanks to the local collector, we were able to recover data from Ecuador. Embryo export records indicate ET activity in eight additional countries that did not report any data to this committee. Altogether, these records suggest that embryo technologies are currently used in approximately one quarter (25.5%) of the countries worldwide.

Of the 41 countries with embryo activity in cattle, 30 reported the production and/or transfer of IVD and 32 of IVP embryos. Europe remains as the only region with more countries submitting IVD than IVP records (22 vs. 14, respectively). In other species, IVP use was reported by three out of six countries in goats, six out of 10 in sheep, and nine out of 13 in horses.

Table 3. Number and proportion of countries submitting ET data, by region and species

Region	Cattle		Other (IVD + IVP) ¹				% Countries within a region ⁴
	IVD	IVP	Horses	Sheep	Goats	Other ²	
Africa	0	1	0	0	0	0	1.9% (1/54)
Asia	1	2	0	1	1	0	4.2% (2/48)
Europe	21	14	9	3	1	4	48.9% (23/47)
North America	3	3	3	2	2	0	100.0% (03/03)
Oceania	1	2	0	1	1	0	14.3% (2/14)
South America ³	4	10	1	3	1	2	27.8% (10/36)
Total	30	32	13	10	6	6	21.3% (41/192)

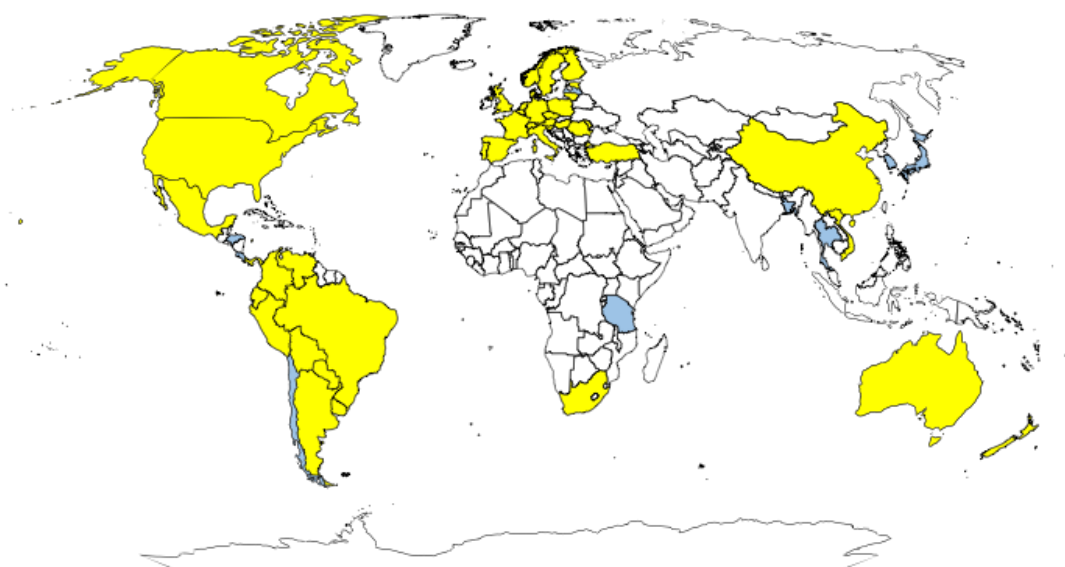
¹IVD: *in vivo*-derived; IVP: *in vitro*-produced.

²Cervids, camelids, buffalo, swine.

³South and Central America and the Caribbean.

⁴Based on the number of countries with records of livestock in the FaoStat database.

Africa and Asia were the regions with the lower percentages of countries submitting ET data. This represents a significant gap in data retrieval, due to the well-known active ET industry in countries such as Japan and Korea. In this regard, embryo export data reported by the AETA provided indirect evidence of ET activity in eight countries that did not report any data to the IETS, including from South and Central America (Chile, Costa Rica, Honduras), Africa (Tanzania) and Asia (Bangladesh, Japan, South Korea, and Thailand).



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Figure 1. World political map highlighting countries that submitted ET data (yellow) or had records about embryo import (blue) in 2024. Image generated using Microsoft Excel.

2.1 Embryo Industry in Numbers

2.1.1 Cattle, IVD

The number of flushes, ova, and transferable embryos collected in 2024 by region is shown in Table 4, while the number of transfers is shown in Table 5. Although there has been a progressive reduction in the use of superovulation over the years, we observed a steeper decline in both the number of IVD embryos collected (-20.1%, 296,520 vs. 371,138 in 2023) and those actually transferred (-16.2%, 274,334 vs. 327,498 in 2023) than that observed from 2022 to 2023 (-6.3% and -11.5%, respectively). Consistently, a proportional reduction was also noted in the number of flushes (-20.2%), and ova recovered (-21.7%), and this decline occurred in both dairy and beef breeds. The fall in the number of IVD embryos collected and

transferred was observed in Asia (-48.0% and -28.7%, respectively), Europe (-14.7% and -12.9%), North America (-19.4% and -17.3%), Oceania (-38.5% and -29.5%). It also occurred in South America, but to a lesser degree (-3.4% and -4.2%, respectively), as in this region the use of IVD was already proportionally low (only 3.7% of the total).

Table 4. Collection of bovine *in vivo*-derived (IVD) embryos by region in 2024

Region/ Country	Flushes			Collected					
	Dairy	Beef	Total	Ova			Transferable embryos		
				Dairy	Beef	Total	Dairy	Beef	Total
Africa	0	0	0	0	0	0	0	0	0
Asia	3,898	88	3,986	17,686	827	18,513	17,564	678	18,242
Europe	17,536	2,470	20,006	145,449	19,923	165,372	99,686	13,450	113,136
N America	6,589	13,850	20,439	62,207	166,319	228,526	37,050	89,339	126,389
Oceania	159	1,978	2,137	1,072	8,853	9,925	688	10,386	11,074
S America	2,524	2,836	5,360	13,980	20,995	34,975	12,502	15,177	27,679
Total	30,706	21,222	51,928	240,394	216,917	457,311	167,490	129,030	296,520

Except for the increase recorded in Argentina (+26.6%), and the relative stability in France (+0.1%), all other countries with five-figure numbers of IVD embryos in 2024 showed a decline in records, compared with 2023: the USA (-23.2%), Canada (-9.9%), Germany (-8.2%), China (-48.0%), Italy (-6.7%), the Netherlands (-17.1%), Australia (-38.5%), and Brazil (-15.2%). These changes were consistent with the global trend. Europe was the only region in which superovulation-derived was the primary source of cattle embryos (71.8%), whereas they represent only 34.9% of the total records (IVD+IVP) in Asia, 17.8% in Oceania, 9.8% in North America, and 3.7% in South America. Dairy breeds accounted for 56.5% of the IVD embryos collected worldwide, with significant variations according to region: 96.3% in Asia, 88.1% in Europe, 45.2% in South America, 29.3% in North America, and 6.2% in Oceania.

No major change was observed in superovulation efficiency, with an estimated worldwide average of 8.8 ova and 5.7 transferable embryos per flush in 2024, compared with 9.0 and 5.7, respectively, in 2023. Sex-sorted semen was used in 24.9% of flushes in dairy breeds and 4.1% of flushes in beef breeds. The number of IVD embryos actually transferred decreased (-16.2%), compared with 2023, and this trend was observed across dairy and beef breeds and for both fresh and frozen embryos transferred. However, the number of transfers of frozen imported embryos increased +28.9% (8,192 vs. 6,354 in 2023). The proportion of transferred IVD embryos that were frozen-thawed (61.4%) increased, compared with that observed in 2023 (58.9%).

Table 5. Transfers of bovine *in vivo*-derived (IVD) embryos by region in 2024

Region/ Country	Fresh			Frozen domestic			Frozen imported			Total ET
	Dairy	Beef	Unsorted	Dairy	Beef	Unsorted	Dairy	Beef	Unsorted	
Africa	0	0	0	0	0	0	72	22	0	94
Asia	1,609	0	0	18,268	0	0	4,001	598	0	24,476
Europe	42,093	4,280	0	47,302	7,145	0	1,477	612	0	102,909
N America	11,190	30,972	0	13,301	52,952	0	122	580	0	109,117
Oceania	226	1,663	0	333	7,452	0	56	219	0	9,949
S America	9,178	4,576	0	4,180	9,422	0	257	176	0	27,789
Total	64,296	41,491	0	83,384	76,971	0	5,985	2,207	0	274,334

2.1.2 Cattle, IVP

The *in vitro* production of embryos in 2024 is summarized in Table 6 (OPU-collected oocytes) and Table 7 (abattoir-derived oocytes). The number of IVP embryos reported worldwide increased by +8.0%, compared with 2023. This increase occurred in all regions but Asia: +18.0% in Africa, +8.5% in Europe, +32.4% in Oceania, +6.3% in North America, and +11.1% in South America. The -15.5% decrease in Asia was driven mainly by a drop in the activity in Vietnam (-49.9%, 5,721 vs. 11,426 in 2023), whereas numbers from China declined only slightly (-1.9%).

Despite the general positive scenario, within each region the trends varied from country to country. In Europe, records of IVP embryos increased in France (+36.9%), Germany (+15.3%), and Spain (+119.1%), but decreased in the Netherlands (-15.8%), and the UK (-57.4%). In North America, records decreased slightly in Canada (-0.8%) and Mexico (-1.6%), but increased in the USA, which surpassed one million IVP embryos (1,037,090) recorded in 2024, corresponding to 51.6% of the world total. In South America, IVP embryo records rose in Argentina (+8.2%), Brazil (+8.5%), Panama (+18.0%), and Venezuela (+220.8%), whereas decreased in Bolivia (-33.2%), Colombia (-13.0%), Paraguay (-0.5%), and Uruguay (-18.2%).

Table 6. Production of embryos *in vitro* with OPU-collected oocytes by region in 2024

Region/ Country	Donors			Oocytes			Transferable embryos		
	Dairy	Beef	Total	Dairy	Beef	Total	Dairy	Beef	Total
Africa	0	1,108	1,108	0	23,762	23,762	0	8,697	8,697
Asia	9,621	3,926	13,547	141,792	33,614	175,406	28,361	5,721	34,082
Europe	12,171	1,035	13,102	139,808	11,790	150,350	39,845	4,562	44,042
N America	143,638	67,138	210,776	3,233,610	1,700,388	4,933,998	634,137	525,242	1,159,379
Oceania	567	3,749	4,316	11,463	78,837	90,300	9,186	42,016	51,202
S America	101,844	48,518	150,362	1,268,861	1,059,616	2,328,477	370,182	343,236	713,418
Total	267,841	125,474	393,315	4,795,534	2,908,007	7,703,541	1,081,711	929,474	2,011,185

In 2024, Brazil recorded 493,989 cattle IVP embryos, which corresponds to 97.2% of the country's total. However, 1,383,720 ET sheaths were sold in the Brazilian market in the same year, a figure that is 172.4% greater than the official records of IVD and IVP embryos combined. This underreporting is associated with the growing use of IVP to produce animals not registered at breeders' associations, and thus skip official records. From 2025 on, a new methodology is under implementation, aiming to correct this bias.

The number of IVP embryos produced using abattoir-derived oocytes in 2024 increased (+26.5%; 17,822 vs. 14,087 in 2023). Europe accounts for the majority of these embryos (78.5%), and thus the +32.1% increase in this region explain most of the overall trend. Yet, embryos produced using abattoir-derived oocytes represent only 0.9% of the world IVP total.

Table 7. Production of embryos *in vitro* with abattoir-derived oocytes by region in 2024

Region/ Country	Donors			Oocytes			Transferable embryos		
	Dairy	Beef	Total	Dairy	Beef	Total	Dairy	Beef	Total
Africa	0	0	0	0	0	0	0	0	0
Asia	0	0	0	0	0	0	0	0	0
Europe	4,248	2,953	7,198	51,962	17,485	68,816	9,133	4,878	13,997
N America	0	0	0	201	14,500	14,701	5	2,954	2,959
Oceania	1	0	1	57	0	57	6	1	7
S America	60	37	97	281	2,678	2,959	17	842	859
Total	4,309	2,990	7,296	52,501	34,663	86,533	9,161	8,675	17,822

There was a substantial increase in the use of FSH stimulation before ovum pickup (OPU) in 2024 (53.9% vs. 38.7% in 2023), driven mainly by the numbers from the United States, where all OPU cycles were reported to be preceded by ovarian stimulation. This proportion may be overestimated, as in 2023 the United States reported the use of FSH in 61.4% of the OPU. In contrast, in South America, the use of FSH (<1%) is likely underreported. In Europe, most OPU were carried out after FSH stimulation (94.9%), whereas in Oceania this percentage drops to 18.9%.

The number of transfers of IVP embryos in 2024 is shown in Table 8. The total transfers of IVP embryos (OPU plus abattoir) increased by +10.6% (1,420,332 vs. 1,284,164), compared with 2023. The proportion of IVP embryos produced that were actually transferred increased (70.0% vs. 68.4% in 2023). This proportion was lower in Europe and North America (54.6% and 54.4%, respectively, in 2024), compared with over 90% in all other regions. Consequently, South America transferred in 2024 more IVP embryos than North America (654,936 vs. 632,046), even though the latter has reported the production of 62.7% more IVP embryos than the former.

Table 8. Transfer of bovine *in vitro*-produced (IVP) embryos by region in 2024

Region/ Country	Embryos transferred							
	OPU				Abattoir			
	Fresh	Frozen		Total	Fresh	Frozen		Total
		Domestic	Foreign			Domestic	Foreign	
Africa	913	7,655	110	8,678	0	0	0	0
Asia	18,331	27,188	224	45,743	0	0	0	0
Europe	12,312	16,980	604	29,896	70	1,920	0	1,990
N America	401,607	227,387	98	629,092	767	2,187	0	2,954
Oceania	16,896	30,027	114	47,037	6	0	0	6
S America	374,390	278,377	1,646	654,413	517	6	0	523
Total	824,449	587,614	2,796	1,414,859	1,360	4,113	0	5,473

Both the number of IVP embryos transferred as fresh and those transferred as frozen-thawed/vitrified-warmed increased, compared with 2023 (11.0% and 10.0%, respectively). The proportion of frozen-thawed IVP embryos transferred in 2024 remained stable, relative to 2023 (41.9% vs. 42.1%, respectively). The transfer of embryos generated with abattoir-derived oocytes increased +18.7%, but still accounted for only 0.36% of the world total. A noteworthy change was the +197.8% increase in the number of imported IVP embryos, compared with 2023.

In 2024, Canada, France, Germany, Hungary, and the Netherlands reported micromanipulation of embryos for sexing and genotyping (Table 9).

Table 9. Micromanipulation of bovine embryos for sexing and/or genotyping in 2024

Country	Sexed		Genotyped	
	IVD	IVP	IVD	IVP
Canada	0	7,988	0	7,988
France	422	0	657	65
Germany	177	1,230	84	626
Hungary	932	0	0	0
the Netherlands	0	0	0	4,623
Total	1,531	9,218	741	13,302

We observed a decrease in embryo genotyping compared with 2023 (-21.4% and -19.7% for IVD and IVP embryos, respectively), which were driven mainly by reductions in IVD embryos micromanipulated in France (657 vs. 701 in 2023) and in IVP embryos micromanipulated in Canada (7,988 vs. 9,135 in 2023) and the Netherlands (4,623 vs. 7,046 in 2023). As reported in 2023, the number of IVP embryos sexed or genotyped from Canada were identical, indicating that the same micromanipulation procedure was applied for both purposes.

2.1.3 Other Species

The numbers of IVD and IVP embryos reported in 2024 for species other than cattle are presented in Tables 10 (sheep), 11 (goats), 12 (horses), and 13 (buffalo, camelids, cervids, and swine).

Table 10. Sheep: *in vivo*-derived (IVD) and *in vitro*-produced (IVP) embryo collections and transfers in 2024

Region/ Country	IVD Embryos					IVP embryos						
	Flushes	Embryos	Embryo transfer			Donors	Oocytes	Embryos	Embryo transfer			
			Fresh	Frozen					Fresh	Frozen		
				Domestic	Foreign					Domestic	Foreign	
Asia												
China	0	0	0	0	0	7,298	131,216	41,248	1,715	5,606	0	
Total	0	0	0	0	0	7,298	131,216	41,248	1,715	5,606	0	
Europe												
Portugal	7	49	24	0	0	0	0	0	0	0	0	0
Spain	35	172	101	22	0	18	243	62	5	0	0	0
Sweden	0	0	0	0	230	0	0	0	0	0	0	0
Türkiye	2	6	6	0	0	0	0	0	0	0	0	0
Total	44	227	131	22	230	18	243	62	5	0	0	0
N America												
Canada	19	91	62	33	0	0	0	0	0	0	0	0
United States	3,196	19,341	17,362	1,731	50	428	3,524	991	653	325	0	0
Total	3,215	19,432	17,424	1,764	50	428	3,524	991	653	325	0	0
Oceania												
Australia	1,237	10,523	10,323	284	0	0	0	0	0	0	0	0
Total	1,237	10,523	10,323	284	0	0	0	0	0	0	0	0
S America												
Brazil	1,569	12,068	10,542	460	0	27	286	187	95	0	0	0
Panama	0	0	0	0	0	10	30	6	0	0	0	0
Peru	19	144	98	32	0	24	143	22	22	0	15	
Total	1,588	12,212	10,640	492	0	61	459	215	117	0	15	
Grand Total	6,084	42,394	38,518	2,562	280	7,805	135,442	42,516	2,490	5,931	15	

There was an overall drop of -44.3% and -4.8% in the numbers of IVD sheep embryos collected and transferred, respectively, recorded in 2024. This change, however, was mostly driven by the lack of data from the UK, rather than a general trend. In fact, among the three countries with the most representative figures in 2024, the records of IVD embryos decreased in Australia (10,523 vs. 19,737 in 2023, -46.7%), but increased in the United States (19,341 vs. 14,893, +29.9%) and Brazil (12,212 vs. 7,281, +65.7%). Conversely, IVP sheep embryos

produced and transferred increased, compared with 2023 (+104.6% and +57.0%, respectively), mostly due to the activity in China, which accounted for most of the records (97.0% of all IVP embryos produced and 86.8% of those transferred). It is noteworthy the lack of report from the UK, considering that this country reported in 2023 the greatest number of IVD embryos collected (31,449; 41.3% of the total on that year). However, the UK reported the transfer or export of only 429 of those embryos, so the fate of the remaining embryos recorded in 2023 is unclear.

We observed a decrease in both the number of IVD and IVP embryos recorded in goats (-24.6% and -38.0%, respectively). The United States remains the main player in the world goat embryo industry, accounting for 82.8% of all IVD embryos collected and 89.1% of IVP embryos produced in 2024. Australia ranked second for IVD embryos, with 12.4% of the reports, whereas China was second for IVP embryos (10.9%). The number of IVD embryos transferred in 2024 decreased, compared with 2023, for both fresh (-11.8%) and domestically produced frozen-thawed embryos (-78.8%). However, the opposite trend was observed for IVP embryos (+64.4% for fresh and +307.3% for frozen-thawed).

Table 11. Goats: *in vivo*-derived (IVD) and *in vitro*-produced (IVP) embryo collections and transfers in 2024

Region/ Country	IVD Embryos					IVP embryos						
	Flushes	Embryos	Embryo transfer			Donors	Oocytes	Embryos	Embryo transfer			
			Fresh	Frozen					Fresh	Frozen		
				Domestic	Foreign					Domestic	Foreign	
Asia												
China	0	0	0	0	0	322	8,240	580	0	1,615	0	
Total	0	0	0	0	0	322	8,240	580	0	1,615	0	
Europe												
Spain	49	656	14	79	0	0	0	0	0	0	0	0
Total	49	656	14	79	0	0	0	0	0	0	0	0
N America												
Canada	0	0	0	11	0	0	0	0	0	0	0	0
Mexico	0	0	0	0	0	0	0	1	0	0	0	0
USA	1,547	9,932	9,264	575	0	579	11,214	4,731	4,073	658	0	
Total	1,547	9,932	9,264	586	0	579	11,214	4,732	4,073	658	0	
Oceania												
Australia	123	1,328	1,328	0	0	0	0	0	0	0	0	0
Total	123	1,328	1,328	0	0	0	0	0	0	0	0	0
S America												
Peru	9	73	73	0	122	0	0	0	0	0	0	0
Total	9	73	73	0	122	0	0	0	0	0	0	0
Grand Total	1,728	11,989	10,679	665	122	901	19,454	5,312	4,073	2,273	0	

As observed in 2023, in 2024 Brazil accounted for most (94.5%) of the IVD embryos in horses, and therefore the reduction observed in the world IVD total and in the number of embryos transferred, compared with 2023 (-2.8% and -7.0%, respectively), were driven by trends in Brazil (-2.1% and -4.2%). On the other hand, the number of IVP embryos increased +46.9% in Brazil, whereas worldwide they decreased -3.1%, due to the trends in Italy (-23.8%; 5,083 vs. 6,667 in 2023) and USA (-79.5%; 605 vs. 2,955 in 2023). Nevertheless, the number of IVP horse embryos actually transferred worldwide increased +24.0%, compared with 2023.

Brazil now leads the production of IVP embryos (9,150 vs. 5,083 from Italy). The majority of Italy's IVP embryos were exported (2,858; 56.2%), whereas in Brazil, all IVP embryos were transferred in the domestic market, either as fresh (4,258; 46.5%) or vitrified-warmed (4,892; 53.5%).

Table 12. Horses: *in vivo*-derived (IVD) and *in vitro*-produced (IVP) embryo collections and transfers in 2024

Region/ Country	IVD Embryos					IVP embryos					
	Flushes	Embryos	Embryo transfer			Donors	Oocytes	Embryos	Embryo transfer		
			Fresh	Frozen					Fresh	Frozen	
				Domestic	Foreign					Domestic	Foreign
Europe											
Estonia	9	7	7	0	0	0	0	0	0	0	1
Finland	5	2	2	0	0	0	0	0	0	0	0
France	1,278	747	747	0	0	31	332	49	0	0	36
Hungary	11	7	4	3	0	117	1,755	267	0	0	104
Italy	0	0	0	0	0	2,694	35,081	5,083	4	809	0
Poland	161	102	10	0	0	0	0	0	0	0	75
Portugal	57	35	35	0	0	41	496	81	0	0	30
Romania	1	0	0	0	0	0	0	0	0	0	0
Spain	12	10	7	3	0	359	3,528	603	13	97	0
Sweden	50	32	32	0	4	0	0	0	0	0	0
Total	1,584	942	844	6	4	3,242	41,192	6,083	17	906	246
N America											
Canada	0	0	0	0	0	26	203	26	0	0	0
Mexico	4	3	3	0	0	3	4	3	3	0	0
USA	680	436	401	13	0	256	2655	605	0	0	0
Total	684	439	404	13	0	285	2862	634	3	0	0
S America											
Brazil	39,726	23,614	22,902	0	0		45,750	9,150	4,258	4,892	0
Total	39,726	23,614	22,902	0	0	0	45,750	9,150	4,258	4,892	0
Grand Total	41,994	24,995	24,150	19	4	3,527	89,804	15,867	4,274	5,798	246

In 2024, three countries reported embryo activity in buffaloes: Spain (28 IVD and 7 IVP), Türkiye (8 IVP), and Ecuador (54 IVP). Poland reported the collection of five IVD embryos from cervids, and Romania reported 33 IVD embryos from swine (Table 13). Peru remained the primary source of ET data from small camelids, with 77 embryos collected from llamas and 65 from alpacas in 2024.

Table 13. Other species: *in vivo*-derived (IVD) and *in vitro*-produced (IVP) embryo collections and transfers in 2024

Region/ Country	IVD Embryos					IVP embryos					
	Flushes	Embryos	Embryo transfer			Donors	Oocytes	Embryos	Embryo transfer		
			Fresh	Frozen					Fresh	Frozen	
				Domestic	Foreign					Domestic	Foreign
Buffalo											
Spain	6	28	0	0	0	3	21	7	0	0	0
Türkiye	0	0	0	0	0	1	20	8	0	5	0

Ecuador	0	0	0	0	0	25	215	54	0	0	0
Total	6	28	0	0	0	29	256	69	0	5	0
Cervids											
Poland	3	5	5	0	0	0	0	0	0	0	0
Total	3	5	5	0	0	0	0	0	0	0	0
Camelids											
Peru (Llamas)	65	77	0	8	0	0	0	0	0	0	0
Peru (Alpacas)	39	65	44	8	0	0	0	0	0	0	0
Total	104	142	44	16	0	0	0	0	0	0	0
Swine											
Romania	1	33	0	0	0	0	0	0	0	0	0
Total	1	33	0	0	0	0	0	0	0	0	0
Grand Total	114	208	49	16	0	29	256	69	0	5	0

2.1.4 Exports

In 2024, there was a reduction in both the number of countries reporting embryo exports and the total number of embryos exported from farm species (11 vs. 13 countries and 31,763 vs. 40,028 embryos, compared with 2023, Table 14). As noted in our last report, in 2024 divergent trends emerged for IVD and IVP embryos in cattle, with a decrease in exports of the former (-32.9%) and an increase in the latter (+7.7%), compared with 2023. Exports of IVD sheep embryos (-69.5%) and IVP horse embryos (-25.0%) decreased, whereas exports of IVD goat embryos increased (+22.4%), compared with 2023. No country reported the export of embryos generated from abattoir-derived oocytes. Only Spain reported exporting IVD goat embryos, and Italy was the sole exporter of IVP horse embryos in 2024.

Table 14. Countries exporting embryos in 2024

Region/ Country	Bovine				Sheep IVD	Goats IVD	Horse IVP
	IVD Dairy	Beef	IVP OPU	Abattoir			
Europe							
Austria	204	0	0	0	0	0	0
Denmark	4	2	0	0	0	0	0
France	148	400	42	0	0	0	0
Germany	79	0	0	0	0	0	0
Italy	0	0	0	0	0	0	2,858
Spain	0	260	0	0	35	268	0
Switzerland	434	27	87	0	0	0	0
Total	869	689	129	0	35	268	2,858
N America							
Canada	1,767	1,708	2,974	0	146	0	0
United States	7,355	1,702	9,239	0	0	0	0
Total	9,122	3,410	12,213	0	146	0	0
Oceania							
Australia	75	1,474	0	0	85	0	0
Total	75	1,474	0	0	85	0	0
S America							
Panama	0	0	390	0	0	0	0
Total	0	0	390	0	0	0	0

Grand Total	10,066	5,573	12,732	0	266	268	2,858
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2.2 Historical Series and Trends

The historical series of cattle embryo production (IVD, IVP, and total) over the past 20 years (2005 to 2024) is shown in Figure 2. No significant change has occurred in the trends for IVD embryos, which have grown uninterruptedly and at about the same rate over the last decade, regardless of occasional underreporting from any of the countries with the most significant embryo industries. Conversely, the decrease in the number of IVD embryos has accelerated, after a period of relative stability between 2020 and 2023, further reinforcing the divergent trends for IVP and IVD embryos worldwide.

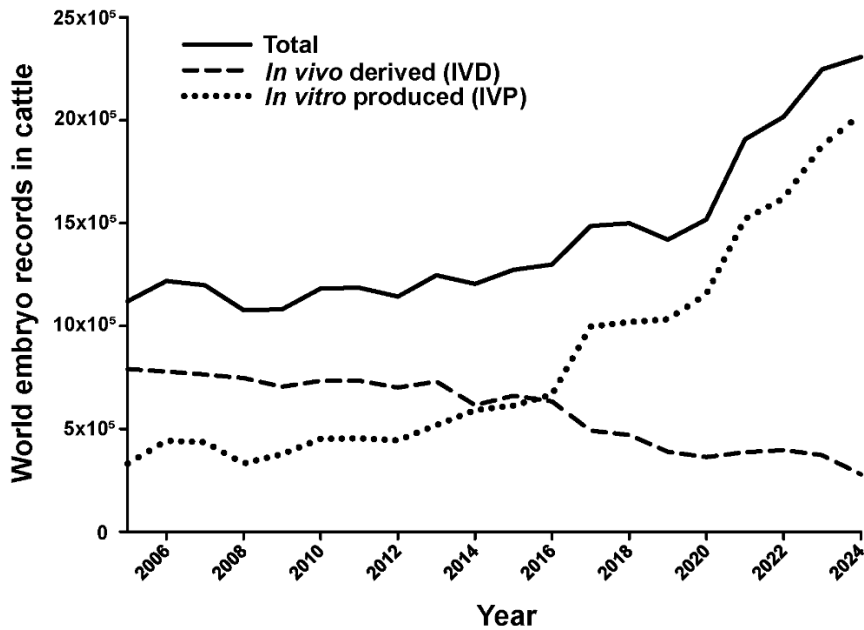


Figure 2. Number of bovine embryos (*in vivo*-derived [IVD], *in vitro*-produced [IVP], and total) recorded in the period 2005-2024.

The numbers of IVP and IVD embryos recorded by region are shown in Figures 3A and 3B, respectively. Unlike what was observed from 2021 to 2023, in 2024 IVP embryo records increased more in South America and Europe than in North America (+11.1% and +8.5% vs. +6.3%, respectively, compared with 2023). Nevertheless, North America still accounts for the majority of the IVP embryos produced worldwide (57.3% of the total). The number of IVD embryos decreased more in North America than in Europe and South America (-19.4% vs. -14.7% and -3.4%, respectively, compared with 2023). If the current trend is kept, it is possible that Europe overtakes North America as the region with the largest number of IVD embryo records in the near future.

The number and percentage share of frozen-thawed IVD and IVP embryos transferred from 2005 to 2024 are shown in Figure 4A and 4B. Following the same trends observed for overall number of embryos collected or produced, the number of IVP embryos transferred as fresh or frozen-thawed both increased, compared with 2023 (+11.0% and +10.0%, respectively), whereas for IVD embryos both decreased (-21.4% and -12.7%, respectively). IVP embryos now account for 88.6% of all embryos transferred as fresh, and 77.9% of those transferred as frozen-thawed.

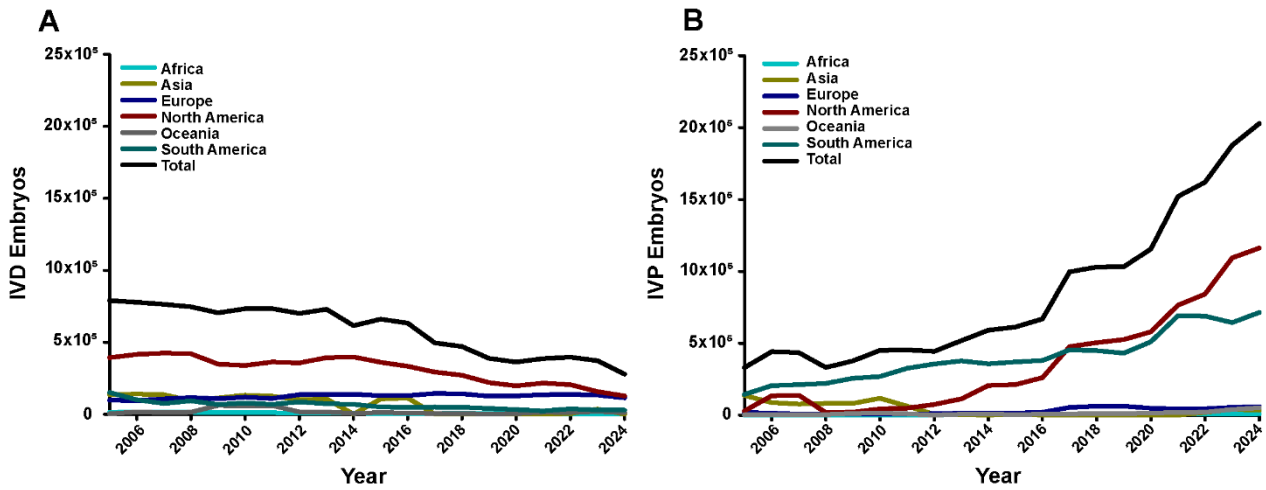


Figure 3. Number of embryos produced or collected in cattle in the period of 2005–2024, by continent. (A) *In vivo*-derived (IVD) embryos. (B) *In vitro*-produced (IVP) embryos.

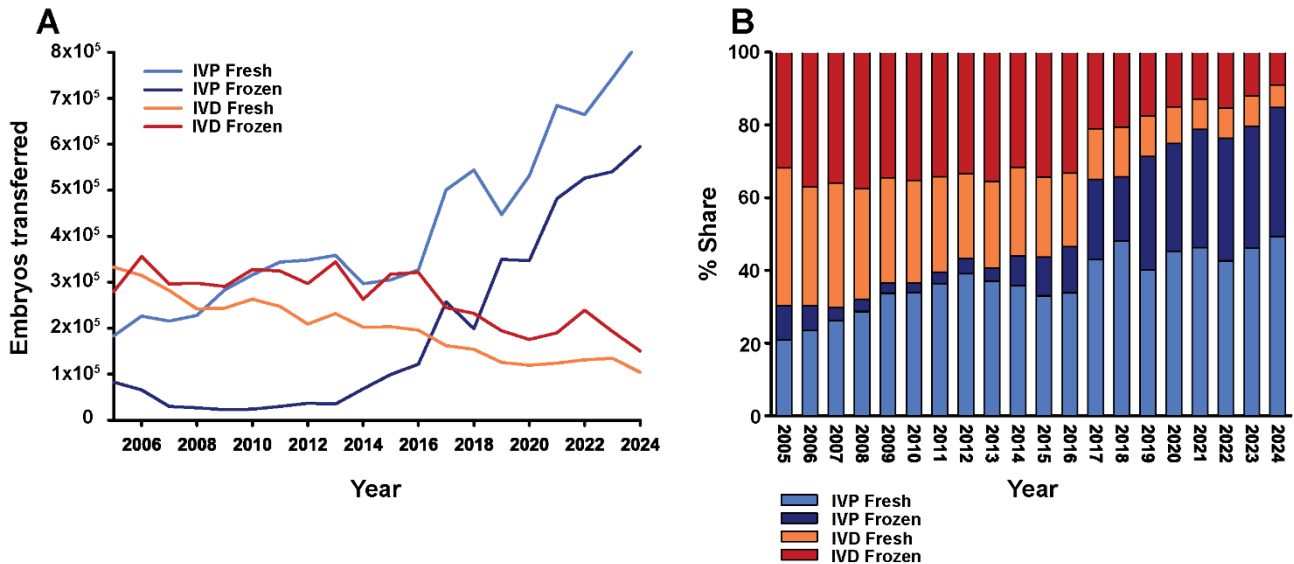


Figure 4. Embryo transfers in cattle in the period of 2005–2024, according to the technique used (*in vivo*-derived [IVD] or *in vitro*-produced [IVP]) and type of embryo (fresh or frozen-thawed). (A) Number of embryos transferred. (B) Percent share of the total embryo transfers per year.

2.3 Embryo Industry Rank

Among the top-10 countries ranked in 2024 according to the intensity index, seven remained unchanged from 2023, whereas Ecuador now appears in third place, and Slovenia and Norway gained the eighth and ninth positions, respectively. Embryo records increased in Brazil, Argentina, and Mexico, which are the second, third, and fourth countries in total embryo numbers, respectively. Nevertheless, Brazil and Argentina remained in the same positions in the intensity index as in 2023 (16th and 18th, respectively), whereas Mexico dropped from 14th to 15th. Minor fluctuations were observed among the remaining countries in the top-20 list (Table 15).

Table 15. Top-20 countries according to the ET intensity index in 2024; this index considers the ratio between the number of embryos recorded and the size of the cattle inventory in each country

Country	Embryos ¹	Embryo rank	Cattle herd ²	Herd rank ³	Index ⁴	Intensity Rank
United States	1,124,267	1	88,841,000	2	126.5	1
the Netherlands	32,196	10	3,739,000	23	86.1	2
Ecuador	30,904	12	3,723,196	24	83.0	3
Canada	82,021	5	11,295,000	13	72.6	4
Panama	9,280	16	1,518,656	31	61.1	5
Finland	3,740	24	798,640	37	46.8	6
Denmark	5,727	19	1,434,870	32	39.9	7
Slovenia	1,348	34	456,050	39	29.6	8
Norway	2,588	29	875,600	35	29.6	9
Germany	31,181	11	10,836,200	15	28.8	10
Switzerland	4,329	22	1,528,595	29	28.3	11
France	46,759	7	16,806,900	7	27.8	12
Italy	16,548	14	5,999,000	21	27.6	13
Paraguay	32,943	9	13,526,256	10	24.4	14
Mexico	82,439	4	36,619,592	4	22.5	15
Brazil	508,843	2	238,626,442	1	21.3	16
Austria	3,668	25	1,835,470	27	20.0	17
Australia	58,366	6	29,878,186	5	19.5	18
Argentina	105,818	3	54,242,595	3	19.5	19
Spain	9,705	15	6,294,640	19	15.4	20

¹Total of embryos (IVD + IVP) recorded in 2024.

²According to FaoStat 2023 [2].

³According to cattle herd size, ranked from the largest to the smallest.

⁴Embryos recorded per 10,000 cattle heads.

3. Discussion

The number of IVP cattle embryos recorded worldwide has been increasing almost linearly over the past decade ($R^2=0.96$, approximately +14.2% per year), and in the year 2024, it overtook two million, a new landmark. This is, for instance, more than the combined total of embryos recorded for all species and techniques in 2021 (1,987,831). Conversely, a declining trend has been observed for IVD embryos, although at a lower rate (-8.4% per year). Graphically, the growing gap between numbers of IVP and IVD cattle embryos observed from 2015 on resembles the “crocodile mouth effect,” with the “upper jaw” representing the rising adoption of in vitro technologies, whereas the “lower jaw” represents the falling numbers of IVD embryos generated by superovulation. It is noteworthy that, in absolute numbers, the +8.1% increase in records of IVP embryos represents far more than the -20.1% decrease in their IVD counterparts. In fact, in 2024, 363,701 fewer IVD embryos were reported, compared with 2015. In contrast, 1,416,298 more IVP embryos were reported in 2024 (i.e., a difference of over one million more embryos). Considering that there was no parallel increase in the number of countries reporting IVP embryo data, it is evident that emerging in vitro embryo technologies have been fulfilling a latent market demand created by the intrinsic limitations of superovulation. In this regard, the average number of transferable IVD embryos recovered per flushing has stagnated over the past decades (5.7 in 2024, slightly less than the 5.9 reported in 2005, i.e., 20 years ago). Additionally, there is little economies-of-scale effect on embryo collection in vivo, particularly compared with the one observed for those produced in vitro, where the high fixed cost can be heavily diluted as the number of embryos increase. Thus, although the generation of offspring using in vitro technologies is still far from optimal and problems such as higher pregnancy losses remain a challenge, the perspectives for

improvements on this technique are likely more promising than those for a major breakthrough in superovulation.

One of the main drivers of this shift was the progressive increase in the number of frozen-thawed or vitrified-warmed IVP embryos transferred, which has grown from 10.7% of the total number of transfers in 2015 to 35.1% in 2024. In fact, the number of fresh IVP embryos transferred increased +170.8% in this period, but increased +499.2% for their frozen/vitrified counterparts. On the other hand, cryopreservation of IVD embryos, which represented a market niche for superovulation until 2015, decreased almost in the same proportion (i.e., from 34.3% in 2016 to only 9.9% in 2024). The IETS database does not include pregnancy outcomes, nevertheless, one can speculate that the growing use of cryopreserved IVP embryos has been associated with improvements in pregnancy rates, compared with those reported in the past. Moreover, there is a trend toward a broader acceptance of frozen IVP embryos as an alternative for the international trade of bovine germplasm. The sanitary safety of using IVP embryos has been supported by the conclusions of the Health Advisory and Safety Committee (HASAC) of the IETS [3]. In fact, in 2024 for the first time, the USA exported more IVP than IVD embryos (9,239 vs. 9,057, respectively). We also recorded in 2024 an increase both in the number of IVP embryos exported (+7.7%) and particularly in the transfer of imported IVP embryos (+197.8%).

In 2024, sheep ET data from the UK were not reported. The number of IVD sheep embryos reported by the UK in the year 2023 represented a very large share of the world total (41.3%). Thus, the lack of data from this country in 2024 resulted in a proportional decrease in the number of IVD sheep embryos recorded worldwide (-44.3%). However, this does not represent a global trend, as the records of sheep embryos in the countries with the greatest shares in this species (USA and Brazil) actually presented increases (+29.9% and 65.7%, respectively). On the other hand, the significant increase observed in IVP sheep embryos was mostly driven by numbers from China. A similar scenario was observed for horses, with most records being reported by Brazil. In this regard, the smaller the embryo industry in a given species, the more prone trends will be to being influenced by fluctuations in the number of countries reporting data, particularly when most of the ET industry is concentrated in so few countries. Therefore, with only six countries reporting ET data for goats, trend analysis should be interpreted with caution. For this reason, the DRC does not present trends for other species (e.g., buffalo, cervids, and swine). Similarly, over the past years, Peru has been the sole source of ET data from small camelids (alpacas and llamas), and thus these numbers reflect a local situation rather than one that could be extrapolated to other regions.

4. Acknowledgments

The DRC thanks the efforts of all regional data collectors and local ET scientific societies, as well as all practitioners or representatives of ET companies who reported data to the database or directly to the chair. The comprehensiveness of the present report is the result of their volunteer collaboration.

5. References

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- [2] FAOSTAT. 2025. Crops and livestock products. <https://www.fao.org/faostat/en/#data/QCL>.
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Appendix 1: National data collectors in 2024

Region/Country	Collector	Region/Country	Collector
Africa		Europe	
Rep South Africa	Morne de la Rey, ABS	AETE	H�el�ene Quinton
Asia		Austria	Eva Dachsberger
China	Joao Viana,* ABS, Vytelle	Belgium	Isabelle Donnay
Vietnam	Joao Viana,* ABS	Czech Republic	Jiri Sichtar
Oceania		Denmark	Henrik Callesen
Australia	Corrie Croton, DAFF, ABS, Vytelle	Denmark	Emma Lorenzen
New Zealand	Joao Viana,* Vytelle	Estonia	Ants Kavak
North America		Finland	Anna Oksa-Pulliainen
Canada	Reuben Mapletoft (CETA)	France	Serge Lacaze
Mexico	Salvador Romo, ABS	Germany	Hubert Cramer
United States	Charles Looney, Alvaro Garcia-Guerra, Scott Larsen (AETA)	Hungary	Ferenc Flink
South & Central America		Hungary	Allat Nfi
Argentina (bovine)	Gabriel Bo (SATE)	Italy	Giovanna Lazzari
Brazil (bovine)	Joao Viana (SBTE)	Latvia	Ilga Sematovica
Brazil (equine)	Marco Alvarenga	Lithuania	Rasa Nainiene
Brazil (small rum)	Joanna Souza-Fabjan	The Netherlands	Anna Beker Van Woundenberg
Bolivia	Joao Viana,* ABS	The Netherlands	Lais Barbosa-Latorraca
Colombia	Jorge Luis Zambrano, ABS	Norway	Tjrand Lunde
Ecuador	Andres Veras Cede�o	Poland	Jedrzej Jaskowski
Panama	Luis Nasser	Portugal	Joao Nestor Chagas e Silva
Paraguay	Marfa Paz Benfitez Mora, Gabriel Soria	Romania	Stefan Ciornei
Peru	Marlene Miguel-Gonzales	Slovenia	Aleksandar Plavsic
Uruguay	Joao Viana,* ABS	Spain	Pablo Bermejo
Venezuela	Joao Viana,* ABS	Sweden	Carolin Wedemalm
		Switzerland	Andreas Fleisch
		T�urkiye	Hakan Sagirkaya
		UK	Jake Olivier

* Data collected/organized by the chair